

Université de Montréal

**Understanding young adults' socioeconomic circumstances and their contribution to  
social inequalities in smoking during the transition towards adulthood**

Par  
Thierry Gagné

Département de médecine sociale et préventive  
École de santé publique

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## Résumé

L'épidémiologie sociale a démontré l'importance des périodes de la natalité, l'enfance, et l'adolescence afin de comprendre le développement des inégalités sociales de santé tout au long de la vie. De nouvelles problématiques nous interpellent cependant à réfléchir la transition vers l'âge adulte (18–25 ans) comme une nouvelle période sensible. Le tabagisme illustre clairement cette problématique. Aujourd'hui, près de 30% des Canadiens qui s'initient à une première cigarette et 40% des Canadiens qui deviennent fumeurs quotidiens le font entre 18 et 25 ans. En dépit des succès escomptés dans les autres groupes d'âge, aucun changement au niveau des taux d'initiation et de cessation tabagique n'a été noté au cours de cette période depuis le début du XXI<sup>e</sup> siècle. Contrairement aux périodes de vie antécédentes, les comportements de santé comme le tabagisme se développent au travers de transitions hautement dynamiques entre les sphères de l'éducation, l'emploi, la famille et le logement. L'entrejeu de ces expériences nécessite donc le développement d'approches adaptées pour mieux comprendre la progression des inégalités sociales de santé au cours de la transition vers l'âge adulte.

En réponse, cette thèse présente quatre articles qui permettent ensemble de mieux comprendre les circonstances socioéconomiques des jeunes adultes et les mécanismes par lesquels celles-ci contribuent aux inégalités sociales liées au tabagisme au cours de cette période. La thèse présente d'abord une revue systématique des études sur les inégalités sociales liées au tabagisme chez les jeunes adultes qui se focalise sur les indicateurs utilisés afin de circonscrire leurs circonstances socioéconomiques. Retenant 89 articles, le 1<sup>er</sup> article démontre que cette littérature s'est appuyée sur un groupe restreint d'indicateurs traditionnels qui sont inadaptés au contexte dynamique des jeunes adultes, laissant derrière un important déficit de connaissance. En réponse, la thèse introduit un nouveau cadre conceptuel qui réfléchit les circonstances des jeunes adultes au croisement de (1) la sociologie bourdieusienne, c.-à-d., au travers de l'entrejeu des ressources économiques, sociales et culturelles auxquels les jeunes adultes ont inégalement accès, et (2) des théories du parcours de vie, c.-à-d., au travers des

différentes étapes de transition et des différents âges où les jeunes adultes progressent au cours de cette période.

Le cœur de la thèse illustre cette proposition théorique avec trois articles utilisant deux bases de données : (1) l'Interdisciplinary Study of Inequalities in Smoking (ISIS), qui a recruté 2 093 jeunes adultes de 18 à 25 ans à Montréal en 2011–2012 et (2) l'Enquête Nationale sur la Santé des Populations (ENSP), qui a suivi 1 243 Canadiens quatre fois à chaque deux ans entre 18 et 25 ans entre les années 1994–1995 et 2010–2011. Le 2<sup>ème</sup> article appuie la diversité des circonstances, c.-à-d. ressources et étapes de transitions, qui sont associées au tabagisme. Il illustre aussi la façon dont l'étude des recoupements entre circonstances peut davantage nuancer notre compréhension de la distribution sociale du tabagisme. Le 3<sup>ème</sup> article complète ces résultats en démontrant qu'une partie significative de ces associations diffère aussi selon l'âge précis auquel ces circonstances sont vécues. Finalement, avec les données de l'ENSP, le 4<sup>ème</sup> article reproduit les résultats dans les articles précédents et teste davantage le cadre conceptuel proposé en démontrant comment les différentes associations entre circonstances socioéconomiques et tabagisme à différents niveaux d'éducation évoluent au cours de cette période, changeant rapidement entre les âges de 18 et 25 ans.

Cette thèse présente une contribution unique afin de mieux comprendre la configuration des circonstances socioéconomiques et sa contribution aux inégalités sociales liées au tabagisme au cours de la transition vers l'âge adulte. Elle apporte plusieurs contributions qui ensemble justifient l'intégration du contexte dynamique des jeunes adultes dans l'étude des inégalités sociales de santé au cours de cette période. Elle démontre finalement que nos efforts de lutte contre les inégalités sociales de santé doivent s'inscrire dans une approche intersectorielle qui valorise les jeunes adultes dans toutes les sphères de l'éducation, l'emploi, la famille et l'habitation afin qu'ils puissent équitablement se développer tout au long du parcours de vie.

**Mots-clés :** Montréal, Canada, *Interdisciplinary Study of Inequalities in Smoking*, Enquête Nationale de Santé des Populations, tabagisme, jeunes adultes, transition vers l'âge adulte, inégalités sociales de santé, caractéristiques socioéconomiques.

## **Abstract**

Social epidemiology has demonstrated the importance of early life periods such as childhood and adolescence for understanding the development of health inequalities over the life course. New issues, however, challenge us to question the role of young adulthood (i.e., ages 18–25) as a new, sensitive period during this time. Smoking clearly illustrates this issue. Today, approximately 30% of Canadians who smoke their first cigarette, and 40% of Canadians who become daily smokers, do so after the end of adolescence. Despite the successes of tobacco control with other age groups, it has not seen any decrease in initiation and cessation rates in young adult Canadians since the beginning of the 21st century.

Smoking behaviour during young adulthood occurs in rapid transitions in and out of education, employment, family, and housing circumstances, which are unequally experienced across social groups. The interplay of these experiences, therefore, requires the development of theoretical and analytic frameworks to better understand the unequal progression of smoking during the transition to adulthood. This thesis presents four articles that provide theoretical insight into, and robust evidence of, the socio-economic circumstances through which young adults progress and the mechanisms through which these circumstances influence smoking.

Article 1 starts with a methodological systematic review of social inequalities in smoking among young adults, focusing on the indicators used to operationalize socio-economic circumstances. Based on 89 articles, the review demonstrates that tobacco research has relied disproportionately on a few traditional indicators to understand social inequalities in smoking during this period, leaving us with inconsistent findings and a significant knowledge gap. In response, I develop a theoretical proposal based on an integration of Bourdieu's practice theory with life-course studies to guide the study of young adults' socio-economic circumstances. This is accomplished by disentangling the interplay of economic, social, and cultural resources to which young adults have access from the transition stages and the different ages through which they progress during this period.

The heart of the thesis tests this proposal based on three empirical studies using two data sets: (1) the Interdisciplinary Study of Inequalities in Smoking (ISIS), which recruited 2,093 young adults aged 18 to 25 in Montreal, Canada, in 2011–2012; and (2) the National Population Health Survey (NPHS), which followed 1,243 young adult Canadians between the ages of 18 and 25 every two years from 1994 to 1995 and 2010 to 2011.

Using ISIS data, Article 2 demonstrates the diversity of resources and transition stages that contribute to the unequal distribution of smoking. This article also illustrates how the associations between resources, transition stages, and smoking may be exacerbated across social groups defined by educational attainment. Article 3 complements these findings by demonstrating that many of these same resources and transition stages also have a different association with smoking depending on the exact age at which they are experienced. Using NPHS data, Article 4 further supports these findings by demonstrating how the associations between resources, transition stages, and smoking unequally develop across education groups during the transition to adulthood, rapidly changing between the ages of 18 and 25.

This thesis makes a unique contribution to public health by helping us better understand the configuration of young adults' socio-economic circumstances and its contribution to social inequalities in smoking during the transition to adulthood. It offers strong tools to support researchers' capacity to integrate the dynamic context of young adulthood into the study of health inequalities. Finally, this thesis demonstrates that efforts to combat health inequalities must be led by intersectoral approaches, which support individuals across education, employment, family, and housing circumstances so that each person may equitably develop their health over the course of their lives.

**Keywords:** Montreal, Canada; Interdisciplinary Study of Inequalities in Smoking; National Population Health Survey; smoking; young adults; transition to adulthood; social inequalities in health; socio-economic characteristics

## Table of contents

<b>Résumé</b> .....	<b>ii</b>
<b>Abstract</b> .....	<b>iv</b>
<b>Table of contents</b> .....	<b>vi</b>
<b>List of figures</b> .....	<b>xiii</b>
<b>List of abbreviations</b> .....	<b>xvi</b>
<b>Acknowledgements</b> .....	<b>xvii</b>
<b>Remerciements</b> .....	<b>xviii</b>
<b>CHAPTER 1. INTRODUCTION</b> .....	<b>19</b>
1.1 Health inequalities in Canada .....	20
1.2 A life-course approach to health inequalities.....	22
1.3 Young adulthood as a new sensitive period.....	23
1.4 Social inequalities in smoking during young adulthood as a case example .....	25
1.5 A new approach to study social inequalities in smoking during young adulthood ...	29
1.6 Aim and objectives of this dissertation .....	31
1.7 Organization of this dissertation .....	33
<b>CHAPTER 2. LITERATURE REVIEW</b> .....	<b>35</b>
2.1 Current evidence on social inequalities in smoking among young adults .....	36
2.2 Systematic and narrative reviews on social inequalities in smoking.....	38
2.3 Systematic and narrative reviews on smoking among young adults .....	39
2.4 Developing a review on social inequalities in smoking among young adults .....	41
<b>ARTICLE 1. A field coming of age? A methodological systematic review of studies on social inequalities in smoking among young adults</b> .....	<b>44</b>
<b>ABSTRACT</b> .....	<b>46</b>
<b>TITLE</b> .....	<b>48</b>
<b>INTRODUCTION</b> .....	<b>48</b>
<b>METHODS</b> .....	<b>50</b>
Search strategy .....	50
Screening of studies .....	51
Criteria for inclusion .....	51
Data extraction .....	52
Considerations regarding quality assessment .....	53
Data synthesis .....	53
<b>RESULTS</b> .....	<b>54</b>
Search results .....	54
Country of origin and study design of included records.....	54
Indicators of socioeconomic circumstances in studies related to social inequalities in smoking among young adults .....	54

<b>DISCUSSION .....</b>	<b>55</b>
Principal Findings .....	55
Moving beyond traditional approaches .....	57
Limitations .....	59
Conclusion .....	59
<b>REFERENCES.....</b>	<b>62</b>
<b>SUPPLEMENTARY MATERIAL.....</b>	<b>72</b>
<b>CHAPTER 3. THEORETICAL FRAMEWORK .....</b>	<b>116</b>
3.1 Revisiting findings from the systematic review.....	117
3.2 Revisiting findings within the context of epidemiological approaches .....	119
3.3 First theoretical foundation: Bourdieu’s practice theory .....	124
3.4 Second theoretical foundation: Life-course theory.....	133
3.5 Summary .....	144
<b>SPECIFIC OBJECTIVES AND HYPOTHESES.....</b>	<b>146</b>
<b>CHAPTER 4. METHODS.....</b>	<b>151</b>
<b>4.1 Data set 1 : Interdisciplinary Study of Inequalities in Smoking.....</b>	<b>152</b>
4.1.1 Study population and sampling strategy .....	153
4.1.2 Ethical considerations .....	154
4.1.3 Sample.....	154
4.1.4 Questionnaire .....	155
4.1.5 Description of variables .....	155
4.1.6 Statistical analyses .....	159
<b>4.2 Data set 2 : National Population Health Survey .....</b>	<b>164</b>
4.2.1 Study population and sampling strategy .....	164
4.2.2 Ethical considerations .....	165
4.2.3 Sample.....	165
4.2.4 Questionnaire .....	165
4.2.5 Description of variable.....	167
4.2.6 Statistical analyses .....	168
<b>CHAPTER 5. RESULTS.....</b>	<b>173</b>
<b>ARTICLE 2. Uncovering Social Inequalities in Health During Young Adulthood: Insights from Bourdieusian and Life-Course Theories.....</b>	<b>174</b>
<b>ABSTRACT .....</b>	<b>176</b>
<b>BACKGROUND .....</b>	<b>177</b>
Using Bourdieu’s practice theory to understand socioeconomic characteristics in young adults .....	178
Using life-course theory to contextualize the implications of resources for the unequal uptake of health practices during young adulthood .....	180

Empirical application .....	182
<b>METHODS .....</b>	<b>182</b>
Data .....	182
Measures .....	183
Statistical analyses .....	184
<b>RESULTS .....</b>	<b>185</b>
Sample characteristics.....	187
Associations between young adults' circumstances and smoking.....	188
Changes in the associations between young adults' circumstances and smoking: educational attainment as a case example.....	190
<b>DISCUSSION .....</b>	<b>195</b>
Limitations .....	198
Conclusion .....	198
<b>REFERENCES.....</b>	<b>200</b>
<b>ARTICLE 3. Considering the Age-Graded Nature of Associations Between Socioeconomic Characteristics and Smoking During the Transition Towards Adulthood</b> .....	<b>215</b>
<b>ABSTRACT .....</b>	<b>217</b>
<b>INTRODUCTION.....</b>	<b>218</b>
Objective .....	220
<b>METHODS .....</b>	<b>220</b>
Data .....	220
Measures .....	221
Statistical analyses .....	222
<b>RESULTS .....</b>	<b>225</b>
Sample characteristics.....	225
Age-based differences in associations between young adults' socioeconomic circumstances and smoking .....	225
<b>DISCUSSION .....</b>	<b>232</b>
Limitations .....	233
Conclusion .....	234
<b>REFERENCES.....</b>	<b>235</b>
<b>ARTICLE 4. Challenging the study of health inequalities during young adulthood: smoking in the Canadian National Population Health Survey as a case example.....</b>	<b>247</b>
<b>ABSTRACT .....</b>	<b>249</b>
<b>INTRODUCTION.....</b>	<b>250</b>
Objectives .....	252
<b>METHODS .....</b>	<b>252</b>
Data .....	252



Measures .....	253
Statistical analyses .....	253
<b>RESULTS .....</b>	<b>255</b>
Sample characteristics.....	255
Associations between young adults’ socioeconomic circumstances and smoking.....	255
Changes across age in associations between young adults’ socioeconomic circumstances and smoking .....	257
<b>DISCUSSION .....</b>	<b>261</b>
Limitations .....	263
Conclusion .....	263
<b>REFERENCES.....</b>	<b>265</b>
<b>CHAPTER 6. DISCUSSION.....</b>	<b>280</b>
6.1 Summary of articles 2 to 4 .....	282
6.2 Returning to the literature review .....	287
6.3 Crosscutting themes .....	306
6.4 Limitations of this thesis.....	317
6.5 Next steps.....	320
<b>CHAPTER 7. CONCLUSION.....</b>	<b>323</b>
<b>REFERENCES.....</b>	<b>326</b>
<b>APPENDIX I. Gagné T, Veenstra G. Trends in smoking initiation in Canada : Does the non-inclusion of young adults in tobacco control strategies represents a missed opportunity? Can J Public Health. 2017; 108(1) : e14-e20 .....</b>	<b>i</b>
<b>APPENDIX II. Gagné T, Ghenadenik AE, Abel T, Frohlich KL. Social inequalities in health information seeking among young adults in Montreal. Health Promot Int. 2018; 33(1) : 390-399. ....</b>	<b>ix</b>
<b>APPENDIX III. Frohlich KL, Shareck M, Vallée J, et al. Cohort Profile : The Interdisciplinary Study of Inequalities in Smoking (ISIS). Int J Epidemiol. 2017; 46(2) : e4.....</b>	<b>xx</b>
<b>APPENDIX IV. ISIS Consent form .....</b>	<b>xxxv</b>
<b>APPENDIX V. Gagné T, Agouri R, Cantinotti M, Boubaker A, Frohlich KL. How important are paper copies of questionnaires? Testing invitation modes when studying social inequalities in smoking among young adults. Int J Public Health. 2014; 59(1) : 207-210.....</b>	<b>xxxix</b>
<b>APPENDIX VI. Ethical approbation (in French).....</b>	<b>xliv</b>
<b>APPENDIX VII. ISIS questionnaire .....</b>	<b>xlvii</b>

**APPENDIX VIII. Gagné T, Ghenadenik A, Shareck M, Frohlich KL. Expected or Completed? Comparing Two Measures of Education and their Relationship to Social Inequalities in Health Among Young Adults. Soc Indic Res. 2018; 135(2) : 549-562..... lxxix**

**APPENDIX IX. Statistics Canada microdata access contract (in French) ..... lxxxiv**

**APPENDIX X. NPHS derived variables .....xcv**

**APPENDIX XI. Associations between educational attainment and other socioeconomic characteristics in the Interdisciplinary Study of Inequalities in Smoking, controlling for age..... xxviii**

**APPENDIX XII. Associations between socioeconomic characteristics and current smoking status in the Interdisciplinary Study of Inequalities in Smoking, controlling for education and personal income.....xcx**

**APPENDIX XIII. Steinmetz-Wood M, Gagné T, Sylvestre MP, Frohlich KL. Do social characteristics influence smoking uptake and cessation during young adulthood? Int J Public Health. 2018; 63: 115-123. .... civ**

**APPENDIX XIV. Curriculum vitae ..... cxii**

## LIST OF TABLES

### ARTICLE 1

TABLE 1 Socioeconomic circumstances in studies related to social inequalities in smoking among young adults .....	69
TABLE 2 Direction of associations reported for common indicators in studies related to social inequalities in smoking among young adults ( <i>n</i> = 89 records) .....	71
SUPPLEMENTARY TABLE 1 Socioeconomic characteristics in studies on inequalities in smoking among young adults ( <i>n</i> = 89 records).....	86
SUPPLEMENTARY TABLE 2 Description of the sample of studies on social inequalities in smoking ( <i>n</i> = 89 records) .....	107
SUPPLEMENTARY TABLE 3 Findings associated with most common indicators in studies on social inequalities in smoking among young adults, with references ( <i>n</i> = 89 records) .....	113

### ARTICLE 2

TABLE 1 Sample characteristics. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083).....	185
TABLE 2 Associations between resources, transition stages, and current smoking status among young adults. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083) .....	189
SUPPLEMENTARY TABLE 1 Results from models with interaction terms. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083).....	208
SUPPLEMENTARY TABLE 2 Predicted probabilities from models with interaction terms. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083) .....	209

### ARTICLE 3

TABLE 1 Sample characteristics. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083).....	223
SUPPLEMENTARY TABLE 1 Variation in associations between young adults' socioeconomic characteristics and smoking status by age: interaction terms. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083).....	240

SUPPLEMENTARY TABLE 2 Variation in associations between young adults' socioeconomic characteristics and smoking status by age: marginal probabilities. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083).....	241
---	-----

**ARTICLE 4**

TABLE 1 Sample characteristics. National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243).....	254
TABLE 2 Associations between young adults' socioeconomic characteristics and smoking. National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243) ....	254
SUPPLEMENTARY TABLE 1 Associations between young adults' socioeconomic characteristics and smoking : interactions with education. National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243).....	268
SUPPLEMENTARY TABLE 2 Associations between young adults' socioeconomic characteristics and smoking : interactions with age (time). National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243).....	269
SUPPLEMENTARY TABLE 3 Associations between young adults' socioeconomic characteristics and smoking : interactions with education and age. National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243).....	270
SUPPLEMENTARY TABLE 4 Smoking status across time and period. National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243).....	271
SUPPLEMENTARY TABLE 5 Predicted probabilities of smoking : interactions with educational attainment. National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243).....	272

**CHAPTER 6**

TABLE 6.1 Findings from the Interdisciplinary Study of Inequalities in Smoking (ISIS) and National Population Health Survey (NPHS).....	286
---	-----

## List of figures

### CHAPTER 1

FIGURE 1.1 Selected health indicators (%) by household income quintiles in Canada (age 18+), Canadian Community Health Survey, 2010-2013 (PHAC 2017) .....	21
FIGURE 1.2 Selected health indicators (%) by age group in Canada (ages 15-19 and 20-29), Canadian Community Health Survey, 2007-2009 (PHAC 2011).....	24
FIGURE 1.3 Smoking status (%) by age group in Canada (ages 15-19 and 20-24), Canadian Tobacco Use Monitoring Survey and Canadian Tobacco, Alcohol and Drugs Survey, 2001-2015 (Reid et al. 2017) .....	26

### ARTICLE 1

FIGURE 1 PRISMA diagram of studies related to social inequalities in smoking among young adults .....	68
---	----

### ARTICLE 2

FIGURE 1 Predicted probabilities of smoking: Interaction between education and personal income. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( $n = 2,083$ ).....	192
FIGURE 2 Predicted probabilities of smoking: Interaction between education and partner's capacity to provide money in case of emergency. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( $n = 2,083$ ) .....	192
FIGURE 3 Predicted probabilities of smoking: Interaction between education and student status. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( $n = 2,083$ ).....	194
FIGURE 4 Predicted probabilities of smoking: Interaction between education and relationship status. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( $n = 2,083$ ).....	194
SUPPLEMENTARY FIGURE 1 Predicted probabilities of smoking: Interaction between education and personal income (with 95% confidence intervals). Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( $n = 2,083$ ) .....	211
SUPPLEMENTARY FIGURE 2 Predicted probabilities of smoking: Interaction between education and partner's capacity to provide money in case of emergency (with 95% confidence intervals). Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( $n = 2,083$ ) .....	212

SUPPLEMENTARY FIGURE 3 Predicted probabilities of smoking: Interaction between education and student status (with 95% confidence intervals). Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083) .....	213
SUPPLEMENTARY FIGURE 4 Participants' probabilities of smoking: Interaction between education and relationship status (with 95% confidence intervals). Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083) .....	214

**ARTICLE 3**

FIGURE 1 Predicted probabilities of smoking, by education and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083) .....	228
FIGURE 2 Predicted probabilities of smoking, by personal income and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083) ...	229
FIGURE 3 Predicted probabilities of smoking, by student status and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083) ...	230
FIGURE 4 Predicted probabilities of smoking, by full-time employment status and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083).....	231
SUPPLEMENTARY FIGURE 1 Predicted probabilities of smoking (with 95% confidence intervals), by education and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083).....	243
SUPPLEMENTARY FIGURE 2 Predicted probabilities of smoking (with 95% confidence intervals), by personal income and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083) .....	244
SUPPLEMENTARY FIGURE 3 Predicted probabilities of smoking (with 95% confidence intervals), by student status and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083).....	245
SUPPLEMENTARY FIGURE 4 Predicted probabilities of smoking (with 95% confidence intervals), by full-time employment status and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( <i>n</i> = 2,083) .....	246

**ARTICLE 4**

FIGURE 1 Predicted probabilities of smoking between ages 18 and 25, by educational attainment. National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243) .....	259
FIGURE 2 Predicted probabilities of smoking between ages 18 and 25, by living arrangements. National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243) .....	259

FIGURE 3 Predicted probabilities of smoking between ages 18 and 25, by educational attainment and relationship status. National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243) .....	260
SUPPLEMENTARY FIGURE 1 Predicted probabilities of smoking, by education status and transition stages. National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243).....	275
SUPPLEMENTARY FIGURE 2 Predicted probabilities of smoking between ages 18 and 25, by educational attainment (with 95% confidence intervals). National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243).....	276
SUPPLEMENTARY FIGURE 3 Predicted probabilities of smoking between ages 18 and 25, by living arrangements (with 95% confidence intervals). National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243).....	277
SUPPLEMENTARY FIGURE 4 Predicted probabilities of smoking between ages 18 and 25, by relationship status (with 95% confidence intervals). National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243).....	278
SUPPLEMENTARY FIGURE 5 Predicted probabilities of smoking between ages 18 and 25, by educational attainment and relationship status (with 95% confidence intervals). National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( <i>n</i> = 1,243).....	279

## List of abbreviations

CEGEP	<i>Collège d'enseignement général et professionnel</i>
CI	Confidence interval
CLSC	<i>Centre local de services communautaires</i>
DV	Dependent variable
ENSP	<i>Enquête Nationale de la Santé de la Population</i>
ISIS	Interdisciplinary Study of Inequalities in Smoking
IV	Independent variable
ME	Marginal effect
NA	Not available
NPHS	National Population Health Survey
NS	Non-significant
OR	Odds ratio
PHAC	Public Health Agency of Canada
p.p.	Percentage point
PR	Prevalence ratio
RAMQ	<i>Régie de l'assurance maladie du Québec</i>
SD	Standard deviation
SES	Socio-economic status
UK	United Kingdom
US	United States
VIF	Variance Inflation Factor
WHO	World Health Organization



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## **CHAPTER 1. INTRODUCTION**

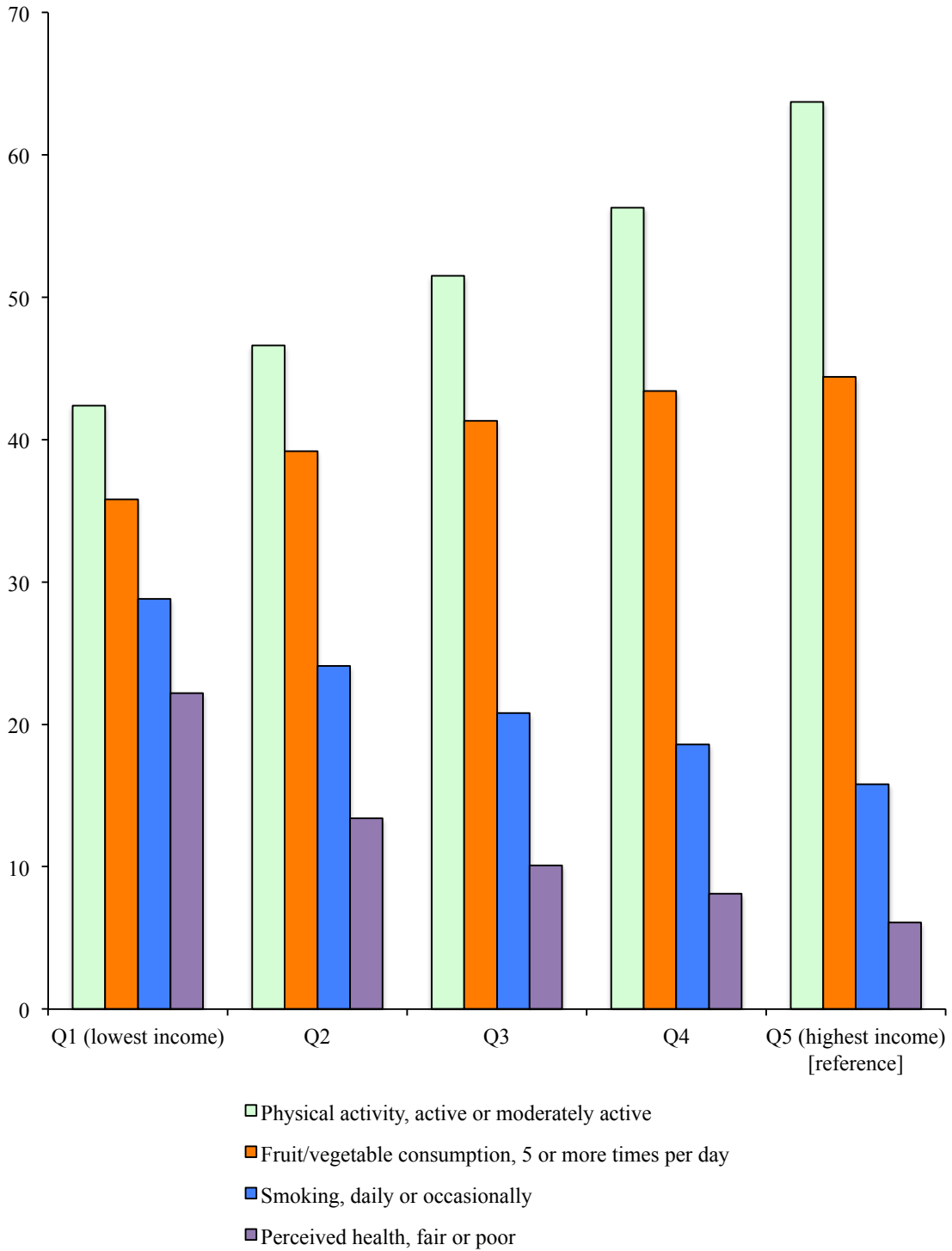
## **1.1 Health inequalities in Canada**

Despite the prominent place of health services funding in government budgets, population health remains heavily dependent on social determinants of health that have very little to do with health care (Labonté 1992; Mustard et al. 1997; Humphries and van Dooslaer 2000; Raphael 2000; PHAC 2008; Bryant et al. 2011; CIHI 2016). While Canada offers much stronger social security measures for those who are socio-economically disadvantaged compared to the United States (US) (Ross et al. 2000; McGrail et al. 2009), a large number of people continue to face inequitable behavioural, morbidity, and mortality outcomes (CIHI 2016; Khan et al. 2017).

Figure 1.1 illustrates some of these health inequalities. Between 2010 and 2013, Canadians in the lowest income quintile suffered a 25% higher risk of not consuming enough fruits and vegetables, a 50% higher risk of being physically inactive, an 80% higher risk of smoking, and a 170% higher risk of reporting poor physical health compared to those in the top income quintile (PHAC 2017). If every Canadian enjoyed the same health profile as those in the top income quintile, approximately 1 million fewer households would experience food insecurity, 673,700 fewer individuals would live with diabetes, 1,656,400 fewer individuals would smoke, 1,042,900 fewer individuals would experience poor mental health, and 40,000 fewer people would die every year (CIHI 2016; Tjepkema, Wilkins, and Long 2013). Adding to these benefits, the Public Health Agency of Canada estimated that eliminating such inequalities would also save at least \$6.2 billion dollars each year in acute-care inpatient hospitalizations, prescription medication, and physician consultations alone (PHAC 2016).

These estimates focus solely on income, thus underestimating the multi-faceted burden of morbidity and mortality faced by Canadians who are socio-economically disadvantaged. For instance, Tjepkema, Wilkins, and Long (2012) estimated that if every Canadian enjoyed a mortality rate equal to those who had completed a university degree, there would be up to 50,000 fewer deaths every year in this country. These socio-economic circumstances, which represent one's access to resources including wealth, knowledge, power, and beneficial social connections, are inequitably distributed in response to our societal and political systems (Phelan et al. 2010; Graham 2007, 2012; WHO 2008). As the first Report of the Public Health

**FIGURE 1.1 Selected health indicators (%) by household income quintiles in Canada (age 18+), Canadian Community Health Survey, 2010-2013 (PHAC 2017)**



Officer on the State of Public Health in Canada and the World Health Organization (WHO) Commission on the Social Determinants of Health attested a decade ago, addressing these social structures and the resulting inequalities in health should represent one of the core mandates of modern public health institutions (Kirkpatrick and McIntyre 2009).

## **1.2 A life-course approach to health inequalities**

The WHO suggests five main mechanisms through which systematic differences in health among social groups occur: different levels of (1) power and resources; (2) exposure to health hazards; (3) impacts of health hazards; (4) illness and disease; and (5) exposure across the life-course (WHO 2008). As a cornerstone of public health science, epidemiology has cemented the importance of life-course principles to understand the lifelong development of health (Ben-Shlomo and Kuh 2002; Viner et al. 2015; Ben-Shlomo, Cooper, and Kuh 2016). A life-course approach explicitly recognizes the importance of time and timing to understanding the causal links between social exposures and outcomes across individual life courses (Lynch and Smith 2005). When applied to health inequalities, this approach posits that the consequences of socio-economic disadvantage begin at conception, accumulate over time, and are exacerbated during certain life periods (Smith, Blane, and Bartley 1994). From this perspective, health behaviours represent a key pathway because they explain the link between early life conditions and adult health (van de Mheen, Stronk, and Mackenbach 1998).

Since the term *life course epidemiology* was first coined in 1997 (Ben-Shlomo, Cooper, and Kuh 2016), a large body of scholarship has emerged, evidencing the insidious, long-term consequences of early disadvantage on morbidity and mortality (Wadsworth 1997; Galobordes, Lynch, and Smith 2004, 2008; Lynch and Smith 2005; Pollitt, Rose, and Kaufman 2005; Liu, Jones, and Glymour 2010; Cohen et al. 2010). Two main mechanisms have been put forward to understand these longitudinal processes: (1) socio-economic circumstances are linked and, cumulatively, they influence health-related outcomes over time (i.e., the “chains of risk” hypothesis); and (2) certain socio-economic circumstances present an excess risk to health-related outcomes during key life periods (i.e., the “critical period” hypothesis) (Bartley 2007; Cable 2014).

Illustrating these in the Canadian context, Roos and Wall-Wieler (2017) examined predictors of high school graduation at age 19 during preschool (ages 0–3), early elementary school (ages 4–8), and early adolescence (ages 9–13) among 90,000 youth in the province of Manitoba. They demonstrated: (1) a “dose-response” effect from repeatedly living in a low-income neighbourhood, moving between residences, reporting mental health problems, and experiencing injuries across these periods; and (2) an added “critical period” effect from experiencing changes in family structure and mental health problems, specifically during early adolescence.

This life-course perspective has now become a driving force behind public policy discourses, both in Canada and in other countries (Graham 2002; Graham and Power 2004; Asthana and Halliday 2006; Estey, Kmetic, and Reading 2007; McDaniel and Bernard 2011; Pratt and Frost 2016). As a result, the second Report of the Chief Public Health Officer on the State of Public Health in Canada used the life-course approach to highlight the importance of the first decade of life. The Report called for priority actions to create supportive environments that would help children and parents along with intersectoral strategies to address injury prevention, poverty reduction, mental health, and the obesity epidemic in this group (PHAC 2009).

### **1.3 Young adulthood as a new sensitive period**

While the bulk of this scholarship has focused on the early life stages of childhood and adolescence, an increasing amount of policy scholarship has begun to discuss the importance of the transitional period between adolescence and adulthood (Gaudet 2007; Franke 2010). In Canada, young adults between the ages of 20 and 34 represent nearly one-quarter of the population (6.9 million) (Statistics Canada 2018). In public health, experts have begun to notice, in the last fifteen years, that young adults are experiencing a rapid increase in the prevalence and incidence of multiple deleterious health outcomes after adolescence (Furstenberg 2006; Park et al. 2006; Mulye et al. 2009; PHAC 2011; IOM 2014; Stroud et al. 2015).

**FIGURE 1.2 Selected health indicators (%) by age group in Canada (ages 15-19 and 20-29), Canadian Community Health Survey, 2007-2009 (PHAC 2011)**

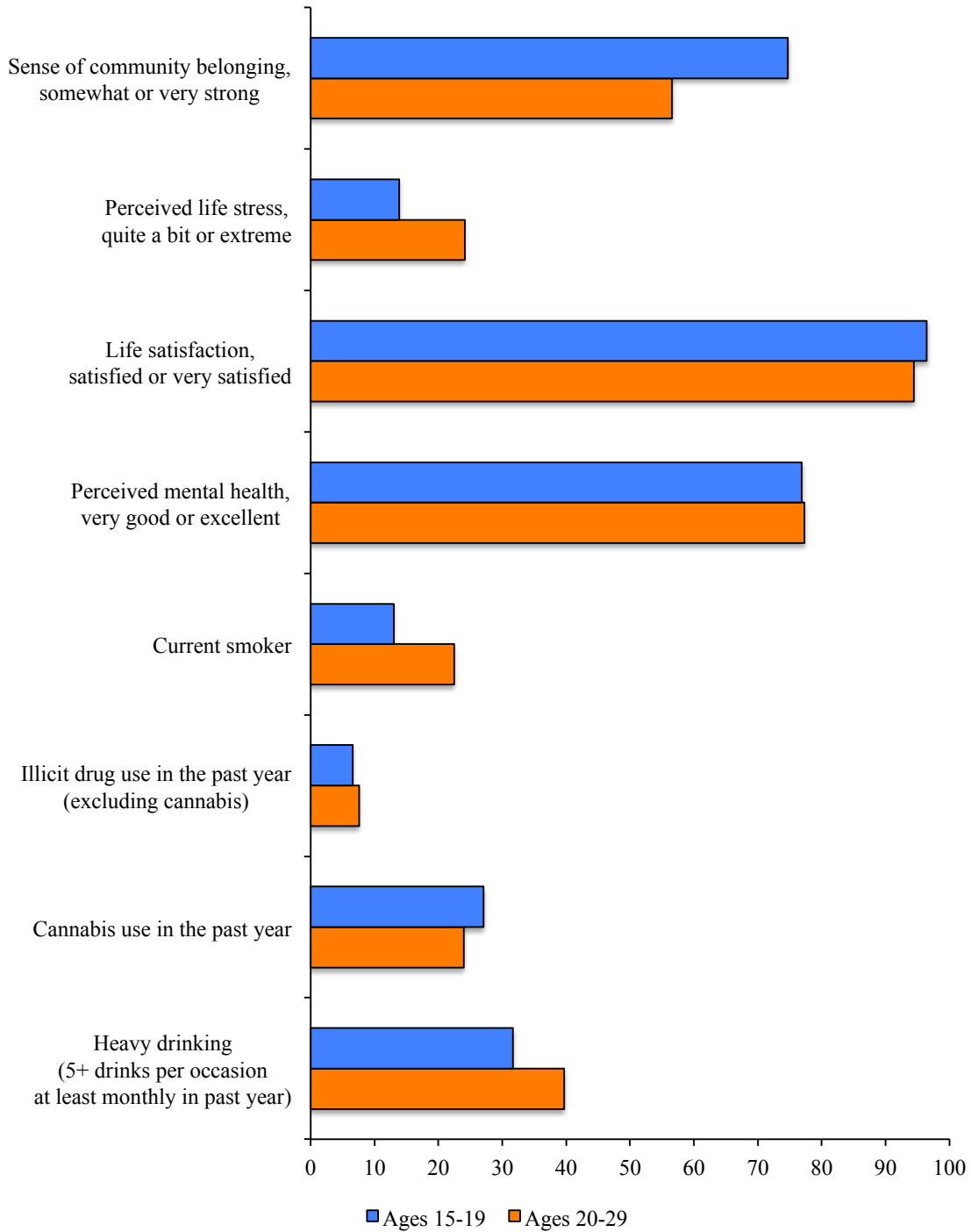


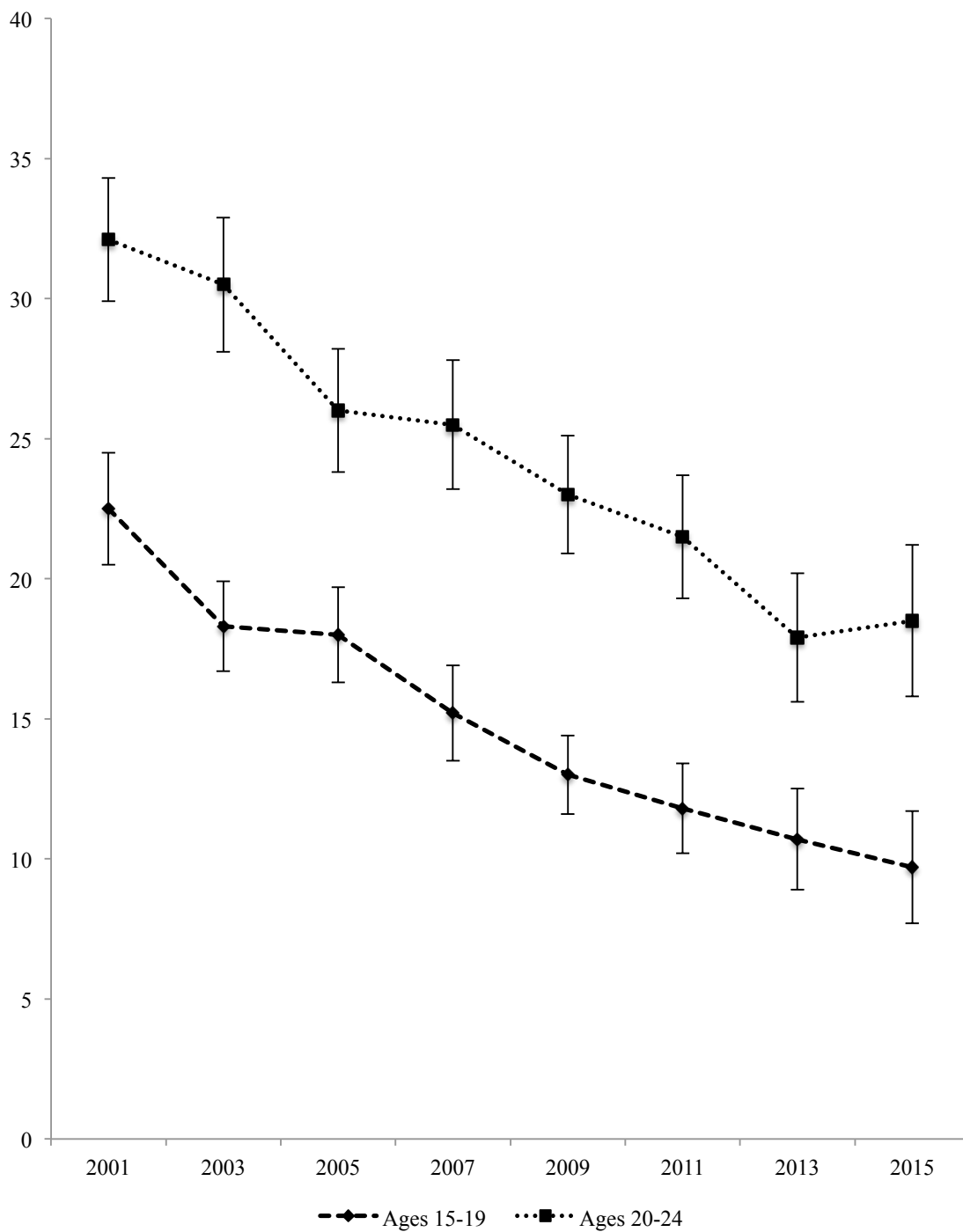


Figure 1.2 highlights some of these trends. Between 2007 and 2009, young adult Canadians between the ages of 20 and 29 were 45% more likely to die from traffic incidents, 80% more likely to die from injuries and poisonings, and 100% more likely to die from intentional self-harm compared to those between the ages of 15 and 19 (PHAC 2011). Canadians between 20 and 29 years old were also 15% more likely to have used illicit drugs in the previous year, 25% more likely to be heavy drinkers, 70% more likely to smoke cigarettes, 70% more likely to report quite a bit of stress in their lives, and 30% more likely to report a low sense of community belonging compared to those aged 15 to 19 (PHAC 2011). The mental and physical health issues that occur during young adulthood are likely to persist over time, in part because they subsequently hinder young adults' capacity to successfully navigate the school-to-work transition and establish relationships (Reichman, Corman, and Noonan 2013; Veldman et al. 2015). This is even more important given that young adults are the least likely of all age groups to seek health care services (Marcus et al. 2012; Ferro, Gorter, and Boyle 2015; Findlay 2017).

#### **1.4 Social inequalities in smoking during young adulthood as a case example**

Smoking offers an illuminating example of recent public health concerns about young adulthood. One of the leading causes of preventable death, leading to 37,000 deaths a year in Canada alone, cigarette smoking kills nearly half its consumers; it costs approximately \$17 billion in Canada, and over \$1 trillion around the world, in direct health costs and productivity losses per year (Rehm et al. 2006; Baliunas et al. 2007; Goodchild et al. 2018). Young adults have the highest prevalence of smoking of all age groups. In 2016, 26% of men and 18% of women between the ages of 20 and 34 reported smoking compared to 19% of men and 15% of women in the general population (aged 12 and over) (Statistics Canada 2017). Young adults are also more likely to be exposed to second-hand smoke in their household (50% higher risk), in private vehicles (150% higher risk), and in public spaces (80% higher risk) compared to the adult population (Dubé, Berthelot, and Provençal 2007). Figure 1.3 illustrates the evolution of the prevalence of smoking among youth and young adults over time in Canada. Since 2001, the prevalence of smoking among young adult Canadians has decreased by approximately 40%; this figure is lower than the 55% decrease among those between the ages of 15 and 19 but similar to other age groups over the same period (Reid et al. 2017).

**FIGURE 1.3 Smoking status (%) by age group in Canada (ages 15-19 and 20-24), Canadian Tobacco Use Monitoring Survey and Canadian Tobacco, Alcohol and Drugs Survey, 2001-2015 (Reid et al. 2017)**



Unlike adolescents, young adults have only very recently become a focus for tobacco control (Lantz 2003; Hammond 2005). In the 1990s, tobacco experts focused on adolescents as a key group because of the limited success of public health interventions that promoted cessation and the evidence of the disproportionate influence of early initiation on subsequent smoking and nicotine dependence (Chassin et al. 1990; USDHHS 1994; Breslau and Pederson 1996; Tyas and Pederson 1998). Reporting on this in Canada, Chen and Millar (1998) found that, compared with those who had started smoking after the age of 19, starting smoking before the age of 13 conferred a twofold risk of subsequently maintaining smoking, and smoking over 20 cigarettes per day, during young and middle adulthood.

The importance of targeting smoking behaviours before the age of 18 was highlighted in the landmark 1994 US Surgeon General's report on youth smoking and led to the subsequent influx of legal, media, and school-based interventions targeting this age group (CDC 1994; Lantz et al. 2000). This report also coincided with the development of new surveillance infrastructures such as the Canadian Tobacco Use Monitoring Survey in 1999, which sought to monitor trends in smoking, with an explicit focus on youth aged 15–24 (Health Canada 2003). A few years later, however, tobacco experts noted a worrying increase in the prevalence of smoking among young adults and those who took up smoking after adolescence, and they questioned whether the focus on youth prevention had led tobacco companies to focus their marketing efforts on young adults (Weschler et al. 1998; Ling and Glantz 2002; Lantz 2003; Biener and Albers 2004; Moran, Rigotti, and Weschler 2004; Gilpin, White, and Pearce 2005; Hammond 2005).

Consequently, in Canada, young adults represent the only age group to have experienced no significant changes in initiation or cessation rates since the turn of the 21st century (Reid et al. 2017; Gagné and Veenstra 2017). Gagné and Veenstra (2017) estimated that, between 2001 and 2013, the relative proportion of young adult Canadians who had smoked their first cigarette and started smoking every day between the ages of 18 and 25 increased from 30% to 40% and from 20% to 30%, respectively. The researchers also found a slight but significant increase in the proportion of Canadians who had smoked their first cigarette during young adulthood between 2007 and 2013 (Appendix I) (Gagné and Veenstra 2017).

Regarding cessation, Reid and colleagues (2017) reported that, between 2001 and 2015, the prevalence of ex-smokers among young adult Canadians has varied between 23% and 29% without any clear trend emerging. This coincides with recent trends in the US. Terry-McElrath and O'Malley (2015) found that the rates of smoking a first cigarette and initiating occasional smoking after high school graduation had increased between 1976 and 2005. Similarly, Farrelly and colleagues (2014) found among US adults between the ages of 18 and 25 that past-year initiation had increased by 28% between 2002 and 2009. Finally, the stagnating cessation rates observed in Canada are similar to those that have been found in the US over the past 20 years (IOM 2007; CDC 2014; Jamal et al. 2018).

These estimates support the hypothesis that the majority of gains observed in the prevalence of smoking among young adults may be attributable only to the lower number of adolescents who initiate, maintain, or intensify smoking before entering young adulthood. This highlights a critical missed opportunity to address a key period in the progression of smoking over the life course. The evidence for the health-related benefits of intervening during this life period is clear. Jha and colleagues (2013) estimated that quitting before the age of 35 was associated with a gain in life expectancy of up to 10 years, effectively nullifying most of the deleterious influence of smoking on the risk of mortality (Taylor et al. 2002; Nash et al. 2017). Successfully quitting smoking during this period is also paramount for curbing the health-related implications of maternal smoking during pregnancy (CDC 2014; Berlin and Oncken 2018).

Young adulthood is being slowly integrated as a focal point into most recent tobacco control initiatives. An increasing number of experts have proposed that the ages of 21 and 25 represent better thresholds for capturing current trends in initiation (Tercyak et al. 2007; Bernat et al. 2012; Edwards et al. 2013; O'Loughlin et al. 2014; IOM 2015; Hair et al. 2017). Others have suggested that tobacco control should no longer target only initiation (as in adolescence) but include the transitions in and out of the smoking stages that are likely to occur during young adulthood (Villanti et al. 2018).

Addressing this issue, in 2012, the latest US Surgeon General's report on youth smoking highlighted young adulthood as a distinct priority group for the first time. In 2015, the US Institute of Medicine released a report synthesizing the public health implications of raising the minimum age of legal access to tobacco products. Last year in Canada, both Health Canada and the Quebec Directeur national de santé publique highlighted young adulthood as a priority action area for tobacco control (Health Canada 2017; Gov Quebec 2017).

### **1.5 A new approach to study social inequalities in smoking during young adulthood**

To evidence social inequalities in smoking in this age group, the majority of public health science has built on the tools and guidelines developed by social epidemiology to measure individuals' socio-economic circumstances and examine their influence on health outcomes (Krieger, Ross, and Williams 1997; Oakes and Rossi 2003; Braveman et al. 2005; Galobordes et al. 2006a, 2006b; Shavers 2007; Adler and Stewart 2010; Braveman et al. 2011). This long-standing scholarship has developed a powerful foundation for supporting the study of health inequalities; its three guiding principles consider: (1) multiple dimensions to represent the forms (e.g., income, education, housing) and levels (e.g., individual, familial, household, neighbourhood) underlying the multi-faceted distribution of health outcomes; (2) adapted measures to capture these dimensions in each of the life periods – childhood, young adulthood, active professional life, and retirement – that are involved in the progression of these inequalities; and (3) the intersections among these dimensions and across these life periods to better understand the multiplicative nature of the risks underlying these inequalities (Diez-Roux et al. 2003; Galobordes et al. 2006a, 2006b; Bartley 2007; Frohlich et al. 2008; Adler and Stewart 2010). Given the prominence of life-course theories in social epidemiology, a lineage of studies has already questioned how research methods should also adapt to the social context of the life periods of adolescence, in which the majority has not finished education (Currie et al. 1997, 2008; Hartley, Levin, and Currie 2016; Lien, Friedman, and Klepp 2001; Ridolfo and Maitland 2011), and old age, in which the majority has exited the workforce (Grundy and Holt 2001).

In this thesis, however, I argue that public health science has yet to question how the social context of young adults fit with traditional concepts and methods. Led by the increasing

average length of studies, the completion of the transition to adulthood is now delayed well into the fourth decade of life (Clark 2007). In 2012, the full-time employment rate began to peak only around the age of 31 (Galarneau et al. 2013). In 2016, the number of young adult Canadians between the ages of 20 and 34 who were living with their parents reached a record 35% (Statistics Canada 2018). The average age of Canadian mothers at their first birth has increased steadily – from 25.9 in 1991, 27.3 in 2001, and 28.5 in 2011 – inching out of the bounds traditionally defined for young adulthood (Statistics Canada 2014). Correspondingly, the proportion of young adult Canadians living with children has decreased by 16% since 2001 (Statistics Canada 2017). Finally, while the proportion of young adult Canadians who live with a common-law partner has remained stable since 2001, the proportion of young adults who live with a married partner has decreased by 30% over this period (Milan and Bohnert 2015). These patterns challenge the notion that achievements in education, occupation, and earnings suffice to inform the dynamic configuration of circumstances experienced by individuals across education, employment, family, and housing arrangements in the decade following the end of adolescence (Graham et al. 2006; Øversveen et al. 2017).

A nuanced approach, integrating the social context of young adulthood, is even more important today because the transition to adulthood is more precariously experienced now than in past decades, obfuscating many of its health-related implications for the young adults of tomorrow (Bynner 2005; Furstenberg 2006; Côté and Bynner 2008; Settersten and Ray 2010; Côté 2014; Furstenberg 2015). According to Statistics Canada's 2018 "A Portrait of Canadian Youth": (1) 50% of young adults in university are now expected to face an average \$26,300 debt upon graduating; (2) the proportion of young adult full-time employees in non-permanent jobs has increased twofold among men and fourfold among women since the 1980s; (3) while the real wages of young adult women have increased in keeping with their accelerated entry into higher education, the real wages of young adult men have not budged since the 1980s; and (4) as a result, the number of homeowners has been decreasing among young adults at a faster pace than any other adult age group (Statistics Canada 2017, 2018).

## **1.6 Aim and objectives of this dissertation**

The issue of social inequalities in smoking provides a unique insight into a new field that is rapidly consolidating across public health disciplines to address the lifelong progression of health inequalities during young adulthood. This life period is characterized by rapid sequences of transition stages, during which young adults are expected to finish studies, find full-time employment, leave their parents, establish their own household, develop romantic relationships, and have children (Clark 2007; Galarneau et al. 2013; Milan and Bohnert 2015; Vespa 2017). Despite the increasing interest in understanding the health profile of young adults today, there have been too few concerted efforts to view young adults back from a life-course perspective and conceptualize the implications of that perspective for the study of health inequalities.

In response, the general aim of this thesis is to advance the study of young adults' socio-economic circumstances and their contribution to social inequalities in health during the transition to adulthood using smoking as a case example. To support its importance, I first systematically review, in article 1, the evidence on social inequalities in smoking among young adults using, as a guiding criterion, the indicators used to represent socio-economic circumstances. Few studies have systematically reviewed the characteristics associated with smoking during young adulthood (Freedman et al. 2012; Cengelli et al. 2012; Stone et al. 2012), and none have focused on its socio-economic distribution. This review, therefore, allows me to appropriately assess the breadth of evidence produced on this issue over the past 20 years. This also allows me to address the contribution of traditional approaches to the current theoretical limitations in studies on social inequalities in smoking among young adults.

Building on these findings, I then introduce a theoretical framework to guide the examination of social inequalities in smoking among young adults. This framework advances the theories in health inequality research by explicitly disentangling: (1) the complex configuration of characteristics that represent young adults' socio-economic circumstances; and (2) the contribution of transition stages and specific ages to the contextualization of these characteristics in the life-course. To do so, I draw from two complementary theoretical foundations. First, I build on the scholarship of Pierre Bourdieu (1979, 1986) to conceptualize

socio-economic circumstances through the range of economic, social, and cultural resources that young adults accumulate (Abel 2008; Abel and Frohlich 2012; Veenstra 2007, 2018). In this framework, the resources accumulated by young adults influence their risk of smoking through both their distinct and their “conditional” presence, leading those with fewer resources across multiple dimensions to experience a multiplicative risk of smoking (Abel 2008; Abel and Frohlich 2012; Veenstra and Abel 2015).

To introduce a temporal dimension into the relationship between resources and smoking, I then expand on this Bourdieusian framework and draw on life-course theory to posit that resources exert their full influence on smoking in keeping with their timing over the course of this life period. To operationalize this principle of timing, I focus on the contexts experienced in different transition stages and at different ages during the transition to adulthood (Hogan and Astone 1986; Shanahan 2000; Elder 1994, 1998; Settersten, Rumbaut, and Furstenberg 2005; Staff et al. 2010; Pampel et al. 2014).

This conceptual proposition is tested across three articles using a first cross-sectional data set of 2,083 young adults between the ages of 18 and 25 recruited in Montreal, Canada in 2011–2012 and a second longitudinal data set of 1,243 young adult Canadians who were followed four times between the ages of 18 and 25 between 1994–1995 and 2010–2011.<sup>1</sup> These empirical studies sequentially build on each of the principles advanced in the theoretical framework to support my proposal. In the first sample, using a Bourdieusian approach, I examine the contribution of the different forms of socio-economic resources that young adults accumulate to social inequalities in smoking in this age group. Using a life-course approach, I then examine the contribution of transition stages through which young adults progress to the same. Testing the principle of “conditionality,” I examine whether these resources and transition stages have different implications for smoking depending on young adults’ level of

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<sup>1</sup> I focus in this thesis on the ages of 18 to 25 to represent young adulthood. This aligns with a majority of public health definitions, including those in the 2012 US Surgeon General’s report on youth smoking and the 2015 US Institute of Medicine report on young adult health. This focus is also in line with smoking trajectories since 99% of people who initiate smoking do so before the age of 25 (USDHHS 2012). It is important to note, however, that this age group represents the first half of modern population patterns of transitions in education, employment, family, and housing. I address this topic in further detail in chapter 3.



education. Testing the role of the timing of these resources and transition stages, I also examine how they have different implications for smoking at different ages over the course of young adulthood.

In the second sample, I corroborate each of these objectives and then explore how differences in associations across levels of education emerge during young adulthood by examining their age-based progression. That is, I explore whether the benefits of accessing resources and navigating transitions will be disproportionately evident among those who are more socially advantaged (in keeping with their education) as age increases. Taken together, these empirical projects demonstrate that social inequalities in smoking during the transition to adulthood are better understood by considering the intersection of the resources, transition stages, and ages through which young adults progress.

### **1.7 Organization of this dissertation**

This thesis is made up of seven chapters. Chapter 2 introduces the literature review, in which I further position my argument in relation to the current research on social inequalities in smoking among young adults. I conclude this chapter with Article 1, “A Field Coming of Age? A Methodological Systematic Review of Social Inequalities in Smoking among Young Adults”, in which I systematically review the evidence on this issue. Focusing on indicators used to operationalize the socio-economic circumstances associated with young adult smoking, I discuss the wide range of dimensions relevant to young adults’ socio-economic circumstances and the disproportionate focus on a few traditional indicators to capture them. Chapter 3 returns to these findings to discuss the limitations of the epidemiological approaches used in health inequality research. It then introduces the two main theoretical foundations that will be mobilized to better understand social inequalities in smoking during the transition to adulthood.

In response, I present the research objectives and specific hypotheses of the contributions through which I seek to address these critiques. Chapter 4 presents the methods I used, focusing on the two data sets used to support the empirical work presented in this thesis: the

Interdisciplinary Study of Inequalities in Smoking (ISIS) and the National Population Health Survey (NPHS).

Chapter 5 presents the results of my three empirical articles. In article 2, “Uncovering Social Inequalities in Health during Young Adulthood: Insights from Bourdieusian and Life-Course Approaches,” I develop my theoretical proposal to situate young adults’ resources within their transition stages. I then test my proposed framework by exploring the social distribution of smoking using ISIS data. In article 3, “Considering the Age-Graded Nature of the Associations between Socio-Economic Characteristics and Smoking during the Transition to Adulthood,” I build on the life-course perspective and examine the varying implications of young adults’ socio-economic circumstances for smoking at different ages in the participants from the same sample. In article 4, “Challenging the Study of Health Inequalities during Young Adulthood: Smoking in the Canadian National Population Health Survey as a Case Example,” I use NPHS data to test the findings of the ISIS study and further disentangle the age-based progression of social inequalities in smoking during this period.

Chapter 6 presents a discussion of the principal findings, their implications for research and intervention, the limitations of this dissertation, and immediate steps for future research. Chapter 7 concludes by addressing how findings inform the questions that have been laid out in this introduction chapter.

## **CHAPTER 2. LITERATURE REVIEW**

This chapter describes the need for a systematic review of the socio-economic circumstances associated with smoking during young adulthood. It does this in four sections. Section 2.1 introduces the current evidence on social inequalities in smoking among young adults in Canada. Section 2.2 then addresses the systematic and narrative reviews that have been published on social inequalities in smoking. Since these reviews focus on adult and adolescent populations, section 2.3 continues by describing the publications that have reviewed the risk factors related to smoking in the young adult population and the extent of the evidence for its socio-economic determinants. Section 2.4 concludes this chapter by introducing the systematic review of social inequalities in smoking among young adults that is conducted in article 1.

### **2.1 Current evidence on social inequalities in smoking among young adults**

The decline in the prevalence of smoking that has been celebrated since the publication of the first US Surgeon General's report on smoking in 1964 has been accompanied by the rapid intensification of social inequalities in smoking (Link and Phelan 2009; Corsi et al. 2013, 2014; Smith, Frank, and Mustard 2009; Reid et al. 2010; CIHI 2016). A massive amount of literature has demonstrated the progression of these inequalities across high-income countries for socio-economic indicators including education, income, occupation, wealth, and area-level deprivation (Pierce et al. 1989; Cavelaars et al. 2000; Giskes et al. 2005; Mackenbach et al. 2008; Schaap and Kunst 2009; Hiscock et al. 2012; Casetta et al. 2016). Illustrating this, Corsi and colleagues (2013) examined trends in education-based inequalities in smoking in Canada between 1950 and 2011 and found that, compared to those who had completed university, (1) men who had not completed high school were 20% more likely to be smokers in 1950 but 340% more likely to be smokers in 2011, and (2) women who had not completed high school had no differences in smoking behaviour in 1950 but were 470% more likely to be smokers in 2011. More recently, the Canadian Institute of Health Information found that differences in the prevalence of smoking between the top and bottom income quintiles increased from 53% to 91% between 2003 and 2013 (CIHI 2016).

The bulk of the evidence for social inequalities in smoking among youth has focused on adolescence (Tyas and Pederson 1998; Hanson and Chen 2007; Amos et al. 2009). Despite this, a growing body of literature has begun to explore how socio-economic circumstances

further contribute to the unequal progression of smoking behaviour during the transition to adulthood (Hammond 2005; Green et al. 2007; Amos et al. 2009; USDHHS 2012; Redonnet et al. 2012; Bowes et al. 2013; Villanti et al. 2017). For instance, the 2012 Surgeon General's report on youth smoking found that smoking between the ages of 18 and 25 was more prevalent among those who were living under the poverty threshold and were out of the education system, while the highest incidence of smoking occurred among those who had not finished high school and were unemployed (Green et al. 2007; Welte et al. 2011; Johnston et al. 2011).

The Canadian evidence for social inequalities in smoking among young adults is surprisingly scarce. Hammond (2005) found in 2003 that the prevalence of smoking among young adult Canadians aged 18–29 varied, from 13% among employees in administrative/clerical work, to 22% among students and those working in professional occupations, to 35%–38% among those working in sales or services and in industries requiring manual labour. Zhang and colleagues (2006) followed young adult Canadians aged 20–24 between 1994 and 1995 and 1996 and 1997 and found that young adults who had not completed high school were five times more likely to become smokers over the two-year period compared to those who had completed post-secondary education. Corsi and colleagues (2013) examined education-based differences in initiation and cessation among young adult Canadians aged 20–24 from 1999 to 2011 and found a clear gradient for both outcomes. Similarly, Gagné and Veenstra (2017) observed, between 2001 and 2013, a clear, education-based gradient in the progression to daily smoking during young adulthood, finding that young adult Canadians who had not completed high school were more than twice as likely to start smoking daily between the ages of 18 and 25 in comparison to those who had completed post-secondary education.

In Quebec, despite the publication of one report on social inequalities in smoking in 2012 and another on young adult smoking in 2017 (Lasnier et al. 2012, Gov. Québec 2017), estimates of the social distribution in smoking among young adults are available only for the region of Montreal. A report published by Montreal's local public health agency noted that, between 2007 and 2010, the prevalence of smoking among young adults aged 18–34 varied across neighbourhoods, from 13% to 36% (Simoneau and Leane 2013). Two previous studies from

the ISIS found, among young adult Montrealers, that (1) those who had not finished high school were 340% more likely to report smoking in comparison to those who had completed some university and (2) those who lived in the most deprived neighbourhoods were 30% more likely to have smoked 100 cigarettes in their lives, and 80% more likely to be daily smokers, compared to those living in the most affluent neighbourhoods (Frohlich et al. 2017; Gagné et al. 2017). A third study followed ISIS participants' smoking behaviour over a two-year period but found no significant effects of personal income, educational attainment, employment status, or financial difficulties on the risk of initiating or quitting during this time (Steinmetz-Wood et al. 2018).

## **2.2 Systematic and narrative reviews on social inequalities in smoking**

Most reviews examining the association of socio-economic characteristics with smoking distinguish only between the adolescent and adult populations, overlooking young adulthood. Hiscock and colleagues (2012), combining a rapid review on PubMed with a purposive search, reviewed over 200 studies on the issue in the general population but addressed only evidence of the social inequalities in smoking initiation during adolescence. Schaap and Kunst (2009) reviewed 70 studies on socio-economic inequalities in smoking, but focused only on samples of the adolescent and adult populations. However, they noted that most studies had either adopted cross-sectional designs or relied on data over few time points to capture socio-economic circumstances over different life periods, thereby precluding a finer assessment of the life-course dynamics of social inequalities.

Among the reviews on youth, Tyas and Pederson (1998) produced a narrative review on the general risk factors associated with smoking and distinguished four central dimensions: socio-demographic, environmental (e.g., peer smoking), behavioural (e.g., alcohol use), and personal (e.g., self-esteem). Addressing the socio-demographic characteristics of smoking, the authors argued that there was sufficient evidence to support the protective influence of having a stable family structure and a higher socio-economic background, but they also highlighted the negative influence of having a higher disposable income. Hanson and Chen (2007) reviewed 21 studies examining the association between socio-economic circumstances (e.g., parents' education, occupation, and income; deprivation at the school or neighbourhood level) and

smoking between young people aged 10–21 and found that 15 studies (71%) had reported a negative association. In the one study on a sample of young adults, parents' education was not significantly associated with smoking (Friedstad et al. 2003).

Similarly, Amos and colleagues (2009) produced a systematic review of studies on smoking among young people between the ages of 11 and 24 in England with a focus on social inequalities, and they reported only one study of young adult women (Graham et al. 2006). The authors found that, among British women aged 25–34, each of the following factors – having a father in a lower occupational class, entering earlier into motherhood, living alone without a partner, being a single mother, having fewer years of education, and working in a routine occupation – was independently associated with a higher risk of smoking during this period. Finally, Henkel and Zemlin (2016) produced a systematic review of studies among youth in Germany but found no studies on young adults.

### **2.3 Systematic and narrative reviews on smoking among young adults**

In keeping with the traditional role that young adulthood has played in smoking trajectories and tobacco control in the past decades, the majority of evidence syntheses with regard to young adult smoking have focused on cessation. In 2007, the *American Journal of Public Health* published a supplement on smoking cessation in young adults in response to the evidence that “too few young adults try to quit, too few get assistance in quitting, and too many relapse” (Husten et al. 2007, 1356). In their contribution, Green and colleagues (2007) focused on social inequalities, highlighting the fact that young adult smokers were more likely to not complete college, to report a lower household income, and to be employed in service or blue-collar work, and they argued that there was a mismatch between the amount of research focusing on college samples and the proportion of young adult smokers found outside the education system.

To address cessation, a series of Cochrane reviews on interventions among youth under 20 years of age have proposed that complex approaches showed promise, but that there was not yet sufficient evidence to recommend widespread implementation of any one model (Fanshawe et al. 2017). In the US, Villanti and colleagues (2010) examined 14 studies on

cessation interventions targeted at young adults and found that there was limited evidence for the efficacy of smoking-cessation interventions for this age group. Suls and colleagues (2012) found with 14 studies that there was sufficient evidence to argue that cessation interventions in the general population were also effective among young adults. They noted, however, that young adults were much less likely to seek traditional cessation interventions in comparison to other age groups, for reasons that were not related to awareness, costs, or education (Curry et al. 2007; Hughes, Cohen, and Callas 2009).

None of these reviews, however, explicitly addressed the implications of young adults' socio-economic circumstances. This may be representative of other age groups as well. A decade ago, Ogilvie and Petticrew (2004, 130) condemned the fact that "existing Cochrane reviews do not present evidence on the differential effectiveness of community based tobacco control interventions in different socioeconomic groups, [which] probably reflects the fact that most primary research has not reported, or sought to establish, how the effects of interventions are distributed between groups." Addressing this in young adults, Filsinger and McGrath (2009, ii) produced a review of interventions addressing prevention and cessation, with a focus on vulnerable populations, and were appalled by their findings: "The research that is being done focuses on college/university students and studies of interventions usually draw from these campuses for their samples. Those in the workforce, particularly blue-collar environments, trade or technical schools, and those with low SES, while being the most vulnerable, are virtually ignored by the research community."

Despite the growing interest of research in young adult smoking, few studies have reviewed the evidence of the determinants of smoking in this age group, with even fewer addressing the socio-economic determinants. Fifteen years ago, Backinger and colleagues (2003) found that very few studies had examined the determinants of smoking initiation and cessation during young adulthood beyond age, sex, and race/ethnicity. Since then, Freedman and colleagues (2012) have developed the only systematic review of the correlates of smoking initiation among young adults. Including 27 studies, the review found four studies suggesting that young adults who had achieved fewer years of education were systematically more likely to initiate during this period (Stockdale et al. 2005; Choi et al. 2003; Staten et al. 2007; Hailpern and



Viola 2005). The majority of the primary findings, however, focused on the proximal determinants of initiation (previous tobacco use, concomitant alcohol and illicit drug use, exposure to tobacco marketing, peer smoking, and attitudes to and perceptions of smoking).

Cengelli and colleagues (2012) produced the only systematic review of the determinants of self-promoted smoking cessation during young adulthood. They found, across nine studies, that educational attainment, marital status, residential mobility (e.g., moving schools), and parents' educational attainment and marital status were associated with smoking cessation; however, these findings were inconsistent with many studies reporting null associations. These studies also disproportionately focused on the proximal correlates of cessation, with the most robust evidence found for peer smoking, parental disapproval of cigarette use, age of initiation, and prior frequency of smoking.

While not specifically focused on smoking, Stone and colleagues (2012) reviewed the protective and risk factors associated with alcohol, smoking, and other drug use between the ages of 18 and 26 across 114 longitudinal studies. They found seven studies suggesting that each of seven factors – neighbourhood deprivation, parents' occupational class, employment in the military, being married, having children, undertaking college studies, and having a higher educational attainment – was associated with a subsequently lower risk of smoking during young adulthood. Each of these characteristics, however, had been examined only once or twice across studies.

Finally, although not exactly representative of the same age group, two systematic reviews examined the determinants of maternal smoking during and after pregnancy, and they found that mothers who had had an earlier pregnancy, lived alone without a partner, achieved fewer years of education, and worked in manual and routine occupations were less likely to quit and more likely to relapse after the pregnancy (Lu, Tong, and Oldenburg 2001; Orton et al. 2018).

#### **2.4 Developing a review on social inequalities in smoking among young adults**

Young adulthood is a sensitive period, one that we now know is actively involved in current smoking trajectories. Given the fundamentally social nature of the distribution of smoking and

its progression across the life-course, it is of crucial importance to review, using systematic methods, how socio-economic circumstances – whether in education, employment, or family or housing arrangements – may contribute to exacerbating the risk of smoking during this period. While an increasing number of studies speak to the unequal progression of smoking in this age group, they are scattered across public health and the social sciences in psychology, demography, sociology, and economics. This thesis will provide evidence to support the work of public health researchers and policy-makers to better identify vulnerable populations and appropriately target interventions. It will also show the limitations of the approaches used so far in understanding the associations between socio-economic characteristics and smoking during this life period.

Article 1, therefore, presents a systematic review of studies on social inequalities in smoking among young adults. In this review, I develop an explicitly methodological focus on the indicators used to represent the socio-economic circumstances of young adults. I build on the work developed by Schaap and Kunst (2009), who performed a strictly methodological review of studies on the socio-economic inequalities in smoking in the general population. They found, across 70 studies, that socio-economic circumstances had been operationalized in those studies across eight broad categories: education, income, occupation, unemployment, housing tenure, financial difficulties, parental background, and neighbourhood deprivation. However, the authors noted that studies disproportionately used the same few indicators to address the extent of socio-economic circumstances. For instance, the measure of educational attainment was used alone in 34% of the included studies and with other variables in 84% of the included studies. Because of the review's methodological focus, they did not report on the distribution of findings, missing the opportunity to explore discrepancies in findings across indicators. Article 1, therefore, advances the work of this review by informing both the distribution of indicators used to operationalize socio-economic circumstances in young adults and the distribution of findings across the indicators commonly used in this age group.

Before presenting the systematic review, I offer a caveat about the concept of *socio-economic circumstances* that is used throughout this thesis. In keeping with the important number of guidelines produced by social epidemiologists (Krieger et al. 1997; Braveman et al. 2005;

Galobardes et al. 2006a, 2006b), the majority of health inequality studies have focused on the concepts of socio-economic status (SES), socio-economic position (SEP), and sometimes social class to operationalize the fundamental causes and the intermediate resources that influence inequalities in health (Link and Phelan 1995, 2009; Phelan, Link, and Tehranifar 2010; Veenstra 2018). These concepts are useful for distinguishing among the different material (e.g., status), psychosocial (e.g., position), and cultural (e.g., class) mechanisms linking social disadvantage and health (Krieger et al. 1997; Bartley 2007, WHO 2008). These approaches, however, may underestimate the extent of the socio-economic circumstances that individuals may experience outside of their achievements in education, employment, and earnings. These approaches may also underestimate the contexts that modify the association of these socio-economic circumstances with health behaviour uptake across social groups (Poland et al. 2006; Øversveen et al. 2017). Therefore, this review uses an inclusive definition of *socio-economic circumstances*, one that includes the traditional indicators of SES and SEP but also incorporates other socio-demographic characteristics that are theoretically relevant for better understanding social inequalities in smoking.

**ARTICLE 1. A field coming of age? A methodological systematic review of studies on social inequalities in smoking among young adults**

## **Revise and re-submit in Tobacco Control**

### **TITLE**

A field coming of age? A methodological systematic review of studies on social inequalities in smoking among young adults

### **AUTHORS**

Thierry Gagné<sup>1,2</sup>, Joseph G. L. Lee<sup>3</sup>, Madeleine Steinmetz-Wood<sup>4</sup>, Katherine L. Frohlich<sup>1,2</sup>

### **AUTHOR AFFILIATIONS**

<sup>1</sup> École de santé publique de l'Université de Montréal (ESPUM), Canada;

<sup>2</sup> Institut de recherche en santé publique de l'Université de Montréal (IRSPUM), Canada;

<sup>3</sup> Department of Health Education and Promotion, College of Health and Human Performance, and Center for Health Disparities, Brody School of Medicine, East Carolina University, USA;

<sup>4</sup> Department of Geography, McGill University, Canada

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## ABSTRACT

**Objective.** Socioeconomic circumstances are critically important to addressing smoking. In young adulthood (ages 18-25), dynamic transitions in education, employment, family, and housing complicate the measurement of socioeconomic circumstances. To better understand approaches to capturing these circumstances, this methodological systematic review examined how socioeconomic characteristics used to identify social inequalities in smoking among young adults are measured.

**Data sources.** We searched PubMed/MEDLINE, Scopus, EMBASE, ERIC, and Sociological Abstracts and used three prior reviews. We updated the search in March 2018.

**Study selection.** Two reviewers independently screened peer-reviewed records from OECD countries published in English, French, German, or Spanish after 1995 whose samples covered at least one year between the ages of 18 and 25. We included 89 of 1,320 records.

**Data extraction.** One reviewer extracted study characteristics, indicators used to operationalize socioeconomic circumstances, and each indicator's relation to results on smoking (i.e., significance and direction). We found 39 indicators of socioeconomic circumstances related to six broad domains. These indicators were used in 425 results.

**Data synthesis.** We descriptively analyzed the extracted data using evidence tables. Educational attainment was most common. Evidence of inequalities varied by indicator used. For example, there was inconsistent evidence regarding the role of parental characteristics and transition stages and insufficient evidence regarding personal income on smoking.

**Conclusion.** Despite its importance, studies have disproportionately examined inequalities among young adults using traditional indicators. The mismatch between young adults' life transitions and measurement strategies may attenuate evidence of inequalities. We suggest strategies to improve future measurement.

## KEYWORDS

Systematic review; Smoking; Young Adults; Social inequalities; Socioeconomic Status; Methods

## **WHAT THIS PAPER ADDS**

- Studies on inequalities in smoking among young adults often use traditional methods not adapted to their life-course context
- This may attenuate evidence of social inequalities in smoking among young adults
- Measurement strategies addressing young adults' life transitions are indicated.

# TITLE

A field coming of age? A methodological systematic review of studies on social inequalities in smoking among young adults

## INTRODUCTION

While young adults had been largely absent from early policies and interventions addressing smoking prevention,<sup>1</sup> more recently researchers have begun to notice that for many, smoking uptake continued to be a risk after the end of adolescence. This has led to concerns that the focus on adolescents alone could fail to address smoking among young adults.<sup>2,3</sup> Thus, young adulthood is increasingly being considered as being a critical part of modern smoking trajectories.<sup>4,5</sup> In Canada, for example, young adults represent the group with the highest prevalence of smoking: in 2016, 26% of Canadians ages 20-34 were current smokers compared to 17% in the overall population.<sup>6</sup> Unlike other age groups, young adults have also enjoyed no appreciable changes in initiation and cessation rates since the early 2000's.<sup>4,5</sup>

Socioeconomic circumstances represent key determinants of smoking.<sup>7-9</sup> While decreases in smoking prevalence represent a public health success, tobacco control efforts have largely failed to address social inequalities in smoking.<sup>10</sup> Large social inequalities in smoking continue to be found among young adults.<sup>4,11-12</sup> Building on the scholarship that has linked socioeconomic status (SES) and smoking,<sup>7,13</sup> studies among young adults have examined social inequalities in smoking using traditional SES indicators (i.e., educational attainment, household income, occupational grade, and home ownership) developed for the adult population.<sup>14,15</sup>

Traditional indicators, however, may perform poorly when studying smoking behaviours during the transition to adulthood. In comparison to other age groups, young adults are in a distinct developmental process characterized by rapid sequences of transitions in and out of education, employment, family, and housing arrangements.<sup>16,17</sup> While young adulthood is often defined as being between the ages of 18 and 25, the transition towards adulthood has



become more elongated, diversified, and fragmented than ever before, continuing for many into the fourth decade of life.<sup>16,17</sup> Thus, static achievements in education, occupation, and wealth may provide only a limited operationalization of young adults' socioeconomic circumstances.

In addition to the limited use of indicators to address dynamic changes in young adults' lives, traditional indicators may neither capture the full extent of socioeconomic circumstances nor the social context in which associations with smoking occur.<sup>18-21</sup> For instance, Graham and colleagues (2006) observed in the UK that using indicators focussed on education and occupation to study inequalities in smoking did not capture the contribution of family and housing circumstances (e.g., early motherhood, non-cohabitation, lone motherhood) to social disadvantage in early adulthood.<sup>22</sup> Similarly, Villanti and colleagues (2017) found in the US that education, household income, employment status, parents' education, family structure, and perceived financial situation were each independently associated with smoking outcomes among young adults, supporting the wide range of circumstances that might contribute to the unequal distribution of smoking during this period.<sup>23</sup> Addressing these critiques, Pampel and colleagues (2014) proposed that the consideration of a life-course perspective, which includes family background and adult achievements, along with life course roles in employment, partnering, and parenthood, could better inform the study of processes of increasing stratification in health behaviour during the transition to adulthood.<sup>24</sup>

These challenges extend to studies of other unequally distributed behaviours among young adults including physical activity, eating practices, alcohol consumption, and illicit substance abuse.<sup>25</sup> However, the issue is of particular importance to tobacco control given the size of inequalities in smoking today and the relatively unchallenged progression of social inequalities in smoking over the past thirty years.<sup>26</sup>

Systematic assessment of the existing literature can identify gaps in methodological approaches and highlight promising ones.<sup>13</sup> Schaap & Kunst (2009) conducted a review of 70 studies with a methodological focus on the role of SES in smoking.<sup>13</sup> They found that studies disproportionately focussed on educational attainment and used cross-sectional designs to study

social inequalities in smoking, neglecting potential differences across life periods and other socioeconomic dimensions. However, they did not specifically address young adults as an age group. Other reviews have similarly focused on the role of SES in smoking among youth but found few or no studies among young adults.<sup>7,27-30</sup> Thus, to inform how tobacco research may better address the critical gap in operationalization of socioeconomic circumstances among young adults, we conducted a methodological systematic review of the measurement of social inequalities in smoking among young adults with particular attention to indicators used to measure socioeconomic circumstances. This study aimed to understand what indicators are used in tobacco research to capture socioeconomic circumstances in young adults and inform future methodological innovations in measurement.

## **METHODS**

### **Search strategy**

We iteratively developed search terminology using three keyword groups relevant to: (1) social inequalities; (2) young adults and; (3) cigarette smoking. We consulted with a librarian to develop our initial keyword search function. The complete search string for the PubMed/MEDLINE database was: (((social determinants of health[mesh] OR health status disparities[mesh]) OR (inequalit\*[tiab] OR inequit\*[tiab] OR disparit\*[tiab])) AND ((Young Adult[mesh]) OR (Young adult\*[tiab] OR emerging adult\*[tiab] OR college student\*[tiab])) AND ((Smoking[mesh] OR Smoking cessation[mesh] OR Tobacco Products[mesh]) OR (cigarette\*[tiab] OR smok\*[tiab] OR tobacco\*[tiab]))). We then translated the controlled vocabulary of the first search to the other databases (see Supplementary Material online). We implemented the search in five scientific databases – PubMed/MEDLINE, Scopus, EMBASE, ERIC, and Sociological Abstracts.

To complement this procedure we searched the references of reviews related to young adult smoking in the online Database of Public Health Effectiveness Reviews (DoPHER) and two other reviews that surveyed smoking initiation and cessation among young adults.<sup>30-32</sup> There were no date, language, or geography limits placed on the search. We used EndNote to de-

duplicate records and confirmed this procedure manually.<sup>33</sup> Records were then uploaded into the online platform Covidence.<sup>34</sup> The review protocol was finalized in March 2016. A first search was conducted on March 24, 2016, and a second one was conducted to update results on March 12, 2018. The review protocol and search results are detailed in Supplementary File 1.

### **Screening of studies**

Two authors independently assessed titles and abstracts and coded them for inclusion or exclusion. Two authors then independently coded the full-texts for inclusion or exclusion. Differences were resolved by discussion or reconciled by a third author.

### **Criteria for inclusion**

We chose for inclusion research articles that: (1) were published in English, French, Spanish, or German in peer-reviewed scientific journals since January 1996; (2) addressed an industrialized country as defined by OECD membership status; (3) were quantitative in nature (i.e., not a conference abstract, essay, qualitative study, or review); (4) used a socioeconomic indicator as an independent or predictor variable; (5) used an outcome related to cigarette smoking (i.e., status, frequency, quantity, initiation, or cessation) as a dependent or outcome variable and; (6) focused on young adults.

For the ‘socioeconomic’ criterion, we did not solely focus on traditional SES indicators and instead developed an inclusive approach to address the broader set of characteristics relevant to young adults’ resources, transition stages in education, employment, family, and housing arrangements, and places where they live, study, work, and socialize. Transition stages in education refer to measures such as ‘student status’ or ‘Neither in Education, Employment, or Training (NEET) status’, which are different from measures of educational attainment such as highest diploma obtained. Raters included articles if they mentioned socioeconomic and/or socio-demographic variables in the title and abstract. Raters did not include articles if they focussed on a subgroup (e.g., low-income single mothers, college students) but did not further examine socioeconomic and/or socio-demographic variables. Raters included articles if they considered socioeconomic indicators as confounders or mediators. For the ‘smoking’ criterion,

raters did not include articles that only examined indirect outcomes (e.g., attitudes and knowledge, other tobacco products, second-hand smoke exposure, nicotine dependence, intervention uptake or follow-up). Raters included articles if they considered smoking outcomes as mediators. Raters also included articles if they recoded smoking into dependent variables representing broader patterns of healthy behaviour. For the ‘young adult’ criteria, we included articles that measured socioeconomic characteristics using a sample of young adults or an analytic strategy that focused on this age group (i.e., stratification or effect modification by age). Raters included studies if samples included at least one year between the ages of 18 and 25 and did not reject articles based on the upper bracket of the age range if there was stratification or effect modification. Raters did not include articles that focused on women of reproductive age unless authors explicitly examined ‘young adult’ women.

### **Data extraction**

From the final set of included articles, one author extracted study characteristics. These included publication data, methodological considerations (i.e., age range, design, country, sample size, outcome), indicators, and modeling approach (i.e., independent variable, transformed through recoding/data reduction analysis, confounding, mediating, or moderating variable).

We iteratively developed our data extraction strategy to evaluate whether an indicator was considered to be representing young adults’ socioeconomic circumstances. We included indicators that were defined or labeled as ‘socioeconomic’, ‘social’, ‘demographic’, or ‘socio-demographic’ except for gender, race/ethnicity, sexual orientation, religion, law (e.g., criminal history), spoken language, geographic region, and psychological factors. However, we included psychosocial indicators if they directly related to financial difficulties, perceived financial situation, or subjective socioeconomic status. If indicators referred to aggregate measures whose component indicators were not explicitly introduced separately (e.g., an area deprivation score), we only considered these as one indicator. We combined three pairs of indicators often found to be combined into single items: student and work statuses into ‘employment status’, living arrangements with parents, partners, and children and parenthood into ‘family status’, and father’ and mother’s education into ‘parental education’. We also

combined indicators related to current and earlier exposures (i.e., those defined to be ‘during childhood’).

We also extracted: 1) the number of indicators per article; 2) the name of the construct if there was recoding; 3) whether the results came from an age-based sub-group analysis in an adult sample; 4) the significance and direction of estimates if they were reported and; 5) strategies with regard to stratification and confounding. We made the following decisions when abstracting results. In studies recoding multiple items into a single index or scale, we abstracted and reported the index or scale as if they represented each of the individual items. In the studies that examined multiple associations, we considered that the article presented a positive or negative association (i.e., in the same or opposite direction) if it found at least one significant result in a given direction (at the  $p < 0.05$  level) and a mixed result if it found both positive and negative results. Finally, we interpreted results as not available if they were not reported or were presented without inferential statistics.

The other authors reviewed the data extraction results and approved the final evidence table. The complete evidence table is available in Supplementary File 2.

### **Considerations regarding quality assessment**

We did not formally assess the methodological quality of reviewed articles because the goal of this review was not to assess the robustness of the evidence but rather to examine the breadth of methods used to operationalize socioeconomic circumstances among young adults. The design, sample size, modelling approach, and stratification/confounding strategy of each article are detailed in the Supplementary Material.

### **Data synthesis**

We conducted a narrative review as heterogeneity in study design, indicators, and outcomes precluded a meta-analysis and study aims were focused on methodological concerns. To illustrate patterns of association with different indicators, we present the count of records showing negative, non-significant, or positive results across smoking outcomes (i.e., prevalence, initiation, and cessation). We do this for indicators reported in five or more

records. We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.<sup>35</sup>

## **RESULTS**

### **Search results**

Figure 1 presents the inclusion process. In March 2016, we found 868 records matching our keyword search and 120 additional records in complementary reviews, including a review of internet-based interventions for smoking cessation found in DoPHER.<sup>36</sup> In March 2018, we found 322 additional records matching our keyword search. Eighty-nine records were included.

*Please insert Figure 1 somewhere here*

### **Country of origin and study design of included records**

A significant portion of records came from the United States ( $n = 48$ ), followed by France ( $n = 7$ ), Canada ( $n = 5$ ), Switzerland ( $n = 4$ ), United Kingdom ( $n = 4$ ), and Germany ( $n = 4$ ). The majority were published in English, with only two articles written in German. With regard to design, forty-two records used cross-sectional designs to examine factors associated with smoking outcomes, with a significant number using single or pooled time points from large cross-sectional surveillance data sets. Three records used cross-sectional designs to retrospectively examine social inequalities in smoking trajectories across the life-course. Eleven records used repeated cross-sectional designs to examine trends in smoking outcomes or the influence of events on smoking outcomes. Thirty-two records used longitudinal cohort designs addressing smoking trajectories and/or their determinants. Finally, one record used a pre-post design on the results of an intervention related to smoking cessation.

### **Indicators of socioeconomic circumstances in studies related to social inequalities in smoking among young adults**

A total of 425 items were found to represent thirty-nine indicators related to young adults' socioeconomic circumstances (see Table 1). We summarize these indicators to represent

circumstances in six broad domains related to income and material wealth, education, occupation, transition stages, housing and neighborhood, and the family. The distribution of the number of indicators per article varied between 1 and 36 with a mean of 4.8 (SD = 4.4). Fifty-three (60%) articles used four indicators or less to capture young adults' socioeconomic circumstances.

*Please insert Table 1 somewhere here*

Table 2 presents the distribution of results for fifteen indicators whose results have been reported in five or more records (see Supplementary File 3 for the reference of each finding). Individual education was by far the most common indicator, found in 75% of included studies. Other traditional indicators, namely, household income (38%), occupational grade (13%), and home ownership (10%), were also among the most common indicators. In comparison to smoking status, we found far fewer reported findings with regard to initiation ( $n = 19$ ) and cessation ( $n = 30$ ). Since many studies used these characteristics to describe their sample and control for the associations between other variables and smoking, a substantial number of associations conducted across studies were unreported or reported without statistical significance considerations (i.e., not available). Ninety percent of articles that reported an association between educational attainment and smoking status found a significant association in the expected direction between these two variables. Results for the five next most common indicators, namely, employment status (48% reporting an association in the expected direction with smoking status), household income (52%), parental education (36%), marital status (55%), and family status (33%), were less consistent.

*Please insert Table 2 somewhere here*

## **DISCUSSION**

### **Principal Findings**

Although socioeconomic circumstances are a critical dimension of the distribution of smoking, many of the included articles used traditional approaches to understand them during young adulthood. In keeping with the extensive literature on socioeconomic inequalities in smoking in the general population, studies favoured indicators associated with adult achievements to operationalize young adults' socioeconomic circumstances. There are important caveats when attempting to measure young adults' circumstances with these traditional indicators. Our findings provide worrying evidence that measurement of socioeconomic circumstances could attenuate evidence of social inequalities for young adults. Yet, promisingly, our review also identified a large number of approaches to measure and analyze young adults' socioeconomic characteristics.

Congruous with the evidence on social inequalities in smoking, educational attainment was the indicator most commonly used to capture socioeconomic circumstances and most consistently associated with smoking outcomes in young adulthood. This consistent pattern, however, does not invalidate concerns about its measurement. During young adulthood, education is often not completed as educational trajectories have become increasingly fractured and elongated. In Canada and the United States, only about 50% of young adults are expected to have finished their studies by age 21.<sup>16,17</sup> In our review, studies proposed different approaches to account for this issue. One study removed students from their sample “as their current socio-economic position was difficult to determine”.<sup>37</sup> Two other studies proposed an alternative measure to current education status, the “eventual” or “expected” education of young adults.<sup>38,39</sup> Another group of researchers determined education based on entrance, not completion, and used a different number of categories across age groups in keeping with the small sample sizes found in certain categories.<sup>40</sup>

Regarding inconsistencies in the pattern of associations for household characteristics, our findings suggest household characteristics such as household income and home ownership can also be critiqued as potentially unreliable indicators of young adults' socioeconomic circumstances in keeping with their rapidly changing housing arrangements. Young adults represent the age group that moves the most with 20% of those between the ages of 25 and 35 moving annually in the United States.<sup>41</sup> Young adults are also more likely to return to live



with their parents because of housing costs, pursuit of higher education, and difficulty finding employment.<sup>42</sup> If young adults live with their parents, they are also less likely to contribute significantly to their household income; this is even more so when compared to previous generations.<sup>43</sup>

Household income may also represent a poor proxy of young adults' disposable income. We found that studies examining the association between personal income and smoking led to different conclusions in comparison to household income. Two studies in the United States and New Zealand found that personal income was positively associated with a higher risk of smoking during young adulthood.<sup>44,45</sup> A third study in the United States found that personal income was positively associated with cessation among African-American men but negatively associated with cessation among Hispanic women.<sup>46</sup> The large variation in interpretations that different measures may provide across studies (e.g., interpreting income to be unimportant based on a measure of household income but important based on a measure of personal income) highlight the need to distinguish the life-course context of young adults to inform the choice of indicators such as education and income to characterize their socioeconomic circumstances.

### **Moving beyond traditional approaches**

The continued use of traditional SES-based indicators is associated with inconsistent or insufficient evidence on the role of socioeconomic circumstances including family background, life course roles, and other characteristics such as personal income on young adults' smoking practices. What this review suggests is that there is a need for a disciplinary shift dedicated to better understanding measuring socioeconomic circumstances in the context of social inequalities in smoking among young adults. While underscoring the limitations of existing approaches to capture the extent of socioeconomic circumstances in this age group, this review may also inform methodological innovations in measurement.

This work can be informed by research among adolescents, a life period where individuals have no diplomas, jobs, or income, and are limited in their capacity to report their parents' circumstances. For instance, the Family Affluence Scale (FAS) is a validated scale developed

over the course of twenty years by the WHO HBSC project to measure adolescents' household assets and capture their socioeconomic status.<sup>47</sup> Other indicators, such as the presence of books in the household, have also been proposed to complement the FAS scale.<sup>48</sup> In our review, two studies used this variable to measure beyond the educational attainment of young adults the cultural resources that the family may transfer regarding the pursuit of healthy lifestyles.<sup>49-51</sup>

This work can also be informed by the growing literature on subjective social status and the influence it may exert on health-related outcomes among adolescents and young adults.<sup>52</sup> In our review, six studies reported associations between young adults' perceived family situation and smoking. Illustrating this, one study among 18- and 19-year-old men argued that "due to the young age of participants at baseline, perceived familial SES was used to account for the unlikely circumstance of generating an annual income of one's own, as well as not being able to precisely recall or gauge their parents' or guardians' actual yearly net income." (D'Avanzo et al. 2016, p. 380).<sup>53</sup> While work is still needed to better understand subjective social status and its influence on smoking practices,<sup>54-56</sup> new developments may support its usefulness in better characterizing young adults' socioeconomic circumstances.

Taken together, our findings highlight the need to explore multiple indicators representing different facets of young adults' socioeconomic circumstances to better understand the distribution of smoking during this period. These should target young adults' access to resources such as money, knowledge, prestige, and beneficial social connections as well as their transition stages in and out of education, employment, family, and housing arrangements. Except for cases where measures require multiple indicators, e.g., those who are Not in Education, Employment or Training (NEET),<sup>57</sup> we also suggest to separate indicators that are commonly recoded together (e.g., marital status, parenthood, and living arrangements) to help disentangle their implications. Many health-related surveillance surveys provide data that easily complement educational attainment and household income.

We acknowledge, however, that it would be presumptuous to propose at this point a 'most appropriate' set of indicators to operationalize young adults' socioeconomic characteristics.

Indicators should be tailored to the outcome, age group, and social context, and include considerations of acceptability, validity, and feasibility.<sup>58</sup> Ultimately, theoretical reflection should guide the selection of socioeconomic indicators. While frameworks specific to young adults are lacking in inequality research, an increasing number of studies are turning to the life-course perspective to better capture the socioeconomic changes that take place during the transition towards adulthood along with their differential impacts on health behaviours.<sup>24, 59-62</sup> This scholarship also informs us that the association between socioeconomic characteristics and smoking varies as a function of age in keeping with their timing and sequence.<sup>24, 59-62</sup> Illustrating this, in our review, one study examined age-based differences in the associations between life-course indicators and smoking and found that young adults who remained unemployed and unmarried reported an excess risk of smoking into the fourth decade of life.<sup>24</sup> This variability might explain part of the inconsistent evidence linking transition stages such as employment status, family status, and marital status with smoking in our review.

### **Limitations**

There are important limitations to our study. First, we focused on keywords related to ‘disparities’, ‘inequalities’, and ‘inequities’ in order to limit the initial pool of records. Another review examined how equity issues were addressed in studies of social inequalities in asthma and found that these keywords covered only a limited proportion of the literature.<sup>63</sup> While this decision led us to miss relevant articles, there is no reason to believe that this has introduced substantial bias in keeping with our objectives. Second, as noted in the methods section, as a systematic review focused primarily on methods, we did not exclude studies based on their risk of bias. Third, we did not assess the gray literature, and we thus cannot rule out the presence of publication bias.

### **Conclusion**

Equity represents a key mandate of modern tobacco control initiatives. That mandate, however, remains unfulfilled. We identified substantial gaps in the study of social inequalities in smoking among young adults. The review findings support our critique that traditional SES indicators do not capture the extent of the circumstances, including parental characteristics, life course roles, and resources such as personal income, which may contribute to social

inequalities in smoking during this period. Seeking measures adapted to young adults' developmental context is likely to help better identify socially disadvantaged groups and support better targeted interventions in this population.

## **ACKNOWLEDGEMENTS**

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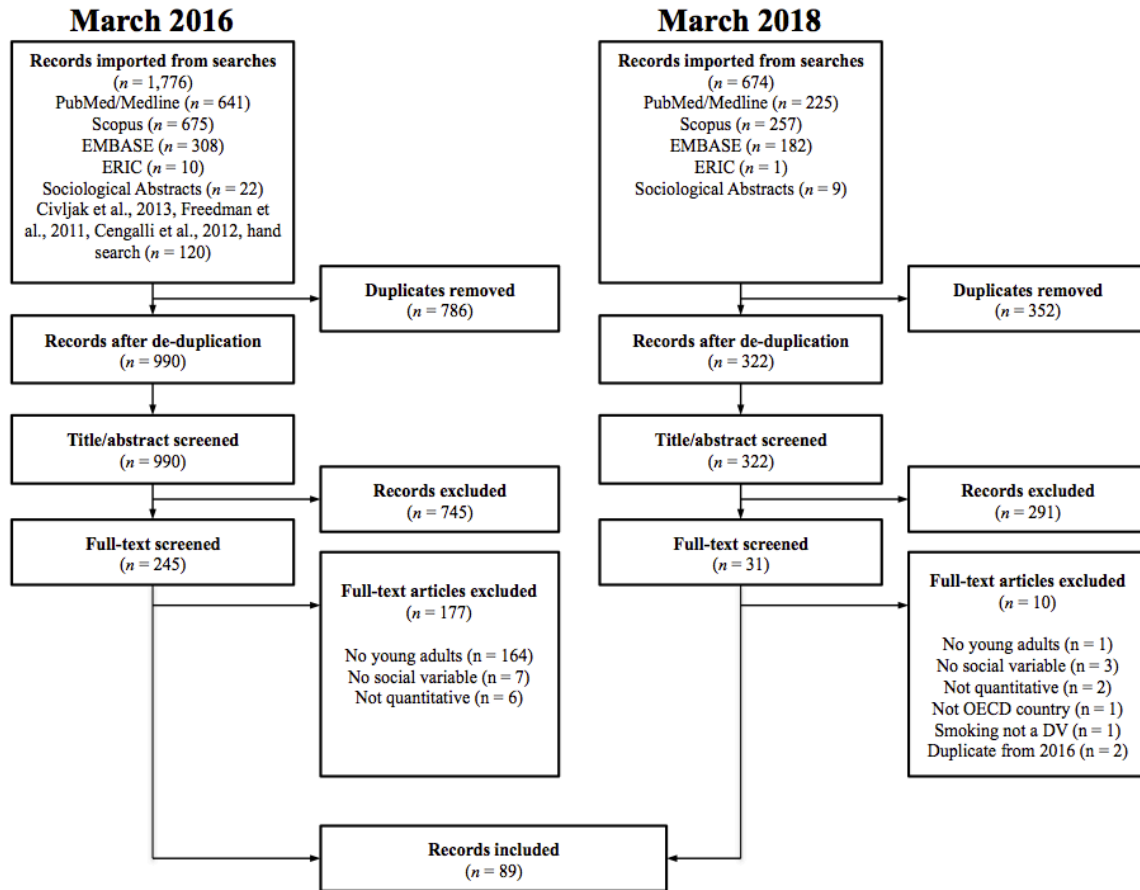


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**FIGURE 1 PRISMA diagram of studies related to social inequalities in smoking among young adults**



**TABLE 1 Socioeconomic circumstances in studies related to social inequalities in smoking among young adults**

Dimension	#	Indicator	References
<b>Income and Wealth</b>	1	Personal income	6, 53, 69, 71, 84
	2	Household income	1, 5, 6, 17, 21, 28, 29, 35, 39, 41, 43, 44, 45, 47, 49, 55, 56, 59, 61, 64, 66, 70, 77, 78, 81, 87, 88, 89
	3	Financial difficulties	6, 9, 15, 18, 39, 46, 51, 57, 58, 69, 79
	4	Having a source of health care	41
	5	Health insurance status	39, 46, 49, 56, 84
	6	Home ownership	9, 15, 16, 39, 42, 51, 53, 70, 80, 85
	7	Books at home	25, 64
	8	Receipt of social benefits	15, 70, 82, 87
	9	Food insecurity	41
	10	Perceived situation	57
<b>Education</b>	11	Educational attainment	1, 3, 4, 5, 7, 8, 9, 10, 11, 12, 15, 16, 17, 19, 21, 22, 23, 24, 25, 26, 28, 29, 30, 31, 33, 35, 36, 37, 38, 39, 41, 43, 44, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 61, 63, 64, 65, 68, 69, 70, 71, 72, 75, 76, 77, 81, 82, 83, 84, 85, 86, 87, 88, 89
	12	Living on campus	13, 60, 67, 73
	13	School year	13, 60, 67, 73, 79
	14	School factors (e.g., 2- or 4-year college)	13, 34, 60, 80
<b>Occupation</b>	15	Unemployment experience	7, 47, 51, 59, 82
	16	Work hours	80
	17	Occupation grade	7, 27, 37, 45, 47, 53, 55, 59, 63, 70, 88
	18	Occupation type	28, 30, 31
	19	Occupational factors (e.g., job control, physical demands)	46, 47, 51

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<b>Transition stages</b>	20	Marital status	5, 9, 15, 21, 29, 39, 47, 48, 49, 50, 52, 53, 56, 57, 59, 60, 61, 68, 70, 75, 79, 84, 89
	21	Employment status (i.e., student and work)	4, 6, 7, 13, 14, 15, 17, 21, 24, 26, 28, 30, 36, 39, 43, 44, 45, 48, 49, 53, 56, 57, 58, 59, 61, 64, 67, 68, 69, 70, 74, 75, 79, 80, 81, 82, 84, 85, 86, 88
	22	Family status (i.e., living arrangements with parents, children, and partner and having children)	5, 6, 21, 36, 50, 53, 59, 61, 68, 75, 76, 77, 79, 84, 88
<b>Housing and Neighborhood</b>	23	Household assets	11, 15, 33
	24	Residential mobility	21
	25	Neighborhood disadvantage	2, 5, 6, 18, 42, 57, 62, 85
	26	Homelessness	15, 26
	27	Overcrowding	15, 51
	28	Urbanization	1, 11, 12, 13, 17, 27, 36, 45, 50, 60, 65
	29	Housing factors (e.g., subsidized, quality, type)	9, 10, 15, 16, 85
<b>Family</b>	30	Parental marital status	7, 18, 20, 36, 42, 51, 52, 59, 61, 81, 84, 87, 88
	31	Family size	42
	32	Perceived family situation	12, 14, 16, 44, 64, 81
	33	Parental household income	7, 9, 10, 18, 21, 42, 46, 52, 87
	34	Parental employment status	7, 42, 87
	35	Parental occupation grade	16, 27, 32, 51, 63, 88
	36	Parental education	1, 9, 10, 12, 13, 18, 20, 21, 25, 36, 40, 42, 44, 46, 52, 53, 57, 60, 61, 63, 67, 73, 79, 81, 84, 87, 88
	37	Parental receipt of social benefits	42, 87
	38	Parental work hours	42
	39	Family adversities (e.g., foster care)	15, 26, 46

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*Reference numbers are detailed in Supplementary File 1.*

**TABLE 2 Direction of associations reported for common indicators in studies related to social inequalities in smoking among young adults (n = 89 records)**

Indicator	N of records reporting (%)	Count of records by smoking outcome												N/A
		Direction of reported association(s): Positive (+), non-significant (NS), negative (-), and mixed associations				Initiation / Progression / Uptake				Cessation				
		+	NS	-	Mix	+	NS	-	Mix	+	NS	-	Mix	
Individual education	67 (75%)	0	3	37	1	1	0	2	1	5	1	0	0	20
Employment status	40 (45%)	1	9	11	2	0	1	2	0	1	2	0	1	12
Household income	34 (38%)	0	10	11	0	0	0	1	0	3	2	0	0	10
Parental education	27 (30%)	0	9	5	0	1	0	1	1	0	0	1	0	10
Marital status	23 (26%)	0	5	6	0	0	0	0	0	2	0	0	0	11
Family status	14 (16%)	0	3	2	1	0	0	0	0	2	0	0	1	6
Parental marital status	13 (15%)	0	1	5	0	0	1	1	0	1	2	0	0	3
Occupational grade	12 (13%)	0	0	7	0	0	0	0	0	0	0	0	0	5
Financial difficulties	11 (12%)	4	1	0	0	1	1	0	0	0	2	0	0	4
Urbanization	11 (12%)	0	3	3	0	0	0	0	0	0	0	0	0	5
Home ownership	9 (10%)	1	0	3	0	0	1	1	0	0	1	0	0	3
Neighborhood disadvantage	8 (9%)	3	0	0	0	1	0	0	0	0	0	1	0	2
Parental occupational grade	6 (7%)	1	1	2	0	0	0	0	0	0	0	0	0	3
Perceived family situation	6 (6%)	1	3	1	0	0	0	0	0	0	0	0	0	1
Personal income	5 (6%)	2	1	0	0	0	1	0	0	0	1	0	1	0

*Records that used a socioeconomic variable but did not report an association with a smoking outcome using inferential statistics were categorized in the 'not available' column. Records in rows may not add up to the number in the 'N of records reporting' column if records reported findings on multiple outcomes. Reference numbers are detailed in Supplementary File 3. NS = Non-significant; N/A = Not available.*

## SUPPLEMENTARY MATERIAL

### Keyword functions for studies on inequalities in smoking among young adults

#### PUBMED

((social determinants of health[mesh] OR health status disparities[mesh]) OR (inequalit\*[tiab] OR inequit\*[tiab] OR disparit\*[tiab])) AND ((Young Adult[mesh]) OR (Young adult\*[tiab] OR emerging adult\*[tiab] OR college student\*[tiab])) AND ((Smoking[mesh] OR Smoking cessation[mesh] OR Tobacco Products[mesh]) OR (cigarette\*[tiab] OR smok\*[tiab] OR tobacco\*[tiab]))))

#### SCOPUS

((INDEXTERMS(social determinants of health) OR INDEXTERMS(health status disparities) OR INDEXTERMS(health disparity)) OR (TITLE-ABS(inequalit\* OR inequit\* OR disparit\*) OR AUTHKEY(inequalit\* OR inequit\* OR disparit\*))) AND ((INDEXTERMS(Young Adult) OR INDEXTERMS(College student)) OR (TITLE-ABS(Young adult\* OR emerging adult\* OR college student\*) OR AUTHKEY(Young adult\* OR emerging adult\* OR college student\*))) AND ((INDEXTERMS(Smoking) OR INDEXTERMS(smoking cessation) OR INDEXTERMS(smoking habit) OR INDEXTERMS(Tobacco Products)) OR (TITLE-ABS(cigarette\* OR smok\* OR tobacco\*) OR AUTHKEY(cigarette\* OR smok\* OR tobacco\*))))

#### EMBASE

1	(social determinants of health or health disparity).sh.
2	(inequalit* or disparit* or inequit*).ti,ab,kw.
3	(smoking or smoking cessation or smoking habit).sh.
4	(smok* or tobacco* or cigarette*).ti,ab,kw.
5	(young adult or college student).sh.
6	(young adult* or college student* or emerging adult*).ti,ab,kw.
7	(1 or 2) AND (3 or 4) AND (5 or 6)



ERIC & Sociological Abstracts

((TI(inequalit\* OR inequit\* OR disparit\*) OR AB(inequalit\* OR inequit\* OR disparit\*)) AND ((SU(young adults) OR SU(college students)) OR (TI(Young adult\*) OR emerging adult\* OR college student\*) OR (AB(Young adult\* OR emerging adult\* OR college student\*))) AND (SU(smoking) OR (TI(cigarette\* OR smok\* OR tobacco\*) OR AB(cigarette\* OR smok\* OR tobacco\*))))

**Identification of records in databases for studies on inequalities in smoking among young adults (January 1<sup>st</sup>, 1996 - March 16<sup>th</sup>, 2016)**

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Databases	Number of articles
PubMed	641
Scopus	675
Embase	308
ERIC	10
Sociological Abstracts	22
Summation	1,656
<hr/>	
<i>Duplicates removed with EndNote</i>	634
<i>Duplicates additionally removed through handpicking</i>	150
<i>Duplicates found during transfer to Covidence</i>	1
TOTAL for screening in Covidence	871
<hr/>	
TOTAL to include in review	68

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**Identification of records in databases for studies on inequalities in smoking among young adults (January 1<sup>st</sup>, 2016 - March 12<sup>th</sup>, 2018)**

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Databases	Number of articles
PubMed	225
Scopus	257
Embase	182
ERIC	1
Sociological Abstracts	9
Summation	674
<hr/>	
<i>Duplicates removed with EndNote</i>	298
<i>Duplicates removed through handpicking</i>	54
TOTAL for title & abstract screening	322
<hr/>	
TOTAL to include in review	21

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### **Entries for studies on inequalities in smoking among young adults**

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**SUPPLEMENTARY TABLE 1 Socioeconomic characteristics in studies on inequalities in smoking among young adults (*n* = 89 records)**

Publication information			Indicators		Analytic approach			Confounding			
Number	Reference	Year	#	Nature	Modeling Approach(es)	Variable recorded?	Subgroup analysis?	Estimate reported?	Significance and direction of estimate*	Confounding	
1	Abel, Hofmann & Schori	2013	4	1. Individual education	1. IV	---	No	1. Yes	1. N among Men and Women 2. N only among Men 3. NS 4. NS	Stratified by sex; controlling for age	
				2. Parental education	2. IV			2. Yes			
				3. Household income	3. IV			3. Yes			
				4. Urbanization	4. IV			4. Yes			
2	Barnett, Pearce & Moon	2009	15	Area-level aggregates; "rel." refers to relative difference in scores between Maori and European descent.							
				1. Personal income (abs.)	1. IV	---	Yes	1. No	Four were specifically tested among young adults 15-29: 8. NS 9. NS 10. N associated with being an ex-smoker among Men 15. N among Men and Women	Stratified by sex; controlling for age and Indicators 1-7	
				2. Home ownership (abs.)	2. IV		2. No				
				3. Employment status (abs.)	3. IV		3. No				
				4. % with university degrees (abs.)	4. IV		4. No				
				5. % with no education qualifications (abs.)	5. IV		5. No				
				6. % with unemployment benefits (abs.)	6. IV		6. No				
				7. % with child support benefits (abs.)	7. IV		7. No				
				8. Personal income (rel.)	8. IV		8. Yes				
				9. Home ownership (rel.)	9. IV		9. Yes				
				10. Employment status (rel.)	10. IV		10. Yes				
				11. % with university degrees (rel.)	11. IV		11. No				
				12. % with no education qualifications (rel.)	12. IV		12. No				
				13. % with unemployment benefits (rel.)	13. IV		13. No				
				14. % with child support benefits (rel.)	14. IV		14. No				
15. Income inequality	15. IV		15. Yes								
3	Baron-Epel, Keinan-Boker, Weinstein, et al.	2010	1	1. Individual education							
				1. IV	---	Yes	1. Yes	Only statistical test was trend test: there was a significant decrease found among young Jewish men with an "academic degree". Comparison across groups, however, was NS	Stratified by sex and ethnicity, no confounders		
4	Baskerville,	2016	2	1. Individual education							
				1. IV/Control	---	No	1. Yes	N with past 7-day	age, education,		

	Azagba, Norman, et al.			2. Employment status (work)	2. IV/Control		2. Yes	prevalence, NS with past 30-day prevalence NS with both outcomes	ethnicity, cigarette consumption, intent to quit in next 30 days, and social support.
5	Benson, Kuipers, Nierkens, et al.	2015	4	1. Individual education 2. Household income 3. Neighborhood deprivation 4. Family status (marital status /living with children)	1. IV 2. IV 3. IV 4. Control	---	Yes	1. N with current smoking; P with smoking cessation 2. N with current smoking; P with smoking cessation only 3. Yes 4. No 3. N with current smoking only pre-financial crisis; NS with smoking cessation	Full model controlling also for gender, ethnicity, house composition, period, stratified by before-after financial crisis
6	Blakely, van der Deen, Woodward, et al.	2014	6	1. Personal income 2. Household income 3. Employment status (work/student) 4. Neighborhood deprivation 5. Financial difficulties 6. Family status (living with couple and children)	1. IV 2. IV 3. IV 4. IV 5. IV 6. IV	---	Yes	1. P 2. Not presented 3. NS 4. NS 5. NS 6. NS	Full model controlling for these variables, fixed model accounts for time-invariant confounding
7	Bowes, Chollet, Fombonne, et al.	2012	7	1. Household income during childhood 2. Individual education 3. Occupation grade 4. Employment stability 5. Employment status 6. Parental unemployment 7. Family structure (parental separation/divorce)	1. Recode & IV 2. Recode & IV 3. Recode & IV 4. Recode & IV 5. Recode & IV 6. Recode & Control 7. Recode & Control	1/5: SEP trajectory 6/7: Family risk	No	1/5: Yes 6/7: NS	Controlling for age, gender, juvenile internalized and externalized symptoms, family risk, school difficulties, and early tobacco/cannabis use
8	Bricard, Jusot, Beck, Khat, Legleye	2016	1	1. Individual education	1. IV	---	Yes	1. Yes N among men across three cohorts; P among women among 1941-1955 cohort; N among two more recent cohorts	Stratified by gender and age, no confounders
9	Brummert, Babyak, Siegler, et al.	2011	7	1. Individual education 2. Parental education 3. Household income 4. Financial difficulties 5. Home ownership	1. IV 2. IV 3. IV 4. IV 5. IV	---	No	1. Yes 2. No 3. Yes 4. No 5. No While smoking was considered a potential mediator of all predictors, only two were considered in an explicit path mediation analysis: Indicator 1 and 3 were both N associated with smoking	Only controlled for individual education and/or household income in path mediation analysis. In their supplementary file, they also mentioned

10	Brummert, Babyak, Singh, et al.	2013	4	1. Individual education 2. Parental education 3. Household income 4. Built environment (quality of housing exterior)	1. IV 2. IV 3. IV 4. IV	---	No	1. Yes 2. Yes 3. Yes 4. Yes	1) N among white men, white women, black men, but NS among Black women 2) NS within all four groups 3) N in all groups except NS among Black men 4) N among White women, NS in all other groups	controlling for parental education in this model, but there are no results with this estimate.
11	Buttenheim, Wong, Goldman, et al.	2010	3	1. Individual education 2. Household assets 3. Urbanization	1. IV 2. IV 3. Control	---	Yes	1. Yes 2. Yes 3. Yes	Results among young adults do not show confidence intervals	
12	Charitonidi, Studer, Gaume, et al.	2016	4	1. Perceived family status 2. Individual education 3. Parental education 4. Urbanization	1. IV 2. IV 3. IV 4. Control	---	No	1. Yes 2. Yes 3. Yes 4. No	1) NS with any use, N with daily use 2) N with any use and daily use 3) NS with any use, NS with daily use	Full model include all three predictors, also control for age, living environment (rural/urban), and linguistic region
13	Choi, Nazir, Pacheco, et al.	2016	7	1. Living on campus 2. Type of program 3. Having children 4. School year 5. Employment status 6. Urbanization (during childhood) 7. Parental education	1. IV 2. IV 3. IV 4. IV 5. IV 6. IV 7. IV	---	No	1. Yes 2. Yes 3. Yes 4. Yes 5. No 6. Yes 7. No	1) Living off-campus was P associated with smoking 2) Non-degree programs was P associated with smoking 3) P 4) NS 6) Growing up on reserve was P associated with smoking	Bivariate description of sample (no confounders or stratification)
14	D'Avanzo, Halkitis, Yu, Kapadia	2016	2	1. Perceived family status 2. Employment status (student)	1. IV 2. IV	---	No	1. Yes 2. Yes	1. NS 2. N	All significant variables associated with smoking in bivariate analyses were then entered in a full model. Therefore, the association of student status was confounded for race, four mental health factors, and alcohol and



15	Das-Munshi, Leavey, Stanfeld, et al.	2014	36	<ol style="list-style-type: none"> <li>1. Overcrowding (during childhood)</li> <li>2. Household assets (Restricted access to basic household amenities; during childhood)</li> <li>3. Financial difficulties (self-reported during childhood, during childhood)</li> <li>4. Financial difficulties (assessed by physician, during childhood)</li> <li>5. Financial difficulties (retrospectively reported, during childhood)</li> <li>6. Employment status (unemployed, age 23)</li> <li>7. Receipt of social benefits (age 23)</li> <li>8. Homelessness (age 23)</li> <li>9. Living in social housing (age 23)</li> <li>10. Household assets (Access to bath/shower, age 23)</li> <li>11. Household assets (Access to toilet, age 23)</li> <li>12. Household overcrowding (age 23)</li> <li>13. Education (age 33)</li> <li>14. Household assets (Central heating, age 33)</li> <li>15. Living in social housing (age 33)</li> <li>16. Household assets (Dampness, age 33)</li> <li>17. Household assets (Telephone, age 33)</li> <li>18. Financial difficulties (age 33)</li> <li>19. Household assets (access to household amenities; age 33)</li> <li>20. Unemployment (age 33)</li> <li>21. Household overcrowding (age 33)</li> <li>22. Household overcrowding (age 42)</li> <li>23. Unemployment (age 42)</li> <li>24. Financial difficulties (age 42)</li> <li>25. Receipt of social benefits (age 42)</li> <li>26. Homelessness (age 42)</li> <li>27. Vehicle ownership (age 42)</li> <li>28. Home ownership (age 42)</li> <li>29. Job insecurity (age 44-45)</li> <li>30. Vehicle ownership (age 44-45)</li> </ol>	All variables are Mediator	--	No	No
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					21. Financial difficulties (money for food, age 44-45)								
					32. Financial difficulties (paying bills, age 44-45)								
					33. Stressful life event? (age 44-45)								
					34. Marital status (age 23)								
					35. Marital status (age 33)								
					36. Marital status (age 42)								
16	Davies, Kuipers, Junger, Kunst	2017	5	1. Individual education 2. Perceived family income 3. Parental occupation grade 4. Home ownership 5. Type of dwelling	1. IV 2. Recode & Control 3. Recode & Control 4. Recode & Control 5. Recode & Control	Social disadvantage	No	Yes	N	Full model controlling also for gender, age, self-control, cognitive ability, reaction time, and memory span			
17	Dilley, Peterson, Bobo, et al.	2013	4	1. Individual education 2. Household income 3. Employment status 4. Urbanization	1. Recode & IV 2. Recode & IV 3. IV 4. IV	Low/High SES	Yes	Yes	Yes	Results among young adults do not show confidence intervals			
18	Doom, Gunnar, Clark	2016	5	1. Parental education 2. Household income (during childhood) 3. Neighborhood poverty (during childhood) 4. Financial stress 5. Family structure (during childhood)	1. Recode & IV 2. Recode & IV 3. Recode & IV 4. Mediator 5. Control	Adolescent SES	No	1/3. Yes	N	N associated with a 12-point score encompassing health behaviours including smoking	In a path analysis, also controlling for parental support. Unclear if other covariates were modeled on the SES-health behaviour path.		
19	Eck, Ostergm, Diderichsen, et al.	2010	1	1. Individual education	1. IV	---	Yes	Yes	N	N associated with ever smoking and daily smoking	Stratified by country and sex, no confounders		
20	Ellison, McGuigan & Klein	2001	2	1. Parental education (during childhood) 2. Family structure (during childhood)	1. IV 2. IV	---	No	Yes	Yes	NS with uptake and cessation at 18 yo; P with uptake and P with cessation at 23 yo	Undisclosed, but given single explained variance estimate, appears to be full model adjusting for gender, race, age, grades, academic aspirations, smoking-specific risk factors, alcohol, and "deviance"		

21	Ensminger, Smith, Junn, et al.	2009	9	<ol style="list-style-type: none"> <li>1. Household income (during childhood)</li> <li>2. Employment status (school drop-out; during childhood)</li> <li>3. Family status (having children, during childhood)</li> <li>4. Household income (age 32)</li> <li>5. Parental education (mother's, during childhood)</li> <li>6. Residential mobility (during childhood)</li> <li>7. Marital status (age 32)</li> <li>8. Residential mobility (age 32)</li> <li>9. Individual education (age 42)</li> </ol>	<ol style="list-style-type: none"> <li>1. Recode &amp; IV</li> <li>2. Recode &amp; IV</li> <li>3. Recode &amp; IV</li> <li>4. Recode &amp; IV</li> <li>5. IV</li> <li>6. IV</li> <li>7. IV</li> <li>8. IV</li> <li>9. IV</li> </ol>	Cumulative disadvantage	No	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Yes</li> <li>3. Yes</li> <li>4. Yes</li> <li>5. Yes</li> <li>6. Yes</li> <li>7. Yes</li> <li>8. Yes</li> <li>9. Yes</li> </ol>	<ol style="list-style-type: none"> <li>1. NS</li> <li>2. No confidence interval</li> <li>3. No confidence interval</li> <li>4. NS</li> <li>5. NS</li> <li>6. NS</li> <li>7. NS</li> <li>8. NS</li> <li>9. N</li> </ol>	The first associations were bivariate; variables that were associated at $p < .25$ were then entered in a multivariate model with 10 variables including e.g., church attendance, parental smoking, education during adulthood.
22	Federico, Costa, Ricciardi, et al.	2009	1	<ol style="list-style-type: none"> <li>1. Individual education</li> </ol>	<ol style="list-style-type: none"> <li>1. IV</li> </ol>	---	No	<ol style="list-style-type: none"> <li>1. Yes</li> </ol>	N among men and women	Stratified by sex, adjusting for age and period
23	Federico, Mackenbach, Eikemo, et al.	2012	1	<ol style="list-style-type: none"> <li>1. Individual education</li> </ol>	<ol style="list-style-type: none"> <li>1. IV</li> </ol>	---	Yes	<ol style="list-style-type: none"> <li>1. Yes</li> </ol>	N	Adjusting for time
24	Gagné, Ghemadenik, Shareck, Frohlich	2018	2	<ol style="list-style-type: none"> <li>1. Individual education</li> <li>2. Employment status (student)</li> </ol>	<ol style="list-style-type: none"> <li>1. Recode</li> <li>2. Recode</li> </ol>	1/2. Expected education	No	<ol style="list-style-type: none"> <li>1/2. Yes</li> </ol>	N	Adjusting for age and sex
25	Gagné, Frohlich & Abel	2015	4	<ol style="list-style-type: none"> <li>1. Books at home</li> <li>2. Parental education (father)</li> <li>3. Parental education (mother)</li> <li>4. Individual education</li> </ol>	<ol style="list-style-type: none"> <li>1. Factor</li> <li>2. Factor</li> <li>3. Factor</li> <li>4. Factor</li> </ol>	<ol style="list-style-type: none"> <li>4. Education and knowledge</li> <li>1/2/3. Family resources</li> </ol>	No	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Yes</li> <li>3. Yes</li> <li>4. Yes</li> </ol>	<ol style="list-style-type: none"> <li>1. N associated with daily smoking and number of cigarettes</li> <li>2. N associated with daily smoking and NS with number of cigarettes</li> </ol>	Adjusting for age, self-rated health, weekly alcohol consumption, and another factor score comprising one interest in health, value towards a healthy lifestyle, and family's value towards a healthy lifestyle
26	Golinelli, Tucker, Shadel	2016	5	<ol style="list-style-type: none"> <li>1. Individual education</li> <li>2. Employment status</li> <li>3. History of foster care placement</li> <li>4. History of abuse by caretaker</li> <li>5. Homelessness severity (eight-item scale)</li> </ol>	<ol style="list-style-type: none"> <li>1. Control</li> <li>2. Control</li> <li>3. Control</li> <li>4. Control</li> <li>5. Control</li> </ol>	---	No	<ol style="list-style-type: none"> <li>1. No</li> <li>2. No</li> <li>3. No</li> <li>4. No</li> <li>5. No</li> </ol>		
27	Gray, Leyland, Benzveval, et al.	2013	3	<ol style="list-style-type: none"> <li>1. Occupation grade</li> <li>2. Parental occupation grade</li> </ol>	<ol style="list-style-type: none"> <li>1. IV</li> <li>2. Control</li> </ol>	---	Yes	<ol style="list-style-type: none"> <li>1. No</li> <li>2. No</li> </ol>		

28	Green, McCausland, Xiao, et al.	2007	4	1. Individual education 2. Occupation grade 3. Employment status 4. Household income	1. IV 2. IV 3. IV 4. IV	---	No	1. Yes 2. Yes 3. Yes 4. Yes	1. P associated with late versus young initiation; NS with intention to quit; P with quit attempts; N with current smoking 2. Service and blue collar is P associated with current smoking 3. No CIs are presented 4. N associated with current smoking	Models with initiation and cessation outcomes are bivariate. Models with current smoking are adjusted for age, gender, college education, occupation type, and household income
29	Haddock, Weg, DeBon, et al.	2001	3	1. Individual education 2. Household income 3. Marital status	1. Control 2. Control 3. Control	---	No	1. No 2. No 3. No	No CIs are presented	
30	Hammond	2005	3	1. Individual education 2. Occupational type 3. Employment status (student/work)	1. Demographic 2. IV 3. IV	---	No	-- 2. Yes 3. Yes	2/3. All occupations were P associated with current smoking compared to students, except for those in "administrative/clerical" jobs. Raising family and looking for work were also P associated with current smoking compared to students.	Bivariate
31	Hanke, Ulbricht, Freyer-Adam, et al.	2013	2	1. Individual education 2. Occupation type	1. IV 2. IV	---	No	1. Yes 2. Yes	Highest proportion of ex-smokers were, first, among those in processing/manufacturing and, second, among those who were raising a family.	
32	Hargreaves, Djafarzadeh, Marbini & Viner	2013	1	1. Parental occupation grade	1. IV	---	Yes	1. Yes	No confidence interval No confidence interval	Bivariate
33	Hassoy, Ergin & Kunst	2014	2	1. Individual education 2. Household assets	1. IV & Control 2. IV & Control	---	Yes	1. No 2. No	N associated with smoking in 2004 and 2006 but not 1999 and 2009 (Results only shown in full sample)	
34	Hinds, Loukas, Perry	2018	1	1. Type of school (2- or 4-year college)	1. Control	---	No	1. No		

35	Huisman, Kunst & Mackenbach	2005	2	1. Individual education 2. Household income	1. IV 2. IV	---	Yes	1. Yes 2. Yes	1) N associated among 15-24 and 25-34 men and women 2) NS among 15-24, but N associated among 25-34 in men and women	Stratified by country and sex, but no confounders
36	Kestila, Martelin, Rahkonen, et al.	2009	9	1. Parental education (during childhood) 2. Urbanization (during childhood) 3. Family structure (during childhood) 4. Adversities (during childhood) 5. Employment status (student / work) 6. Family structure (living alone, with parents and/or partners) 7. Family status (having children) 8. Urbanization 9. Individual education	1. IV & Control 2. IV & Control 3. IV & Control 4. IV & Control 5. IV & Control 6. IV & Control 7. IV & Control 8. IV & Control 9. IV	---	No	1. No 2. No 3. No 4. No 5. No 6. No 7. No 8. No 9. Yes	9. N	Adjusted for 15 indicators related to childhood circumstances, current circumstances, and health behaviour
37	Khang & Cho	2006	2	1. Individual education 2. Occupation grade	1. IV 2. IV	---	Yes	1. Yes 2. Yes	1. N among men and women 2. NS among men and women	Stratified by gender, no confounders
38	Khiat, Pampel, Bricred, Legleye	2016	1	1. Individual education	1. IV	---	Yes	1. Yes	N among men and women in US and France	Stratified by age, country, and gender, no confounders
39	Kiefe, Williams, Lewis, et al.	2001	7	1. Individual education 2. Household income 3. Employment status (work) 4. Marital status 5. Financial difficulties 6. Home ownership 7. Health insurance status	1. IV 2. IV 3. IV 4. IV 5. IV 6. IV 7. IV	---	No	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6. Yes 7. Yes	1. N with initiation among men and women; P with cessation among men and women 2. N with initiation among men but NS among women; NS with cessation among both sexes 3. N with initiation among women but not men; P with cessation among women but not men 4. NS with initiation and cessation among both sexes 5. P with initiation among women but NS among men; NS with cessation among both sexes 6. P with initiation among	Stratified by sex; full model adjusting for all seven variables plus age and race.

40	King, Reboussin, Spangler et al.	2018	1	1. Parental education (mother)	1. Control	---	No	1. No	men but NS among women, NS with cessation among both sexes 7. NS with initiation and cessation among both sexes	
41	Kim & Tsouh	2016	4	1. Individual education 2. Household income (poverty) 3. Food insecurity (six-item scale) 4. Having a usual source of health care	1. IV 2. IV 3. IV 4. IV	---	No	1. Yes 2. Yes 3. Yes 4. Yes	1. N with daily smoking, but not non-daily 2. NS with both 3. P with daily and current, but not non-daily 4. NS with both	Multivariate controlling for four variables plus distress, alcohol, age, sex, and race
42	Kravitz-Wirtz	2016	11	1. Neighborhood deprivation (poverty) 2. Family structure during childhood 3. Parental education during childhood 4. Parental employment status during childhood 5. Parental work hours during childhood 6. Family size during childhood 7. Home ownership during childhood 8. Receipt of social benefits during childhood 9. Household income during childhood 10. Neighborhood deprivation (age 4) 11. Family structure (mother's at birth) during childhood	1. IV 2. Control 3. Control 4. Control 5. Control 6. Control 7. Control 8. Control 9. Control 10. Control 11. Control	---	No	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6. Yes 7. Yes 8. Yes 9. Yes 10. Yes 11. Yes	1. N among white, NS among nonwhite 2. NS among white and nonwhite 3. N with initiation among white, NS among nonwhite 4. NS among white and nonwhite 5. NS among white and nonwhite 6. NS among white and nonwhite 7. NS among white and nonwhite 8. NS among white, P with initiation among nonwhite 9. NS among white and nonwhite 10. NS among white and nonwhite 11. NS among white and nonwhite	Full model adjusted through multivariate regression and through IPTV.
43	Lampert, von der Lippe & Mulers	2013	3	1. Individual education 2. Employment status 3. Household income	1. Recode 2. Recode 3. Recode	1/3. Social status	Yes	1/3. Yes	NS among men and women	Stratified by age and sex, no confounders
44	Larisey, Hummer,	2013	6	1. Individual education	1. Control	---	No	1. No		

Rath, et al.

2. Household income (ratio to poverty threshold)
3. Employment status (work)
4. Parental education (father)
5. Parental education (mother)
6. Perceived financial situation (during childhood)

2. Control
3. Control
4. Control
5. Control
6. Control

45

Lawrence, Fagan, Backinger, et al.

2007

5

1. Occupation grade
2. Employment status (work)
3. Household income
4. Urbanization
5. Employment status (student)

1. IV
2. IV
3. IV
4. IV
5. IV

---

No

Yes

2. No
3. No
4. No
5. No
6. No

In Bivariate:

1. N with current smoking, N with daily smoking, NS with former smoker, N with cigarette consumption
2. N with current smoking, N with daily smoking, NS with former smoker, NS with cigarette consumption
3. N with current smoking, N with daily smoking, NS with former smoker, NS with cigarette consumption
4. N with current smoking, N with daily smoking, NS with former smoker, N with cigarette consumption
5. N with current smoking, N with daily smoking, N with former smoker, N with cigarette consumption

Multivariate model controls for each predictor, gender, and race/ethnicity

In multivariate:

1. N with daily smoking, N with current smoking, P with light smoking, N with heavy smoking
2. N with daily smoking, N with current smoking, NS with light smoking, N with heavy smoking
3. N with daily smoking, N with current smoking, NS with light smoking, N with heavy smoking
4. NS with daily smoking, NS with current smoking, NS with light smoking, NS with heavy smoking
5. N with daily smoking, N with current smoking, P with light smoking, N with heavy smoking

smoking

46	Lee, Kosterman, Jones et al.	2016	7	<ol style="list-style-type: none"> <li>1. Individual education</li> <li>2. Household income (during childhood)</li> <li>3. Parental education (during childhood)</li> <li>4. Stressful life events (age 30)</li> <li>5. Financial difficulties (age 33)</li> <li>6. Job control (age 30)</li> <li>7. Health insurance coverage (age 33)</li> </ol>	<ol style="list-style-type: none"> <li>1. IV</li> <li>2. Recode &amp; Control</li> <li>3. Recode &amp; Control</li> <li>4. Control</li> <li>5. Control</li> <li>6. Control</li> <li>7. Control</li> </ol>	---	No	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> <li>3. No</li> <li>4. No</li> <li>5. No</li> <li>6. No</li> <li>7. No</li> </ol>	<p>N associated with a measured variable combining smoking, problem drinking, and physical activity</p>	<p>Modeled inside a path analysis also controlling baseline health status, SES during childhood, and cognitive ability</p>
47	Legeyve, Khat, Beck, et al.	2011	8	<ol style="list-style-type: none"> <li>1. Occupational factor (physical demands at work)</li> <li>2. Occupational factor (psychological demands at work)</li> <li>3. Occupational factor (job dissatisfaction)</li> <li>4. Occupational factor (short-term employment)</li> <li>5. Individual occupational grade</li> <li>6. Individual education</li> <li>7. Marital status</li> <li>8. Household income</li> </ol>	<ol style="list-style-type: none"> <li>1. IV</li> <li>2. IV</li> <li>3. IV</li> <li>4. IV</li> <li>5. Control</li> <li>6. Control</li> <li>7. Control</li> <li>8. Control</li> </ol>	---	Yes	<ol style="list-style-type: none"> <li>1. NS</li> <li>2. NS</li> <li>3. N with daily smoking</li> <li>4. NS</li> </ol>	<p>Stratified by sex, indicators 1-4 were modeled in a multivariate model controlling for indicators 1-8 plus age</p>	
48	Ling, Neilands & Glantz	2007	3	<ol style="list-style-type: none"> <li>1. Individual education</li> <li>2. Marital status</li> <li>3. Employment status (work)</li> </ol>	<ol style="list-style-type: none"> <li>1. Control</li> <li>2. Control</li> <li>3. Control</li> </ol>	---	No	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Yes</li> <li>3. Yes</li> </ol>	<ol style="list-style-type: none"> <li>1. N</li> <li>2. N</li> <li>3. NS</li> </ol>	<p>Indicators 1-3 were entered in a backwards elimination model including past smoking behaviour, drug use, and alcohol</p>
49	Massetti, Thomas, King et al.	2017	5	<ol style="list-style-type: none"> <li>1. Marital status</li> <li>2. Individual education</li> <li>3. Employment status</li> <li>4. Household income</li> <li>5. Health insurance coverage</li> </ol>	<ol style="list-style-type: none"> <li>1. Control</li> <li>2. Control</li> <li>3. Control</li> <li>4. Control</li> <li>5. Control</li> </ol>	---	No	<ol style="list-style-type: none"> <li>1. No</li> <li>2. No</li> <li>3. No</li> <li>4. No</li> <li>5. No</li> </ol>	<p>In bivariate seven years later:</p> <ol style="list-style-type: none"> <li>1. N with daily/non-daily smoking</li> <li>2. Married N associated with daily/non-daily smoking</li> <li>3. Normal parenthood N</li> </ol>	<p>Indicators 1-3 were entered in a backwards elimination model including past smoking behaviour, drug use, and alcohol</p>
50	McDermott, Dobson & Owen	2007	4	<ol style="list-style-type: none"> <li>1. Individual education</li> <li>2. Marital status</li> <li>3. Family status (having children)</li> <li>4. Urbanization</li> </ol>	<ol style="list-style-type: none"> <li>1. IV</li> <li>2. IV</li> <li>3. IV</li> <li>4. IV</li> </ol>	---	No	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Yes</li> <li>3. Yes</li> </ol>	<p>In bivariate seven years later:</p> <ol style="list-style-type: none"> <li>1. N with daily/non-daily smoking</li> <li>2. Married N associated with daily/non-daily smoking</li> <li>3. Normal parenthood N</li> </ol>	<p>Indicators 1-3 were entered in a backwards elimination model including past smoking behaviour, drug use, and alcohol</p>



51	Novak, Ahlgren & Hammarstrom	2007	8	<ol style="list-style-type: none"> <li>1. Unemployment experience</li> <li>2. Individual education</li> <li>3. Financial difficulties</li> <li>4. Job control (Karasek scale)</li> <li>5. Parental occupational grade (during childhood)</li> <li>6. Home ownership (during childhood)</li> <li>7. Overcrowding (during childhood)</li> <li>8. Family structure (during childhood)</li> </ol>	<ol style="list-style-type: none"> <li>1. Mediator</li> <li>2. Mediator</li> <li>3. Mediator</li> <li>4. Mediator</li> <li>5. Recode</li> <li>6. Recode</li> <li>7. Recode</li> <li>8. Mediator</li> </ol>	5/6/7 Adolescent SES	No	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Yes</li> <li>3. Yes</li> <li>4. Yes</li> <li>5/6/7. Yes</li> <li>8. Yes</li> </ol>	<ol style="list-style-type: none"> <li>1. NS among both sexes</li> <li>2. NS among both sexes</li> <li>3. N among men, NS among women</li> <li>4. N among men, NS among women</li> <li>5/6/7. N among both sexes</li> <li>8. NS among men, N among women</li> </ol>	<p>Path analysis stratified by gender. Education was N associated with smoking in bivariate analyses. However, the interpretation of full model (without explicit mediation analyses) is "enthusiastic".</p>
52	Olson, Hummer & Harris	2017	5	<ol style="list-style-type: none"> <li>1. Individual education</li> <li>2. Marital status</li> <li>3. Parental education</li> <li>4. Household income (during childhood)</li> <li>5. Family structure (during childhood)</li> </ol>	<ol style="list-style-type: none"> <li>1. IV</li> <li>2. IV</li> <li>3. IV</li> <li>4. IV</li> <li>5. IV</li> </ol>	---	No	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Yes</li> <li>3. Yes</li> <li>4. Yes</li> <li>5. Yes</li> </ol>	<ol style="list-style-type: none"> <li>1. N with unhealthy behaviour</li> <li>2. N with unhealthy behaviour</li> <li>3. NS among both sexes</li> <li>4. NS among both sexes</li> <li>5. N among men, NS among women</li> </ol>	<p>Outcome was LCA with "unhealthy" with a predicted probability of about 70% of being smoker. Model was stratified by gender and controlling for these five indicators: age, race, region, parents' behaviour and immigration status, seven peer characteristics, and</p>

associated with non-daily smoking; Early parenthood P associated with daily smoking

consumption. Indicator 4 was bivariate.

4. N with daily/non-daily smoking

In multivariate:

1. N associated with daily smoking 4 years later; Vocational training P associated with daily and non-daily smoking 7 years later

2. N associated with daily smoking 4 years later; NS with non-daily smoking 4 years later; N associated with daily smoking 7 years later; N with non-daily smoking 7 years later

3. Normal parenthood N associated with non-daily smoking 4 years later; NS with other three outcomes

4. Not included

53	Pampel, Mollborn & Lawrence	2014	10	1. Parental education 2. Individual education 3. Personal income 4. Home ownership 5. Employment status (work) 6. Employment status (student) 7. Family status (living with parents) 8. Marital status 9. Family status (living with children) 10. Occupational grade (in professional or non-professional occupation)	1. IV 2. IV 3. IV 4. IV 5. IV 6. IV 7. IV 8. IV 9. IV 10. IV	---	No	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6. Yes 7. Yes 8. Yes 9. Yes 10. Yes	1. N among both sexes 2. N among both sexes 3. Making \$5k-\$18k was P associated with current smoking compared to making less than \$5k among both sexes 4. N among both sexes 5/10. "Professional" occupation was N and "Not professional" occupation was P with smoking among both sexes 6. NS among women, N among men 7. NS among both sexes 8/9. Married was N among both sexes; Not married with children was N among women and P among men	seven psychological characteristics Model for main effects of parental education were stratified by sex and controlled for time-invariant variables of age, race, and parental smoking behaviour.
54	Pampel, Bricard, Khlat, Legleye	2017	1	1. Individual education	1. IV	---	Yes	1. Yes	N	Stratified by country. Model controlling for gender, age, and two- and three-way interaction effects between gender, age, and education.
55	Peretti-Watel, Constance, Serot, et al.	2009	3	1. Occupation grade 2. Individual education 3. Household income	1. IV 2. IV 3. IV	---	Yes	1. Yes 2. No 3. No	Interpreted as N, but no explicit confidence intervals	
56	Pletcher, Hully, Houston, et al.	2006	5	1. Individual education 2. Household income 3. Marital status 4. Employment status (work) 5. Health insurance status	1. IV & Control 2. IV & Control 3. IV & Control 4. IV & Control 5. IV & Control	---	No	1. No 2. No 3. No 4. No 5. No		
57	Porter	2014	7	1. Neighborhood deprivation	1. Control	---	No	1. No	4. NS	Adjusted for a 14-

Author(s)	Year	Number of Variables	Independent Variables	Control Variables	Outcome	Significance	Direction	Notes	Methodology
Rath, Vilhant, Rubenstein, et al.	2013	3	1. Individual education	2. Control	2. No	---	5. N	1. N among heterosexual and LGB 2. NS among both sexual orientation groups 3. N among heterosexual; NS among LGB  (note that effect sizes are the same, so power must explain difference here)	Stratified by sexual orientation. Multivariate controlling for age, gender, race, and six health and health behaviour variables.
			2. Employment status (work)	3. Control	3. No	6. N			
			3. Financial difficulties	4. Mediator	4. Yes	7. NS			
Redonnet, Chollet, Fombonne, et al.	2012	9	1. Employment status (student and work)	1. IV	No	1. Yes	1. NS among both sexes	2 was adjusted for age, sex, predictors 6-9, parental smoking and alcohol, externalizing problems, and academic difficulties	1 was stratified by sex
			2. Individual education	2. Recode	2/3/4/5: SEP	2. Yes	2. SEP score was N associated with smoking		
			3. Occupation grade	3. Recode	2/3/4/5: Yes	3. Yes	6. N		
			4. Employment stability	4. Recode		4. Yes	7. NS		
			5. Unemployment experiences	5. Recode		5. Yes	8. NS		
			6. Marital status (labeled as demographic)	6. IV & Control		6. Yes	9. Parental divorce was P associated with smoking		
			7. Living with children (labeled as demographic)	7. IV & Control		7. Yes			
			8. Household income (labeled as family)	8. IV & Control		8. Yes			
			9. Family structure (labeled as family)	9. IV & Control		9. Yes			
Rigotti, Moran & Weschler	2005	5	1. Year in school	1. Control	No	1. Yes	1. N	Multivariate model controlling for exposure to tobacco promotion, gender, age, race/ethnicity, attending bars, binge drinking, region, and urbanization	Bivariate
			2. Marital status	2. Demographic	2. No	2. No	5. NS		
			3. Parental education	3. Demographic	3. No	3. No			
			4. Living situation on campus	4. Demographic	4. No	4. No			
			5. School factor (urbanization around college)	5. Control	5. Yes	5. Yes			
Rohde, Kahler, Lewinsohn, et al.	2004	7	1. Individual education	1. IV	No	1. Yes	1. NS		
			2. Marital status	2. IV	---	2. Yes	2. P with quitting		
			3. Family status (having children)	3. IV		3. Yes	3. NS		
			4. Employment status	4. IV		4. Yes	4. NS		

62	Salmond, Crampton, Atkinson, et al.	2012	1	1. Neighborhood deprivation	1. IV	---	Yes	1. Yes	No confidence intervals	
63	Savitsky, Manor, Friedlander et al.	2017	4	1. Parental occupation grade (father) 2. Parental education (during childhood) 3. Occupation grade 4. Individual education	1. IV 2. IV 3. IV 4. IV	---	No	1. No 2. No 3. No 4. No		
64	Schorf, Hoffmann & Abel	2014	9	1. Father's education 2. Mother's education 3. Books in home 4. Perceived financial situation 5. Perceived financial situation during childhood 6. Household income 7. Individual education 8. Employment status (student / work) 9. Individual education (school level at grade 9)	1. Factor 2. Factor 3. Factor 4. Factor 5. Factor 6. Factor 7. Factor 8. Factor 9. Factor	Parents' cultural capital Parents' economic capital Young adults' academic track	No	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6. Yes 7. Yes 8. Yes 9. Yes	1. N 2. N 3. N 4. N 5. N 6. N 7. N 8. N 9. N	Correlations were bivariate. Structural equation model suggests that parents' cultural capital was associated with smoking indirectly through young adults' academic track. No direct/indirect effects of Parents' economic capital. No confounders.
65	Schuller	1999	2	1. Individual education 2. Urbanization	1. IV 2. Moderator	---	No	1. Yes 2. No	1. N	Bivariate
66	Siegel	2014	1	1. Household income	1. IV	---	Yes	1. Yes	N with ever smoking; P with smoking cessation	
67	Staten & Ridner	2007	4	1. Parental education (mother) 2. Year of school 3. Current living situation (living on campus) 4. Employment status (work)	1. IV 2. Demographic 3. IV 4. IV	---	No	1. Yes 2. Yes 3. Yes 4. Yes	1. N associated with early initiation (vs late); P associated with late initiation (vs never) 2. Junior/Senior P associated with late initiation 3. NS 4. NS	Predictors 1/2, 4, and 5 were entered in multivariable regression adjusting also for sex, race, age, fraternity membership, smoking and alcohol behaviour.
68	Steele, Raymond, Ness, et al.	2007	6	1. Employment status (student) 2. Individual education	1. Control 2. Control	---	No	1. Yes 2. Yes	1. N in both region-based samples 2. N in one of two region-	All variables except 1 were bivariate. Indicator

5. P with quitting

6. NS

7. NS

69	Steinmetz-Wood, Gagné, Sylvestre, Frohlich	2018	4	1. Individual education 2. Personal income 3. Employment status 4. Financial difficulties	1. IV 2. IV 3. Control 4. Control	---	No	1. Yes 2. Yes 3. Yes 4. Yes	1. Pre-university/Vocational training P associated with two-year uptake; NS with two-year cessation 2. NS with both outcomes 3. NS with both outcomes 4. NS with both outcomes	Full model controlling for gender, age, the four predictors, social support, and peer smoking
70	Stewart, Berry, Przulj & Treanor	2017	8	1. Employment status (NEET) 2. Marital status 3. Access to a vehicle 4. Individual education 5. Housing tenure 6. Receipt of social benefits 7. Household income 8. Occupation grade	1. IV 2. Control 3. Control 4. Control 5. Control 6. Control 7. Control 8. Control	---	No	1. Yes 2. No 3. Yes 4. Yes 5. Yes 6. No 7. No 8. Yes	1. N 2. --- 3. N 4. N 5. N 6. 7. 8. N compared to other occupation grades, but P compared to unemployed	Multivariate model adjusting for each of the five shown variables and sex, age, ethnicity, and self-rated health
71	Stilman, Bone, Mltam, et al.	2014	2	1. Individual education 2. Personal income	1. IV/Control 2. IV/Control	---	No	1. Yes 2. Yes	1. N 2. NS	Bivariate
72	Stoddard & Adler	2011	1	1. Individual education	1. IV	---	Yes	1. Yes	N among US Hispanics and Asians	Stratified by ethnicity, controlling for age, sex, immigration, ethnic subgroup
73	Sutrin, Reboussin, McCoy, et al.	2009	4	1. Parental education (Father) 2. Parental education (Mother) 3. Year in school 4. Living situation on campus	1. IV 2. IV 3. IV 4. IV	---	No	1. Yes 2. Yes 3. Yes 4. Yes	1. NS 2. NS 3. N with being Puffer compared to Heavy and Social	LCA of smoking in five categories: heavy, moderate, social, puffer, no-context. Bivariate

1 was entered in a data-driven model of variables that were significantly associated with smoking.

74	Tercyak, Rodriguez & Audrain-McGovern	2007	1	1. Employment status (attending college)	1. IV	---	No	1. Yes	4. P with Partner compared to Heavy, Moderate, and Social	Multivariate controlling for alcohol, best friend smoking, race, gender, age
75	Thompson	2014	6	1. Individual education (in adulthood) 2. Employment status (in adulthood) 3. Age of first marriage 4. Age of first child 5. Marital status (in adulthood) 6. Family status (number of children, in adulthood)	1. Control 2. Control 3. Recode & IV 4. Recode & IV 5. Control 6. Control	Sequencing Order	No	1. Yes 2. Yes 3. Yes 4. Yes 5. Yes 6. Yes	1. P with cessation 2. NS 3/4. Being both married and with children before initiating was N associated with quitting 5. NS 6. 1-2 children P with cessation, 3+ children NS with cessation compared 0 children	Multivariate controlling for race, family situation before initiation, interaction term race*family, age, education, employment, marital status, and number of children.
76	Tong, Dietz, England, et al.	2011	3	1. Individual education 2. Poverty (Medicaid status) 3. Family status (having children)	1. IV 2. IV 3. IV	---	Yes	1. No 2. No 3. No		
77	Tucker, Elickson, Orlando, et al.	2005	4	1. Individual education 2. Household income 3. Co-habitation with partner 4. Family status (having children)	1. IV 2. IV 3. IV 4. IV	---	No	1. Yes 2. Yes 3. Yes 4. Yes	1. NS with quit attempt and 6-month abstinence 2. P with quit attempt, NS with 6-month abstinence 3. Started living with partner who smokes was NS with quit attempts; started living with partner who does not smoke was P with quit attempt	
78	Vallejo-Torres, Hale, Morris, et al.	2014	1	1. Household income	1. IV	---	Yes	1. Yes	N	
79	Vankim & Laska	2012	6	1. Parental education 2. Financial difficulties 3. Employment status (work) 4. Marital status 5. Family status (number of children)	1. IV 2. IV 3. Control 4. Control 5. Control	---	No	1. Yes 2. Yes 3. No 4. No 5. No	1. NS 2. P	Only controlling for race

80	Vankim, Laska, Ehlinger, et al.	2010	4	<ol style="list-style-type: none"> <li>1. Type of institution enrolled in</li> <li>2. Employment status (work hours)</li> <li>3. Living arrangements (Living with parents)</li> <li>4. Home ownership</li> </ol>	<ol style="list-style-type: none"> <li>1. Moderator</li> <li>2. Control</li> <li>3. Control</li> <li>4. Control</li> </ol>	---	No	<ol style="list-style-type: none"> <li>1. No</li> <li>2. No</li> <li>3. No</li> <li>4. No</li> </ol>	6. No	
81	Villanti, Johnson, Rath	2017	8	<ol style="list-style-type: none"> <li>1. Household income</li> <li>2. Individual education</li> <li>3. Employment status</li> <li>4. Subjective financial status</li> <li>5. Family structure (during childhood, parental divorce)</li> <li>6. Parental education (mother)</li> <li>7. Parental education (father)</li> <li>8. Subjective financial status (during childhood)</li> </ol>	<ol style="list-style-type: none"> <li>1. IV</li> <li>2. IV</li> <li>3. IV</li> <li>4. IV</li> <li>5. IV</li> <li>6. IV</li> <li>7. IV</li> <li>8. IV</li> </ol>	---	No	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Yes</li> <li>3. Yes</li> <li>4. Yes</li> <li>5. Yes</li> <li>6. Yes</li> <li>7. Yes</li> <li>8. Yes</li> </ol>	<p>1. N with ever-smoking: N with past 30-day smoking: NS with daily smoking</p> <p>2. N with ever-smoking: N with past 30-day smoking: NS with daily smoking</p> <p>3. Full-time employment is P with ever-smoking: NS with past 30-day smoking: NS with daily smoking</p> <p>4. N with ever-smoking: N with past 30-day smoking: N with daily smoking</p> <p>5. Divorce is P with ever-smoking: NS with past 30-day smoking: NS with daily smoking</p> <p>One parent living is NS with ever-smoking: P with past 30-day smoking: P with daily smoking</p> <p>6. NS with ever-smoking: NS with past 30-day smoking: N with daily smoking</p> <p>7. N with ever-smoking: N with past 30-day smoking: NS with daily smoking</p> <p>8. NS with ever-smoking: NS with past 30-day smoking: NS with daily smoking</p>	Full model controlling for these eight variables plus age, gender, and race
82	Virtanen, Vahtera, Broms, et al.	2008	4	<ol style="list-style-type: none"> <li>1. Employment status (work)</li> <li>2. Unemployment benefits</li> <li>3. Unemployment experience</li> <li>4. Individual education</li> </ol>	<ol style="list-style-type: none"> <li>1. Recode &amp; IV</li> <li>2. Recode &amp; IV</li> <li>3. Recode &amp; IV</li> <li>4. Demographic</li> </ol>	1/2/3. Employment trajectory	Yes	<ol style="list-style-type: none"> <li>1/2/3. Yes</li> <li>4. No</li> </ol>	Chronic unemployment was P associated with number of cigarettes per day	Bivariate

83	Wagenknecht, Craven, Preisser, et al.	1998	1	1. Individual education	1. IV	---	No	Yes	No direction associations between education and smoking (with confidence intervals)	Bivariate
									Differences in trends in prevalence across education groups over ten years were NS.	
84	Weden, Astone & Bishai	2006	9	1. Employment status 2. Personal income 3. Health insurance status 4. Individual education 5. Marital status 6. Family structure (having children) 7. Family structure during childhood 8. Parental education (mother) during childhood 9. Parental education (father) during childhood	1. IV 2. IV 3. IV 4. IV 5. IV 6. IV 7. Control 8. Control 9. Control	---	No	Yes Yes Yes Yes Yes Yes Yes Yes Yes	Among six groups of men and women from European American (EA), African American (AA), and Hispanic descent 1. P with cessation among EA women, N with cessation among AA men 2. N among Hispanic women 3. P among EA men 4. P among every group except AA women 5. P among EA women, AA men and women, and Hispanic women 6. P among AA women 7. Step-parent N among AA men and Hispanic women 8. NS 9. NS	Multivariate controlling for the nine variables, self-esteem, locus of control, cognitive ability, age, age of initiation, and language at home
85	Wf, Gauger, Bachman, et al.	2016	10	1. Home ownership 2. Lot size of housing unit 3. Square footage of housing unit 4. Zoning of residential area 5. Number of bathrooms 6. Number of bedrooms 7. Building value 8. Neighborhood SES 9. Individual education 10. Employment status	1. Recode 2. Recode 3. Recode 4. Recode 5. Recode 6. Recode 7. Recode 8. Recode 9. IV 10. IV	SES	No	Yes	1/8 N 9. N 10. Student is N (versus employed)	1/8 was in a multivariate model controlling for medical exam, age, and gender 9 and 10 were bivariate
86	Widome, Wall, Laska, et al.	2013	2	1. Individual education	1. Recode	Eventual educational	No	Yes	N	



87	Yang, Johnson, Schorpp et al.	2017	8	<ol style="list-style-type: none"> <li>1. Parental welfare receipt (during childhood)</li> <li>2. Parental education (during childhood)</li> <li>3. Household income (during childhood)</li> <li>4. Parent unemployment (during childhood)</li> <li>5. Family structure (during childhood)</li> <li>6. Welfare receipt</li> <li>7. Individual education</li> <li>8. Household income</li> </ol>	<ol style="list-style-type: none"> <li>1. Recode</li> <li>2. Recode</li> <li>3. Recode</li> <li>4. Recode</li> <li>5. Recode</li> <li>6. Recode</li> <li>7. Recode</li> <li>8. Recode</li> </ol>	1/5. Adolescent SES disadvantage	No	Yes	Appears to be N among men and NS among women, but no confidence intervals or interpretation.	
88	Yang, Lynch, Schultenberg et al.	2008	7	<ol style="list-style-type: none"> <li>1. Employment status (student and work)</li> <li>2. Individual education</li> <li>3. Individual occupation grade</li> <li>4. Parental occupation grade</li> <li>5. Household income</li> <li>6. Parental education (mother)</li> <li>7. Family structure (with one or both parents)</li> </ol>	<ol style="list-style-type: none"> <li>1. Recode</li> <li>2. Recode</li> <li>3. Recode</li> <li>4. Recode</li> <li>5. Recode</li> <li>6. Recode</li> <li>7. IV</li> </ol>	Young adult SEP  Family SEP	No	Yes	<p>Among <u>Men</u>:</p> <p>1/2/3: No education and economically inactive P with light/moderate smoking and P with heavy smoking; Blue-collar work NS with light/moderate smoking and P with heavy smoking; White-collar work NS with both outcomes compared to further education</p> <p>4/5/6: NS with both outcomes</p> <p>7: NS with light/moderate smoking; NS with heavy smoking</p> <p>Among <u>Women</u>:</p> <p>1/2/3: No education and economically inactive NS with light/moderate smoking and P with heavy smoking; Blue-collar work P with both outcomes; White-collar work P with both outcomes compared to further education</p> <p>4/5/6: NS</p> <p>7: Living with a single parent P with daily smoking</p>	Stratified by gender. Multivariate model controlling for these three variables: family connectedness, smoker in home, access to cigarettes, GP A, depression, and past smoking behaviour
89	Zhang, Cohen, Ferrance, et al.	2006	3	<ol style="list-style-type: none"> <li>1. Individual education</li> <li>2. Household income (income adequacy)</li> </ol>	<ol style="list-style-type: none"> <li>1. Control</li> <li>2. Control</li> </ol>	---	No	Yes	<p>1. N with initiation</p> <p>2. NS</p>	Bivariate (multivariate is not presented)

3. Marital status

3. Control

Yes

3. NS

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\* N = Negative, NS = Non significant, P = Positive

**SUPPLEMENTARY TABLE 2 Description of the sample of studies on social inequalities in smoking (*n* = 89 records)**

Number	Publication information Reference	Year	Age Group (Age of outcome if longitudinal or retrospective)	Design	Country	Sample Size	Outcome*
1	Abel, Hofmann & Schori	2013	18-25; Mean = 19.7	Cross-sectional	Switzerland	33,891	Daily smoking
2	Barnett, Pearce & Moon	2009	15-60+, stratified with 15-19, 20-29, 30-39, 40-49, 50-59, 60+	Cross-sectional	New-Zealand	???	Cessation: ex-smoker status
3	Baron-Epel, Keinan-Boker, Weinstein, et al.	2010	12-65+, stratified with 1) 21-44, 45-64, 65+ and 2) 12-44, 45-64, and 65+	Repeated cross-sectional	Israel	27,540 for entire sample; no data by age group	Current smoking
4	Baskerville, Azagba, Norman, et al.	2016	19-29	Pre-post intervention	Canada	238	Cessation: 1) 7-day abstinence and 2) 30-day abstinence
5	Benson, Kuipers, Nierkens, et al.	2015	18-65+, stratified with 18-30, 31-44, 45-64, 65+	Repeated cross-sectional	Netherlands	66,960; 18% of sample were between 18-30 (+/- 12,052)	1) Current smoking 2) Cessation: ex-smoker status
6	Blakely, van der Deen, Woodward, et al.	2014	15+, stratified in 15-24 and 25+	Longitudinal	Australia	17,140 for entire sample; no data by age group	1) Current smoker / Ex-smoker / Non-smoker 2) Number of cigarettes per day
7	Bowes, Chollet, Fonbonne, et al.	2012	22-35	Longitudinal	France	1,103	Current smoking (1+ cigarette per day in the last year)
8	Bricard, Jusot, Beck, Khlaf, Legleye	2016	15-75	Retrospective cross-sectional	France	27,653	Retrospective smoking trajectory based on time of daily smoking initiation and time of cessation
9	Brummett, Babyak, Siegler, et al.	2011	Mean 29, IQR 28-30	Longitudinal	United States	14,299	Daily smoking
10	Brummett, Babyak, Singh, et al.	2013	Mean across four race/ethnicity groups 28.9, 28.7, 29.2, 29.0	Longitudinal	United States	11,371	Daily smoking
11	Buttenheim, Wong, Goldman, et al.	2010	20-69, stratified with 20-29, 30-39, 40-49, 50-69	Cross-sectional	Mexico	38,901 for entire sample; 37% of sample were between 20-29 (+/- 14,393)	Current smoking
12	Charionidi, Studer, Gaume, et al.	2016	Mean 19.99, SD 1.23	Cross-sectional	Switzerland	5,702	1) Any use in last 12 months 2) Daily smoking
13	Choi, Nazir, Pacheco, et al.	2016	Mean 25.5, SD 9.03	Cross-sectional	United States	1,256	Current smoking
14	D'Avanzo, Halkitis, Yu, Kapadia	2016	18-19	Cross-sectional	United States	598	Current smoker / Ex-smoker / Non-smoker

15	Das-Munshi, Leavey, Stanfield, et al.	2014	22, 33 & 42	Longitudinal	United Kingdom	16,765	Current smoker / Ex-smoker / Non-smoker
16	Davies, Kuipers, Junger, Kunst	2017	15-20	Cross-sectional	Netherlands	191	Current smoking (at least once a month)
17	Dilley, Peterson, Bobo, et al.	2013	18-50+, stratified with 18-29, 30-49, 50+	Cross-sectional	United States	22,311 for entire sample, 3,007 were between 18-29	Current smoking
18	Doom, Gunnar, Clark	2016	28.7	Longitudinal	United States	11,013	Current smoker (smoked at least once in last month) / Ex-smoker (smoked but not in last month) / Non-smoker
19	Eck, Ostergm, Diderichsen, et al.	2010	18-80, stratified with 18-44, 45-64, 65-80	Cross-sectional	Sweden / Denmark	19,834 for entire sample, 9,574 were between 18-44	1) Daily smoking 2) Current smoking vs Ex-smoking
20	Ellikson, McGuigan & Klein	2001	18 & 23	Longitudinal	United States	3,056	1) Smoking status (at least a cigarette in last year) 2) Initiation after 18 3) Cessation after 18
21	Eisminger, Smith, Juon, et al.	2009	42	Longitudinal	United States	457	Current smoker / Ex-smoker / Non-smoker
22	Federico, Costa, Ricciardi, et al.	2009	20-67, stratified into 20-44 and 45+	Repeated cross-sectional	Italy	67,924 for entire sample, no data for 20-44 group	Smoking cessation (having smoked one full year and having quit for over a year)
23	Federico, Mackenbach, Eikemo, et al.,	2012	20-64, stratified in 20-24 and 25-64	Repeated cross-sectional	Italy	369,577 for entire sample, no data for 20-24 group	1) Current smoking 2) Ex-smoking 3) Number of cigarettes per day
24	Gagne, Gheradenik, Shareck, Frohlich	2018	18-27	Longitudinal	Canada	1,457	Current smoking
25	Gagne, Frohlich & Abel	2015	18-25	Cross-sectional	Switzerland	10,736	1) Daily smoking 2) Number of cigarettes per day
26	Golinelli, Tucker, Shadel	2016	13-24	Cross-sectional	United States	334	Daily smoking
27	Gray, Leyland, Benzerval, et al.	2013	18-65+, stratified with 1) 18-39, 40-64, 65+ and 2) 18-44 and 45+	Repeated cross-sectional	Scotland	24,500 for entire sample, 4,191 were between 18-39	Current smoker / Ex-smoker / Non-smoker
28	Green, McCausland, Xiao, et al.	2007	18-34, stratified with 18-24 and 25-34	Cross-sectional	United States	16,395 were between 18-24; 31,592 were between 25-34	1) Current smoking 2) Initiation at 18+ 3) Quit attempt in last year

29	Hadduck, Wege, DeBon, et al.	2001	Mean across "smokeless tobacco" groups: 19.8 (SD 2.2), 20.0 (SD 2.0), 19.7 (SD 2.1)	Longitudinal	United States	7,865	Current smoking (7-day prevalence)
30	Hammond	2005	15+, stratified with 15-17, 18-29, 30+	Cross-sectional	Canada	10,559 for entire sample, 3,812 for 18-29	Current smoker / Daily smoker / Occasional smoker / Ex-smoker / Non-smoker / Number of cigarettes per day
31	Hanke, Ulbricht, Freyer-Adam, et al.	2013	15-23+, stratified into 15-17, 18-20, 21-23, 23+	Cross-sectional	Germany	1,124 for entire sample; 535 were between 18-20, 156 were between 21-23, 71 were 23+	1) Current smoking; 2) Daily smoking
32	Hargreaves, Djalal Marbuti & Viner	2013	8-24, stratified into 8-15, 16-24	Repeated cross-sectional	Scotland	2,951, were 16-24	Current smoking
33	Hassoy, Ergin & Kunst	2014	20+, stratified into 20-39, 40+	Cross-sectional	Turkey	10,470	Daily smoking
34	Hinds, Loukas, Perry	2018	19-29	Longitudinal	United States	4,252	1) Current smoking (Past 30-day prevalence); 2) Age of first cigarette initiation
35	Huisman, Kunst & Mackenbach	2005	16+, stratified with 16-24, 25-59, 60+	Cross-sectional	11 countries in European Union	101,312 for entire sample, 15,369 were between 16-24	Daily smoking
36	Kesäniemi, Martelin, Rakkonen, et al.	2009	18-29	Cross-sectional	Finland	1,282	Daily smoking
37	Khang & Cho	2006	20+, stratified into 20-24, 25-44, 45-64, 65+	Repeated cross-sectional	Korea	344,969 for entire sample, 38,223 were between 20-24	Current smoking
38	Khlat, Pampel, Briard, Legleye	2016	25-69, with focus on 30-34	Retrospective cross-sectional	United States / France	41,384	Retrospective smoking trajectory based on time of daily smoking initiation and time of cessation
39	Kiefe, Williams, Lewis, et al.	2001	28-40	Longitudinal	United States	3,950	1) Smoking uptake after 18-30; 2) Smoking cessation after 18-30
40	King, Rebousin, Spangler et al.	2018	Mean 21.1 (SD 0.4)	Cross-sectional	United States	2,370	Current smoking (past 30-day prevalence)
41	Kim & Tsoh	2016	18-30	Cross-sectional	United States	1,511	Current smoking
42	Kravitz-Wirtz	2016	0-25	Longitudinal	United States	2,121	Smoking initiation by age 25
43	Lampert, von der Lippe & Muters	2013	18-79, stratified with 18-29, 30-44, 45-64, 65-79	Cross-sectional	Germany	12,409	Daily smoking / Social smoking / Ex-smoking / Non-smoking
44	Larisey, Hummer, Rath, et al.	2013	18-34	Cross-sectional	United States	3,696	1) Current smoking (past 30-day prevalence) 2) Self-reported status (Smoker, Occasional/social, Ex-smoker, Ever-smoker)

45	Lawrence, Fagan, Backinger, et al.	2007	18-24	Cross-sectional	United States	15,371	1) Current / Daily / Ex-smoker / Ever-smoker; 2) Number of cigarettes per day (Light / Moderate / Heavy)
46	Lee, Kosterman, Jones et al.	2016	33	Longitudinal	United States	808	Smoking status (5 point likert scale from Non-smoker to Daily smoker)
47	Legleye, Khlat, Beck, et al.	2011	19-59, stratified with 39, 40-59	Cross-sectional	France	13,241 for entire sample, 2,133 were between 18-29	Daily smoking
48	Ling, Neijlands & Glantz	2007	18-29	Cross-sectional	United States	9,455	Current smoking / Ever-smoker / Experimenters (1-99 cigarettes smoked in lifetime)
49	Masseti, Thomas, King et al.	2017	18-29	Cross-sectional	United States	90,821	Current or ex-smoking
50	McDermott, Dobson & Owen	2007	25-30	Longitudinal	Australia	7,510	Smoking status (Daily / Occasional / Non-smoker)
51	Novak, Ahlgren & Hammarstrom	2007	30	Longitudinal	Sweden	1,083	Current smoking
52	Olson, Hummer & Harris	2017	24-32	Longitudinal	United States	14,338	Current smoking (past 30-day prevalence)
53	Pampel, Mollborn & Lawrence	2014	11-34	Longitudinal	United States	60,857 observations nested within 20,745 participants	Current smoking (past 30-day prevalence)
54	Pampel, Briard, Khlat, Legleye	2017	14-39	Retrospective cross-sectional	United States / France	41,384	Retrospective smoking trajectory based on time of daily smoking initiation and time of cessation
55	Peretti-Watel, Constance, Seror, et al.	2009	18-75, stratified with 45, 46-75	Repeated cross-sectional	France	51,555 for entire sample, no data for sub-groups	Current smoking / Ex-smoking / Ever-smoking
56	Pletcher, Hully, Houston, et al.	2006	32-45	Longitudinal	United States	1,535	1) Smoking cessation; 2) Quit attempts in past 12 months; 3) Outcome of attempts; 4) Sustained cessation or 5) Relapse
57	Porter	2014	24-32	Longitudinal	United States	1,670	Current smoking (past 30-day prevalence)
58	Rath, Villani, Rubenstein, et al.	2013	18-34	Cross-sectional	United States	4,215	Current smoking (past 30-day prevalence)
59	Redonnet, Chollet, Fonbonne, et al.	2012	22-35	Longitudinal	France	1,103	Daily smoking (1+ cigarette per day in past 12 months)
60	Rigotti, Moran & Weschler	2005	None specified, but 89% of sample was between 18-24	Cross-sectional	United States	10,904	Current smoking (past 30-day prevalence)
61	Rohde, Kahler, Lewinsohn, et al.	2004	Mean 28.2 SD 1.4	Cross-sectional	United States	242	Smoking cessation (ex-smoker for 12 months or more)
62	Sahmond, Crampton, Atkinson, et al.	2012	15+, stratified with 45-64, 65+	Repeated cross-sectional	New Zealand	???	Current smoking
63	Savitsky, Manor, Friedlander et al.	2017	32	Longitudinal	Israel	1,132	Current smoking

64	Schorf, Hofmann & Abel	2014	18-25	Cross-sectional	Switzerland	10,546	Daily smoking
65	Schuller	1999	23-24	Repeated cross-sectional	Norway	1,250	Current smoking / Ex-smoking / Ever-smoking
66	Siegel	2014	15+	Cross-sectional	Germany	316,976	Current smoking / Ex-smoking / Ever-smoking
67	Staten & Ridner	2007	18-24	Cross-sectional	United States	437	Age of initiation (before 18, 18+)
68	Steele, Raymond, Ness, et al.	2007	18-24	Cross-sectional	United States	995	Current smoking / Ex-smoking / Ever-smoking
69	Stemmetz-Wood, Gagne, Sylvestre, Frohlich	2018	20-27	Longitudinal	Canada	1,450	1) Smoking uptake in two years; 2) Smoking cessation in two years
70	Stewart, Berry, Przulj & Treanor	2017	16-24	Cross-sectional	United Kingdom	4,272	Current smoking
71	Stilman, Bone, Milam, et al.	2014	18-24	Cross-sectional	United States	488	Current smoking / Ex-smoking / Ever-smoking
72	Stoddard & Adler	2011	18-30	Cross-sectional	United States	15,873	Current smoking
73	Sutrin, Reboussin, McCoy, et al.	2009	???	Cross-sectional	United States	1,102	Latent class analysis from 11 indicators: Heavy smokers / Moderate smokers / Social smokers / Puffers / No context
74	Tercyak, Rodriguez & Audran-McGovern	2007	Among initiators after high school M 18.9 SD 0.5; Among intensifiers after high school M 19.0 SD 0.5	Cross-sectional	United States	790	1) Initiation after high school; 2) Progression to more frequent smoking after high school
75	Thompson	2014	18-25 for initiation; 18-64 for cessation	Longitudinal	United States	673	Length of smoking career based on age of initiation and age of cessation
76	Tong, Dietz, England, et al.	2011	18+, stratified with 18-24 and 25+	Cross-sectional	United States	186,064 for entire sample; 61,759 for 18-24	1) Current smoking before pregnancy; 2) Number of cigarettes per day before pregnancy (5 or less, 6-20, 20 or more)
77	Tucker, Ellickson, Orlando, et al.	2005	23-29	Longitudinal	United States	1,982	1) Heavy smoking (40+ times in past year) / Light smoking (Less than 40 times in past year) / Non-smoking; 2) Quit attempt; 3) 6-month abstinence
78	Vallejo-Torres, Hale, Morris, et al.	2014	0-65+, stratified with 8-15, 16-19, 20-24, 25-44, 45-64, 65+	Cross-sectional	United Kingdom	54,228 for entire sample; 2,275 were between 16-19, 2,725 were between 20-24	Current smoking
79	Vankim & Laska	2012	None specified, but "Additionally, in the 4-year university sample there were differences in age (11% under 19 years old, 83% 19-24	Cross-sectional	United States	1,201	Heavy smokers (10+ days per month) / Light smoker (Less than 10 days per month) / Non smoker

80	Vankim, Laska, Ehlinger, et al.	2010	15-98, stratified by 18 or less, 19-20, 21-22, 23-24, 25-30, 31+	Cross-sectional	United States	9,931	1) Weekday smoking (+10 cigarettes during week / Less than 10 cigarette during week / Non-smoker); 2) Weekend smoking (+10 cigarettes during weekend / Less than 10 cigarette during weekend / Non-smoker)
81	Villanti, Johnson, Rath	2017	18-34	Cross-sectional	United States	3,364	1) Ever-initiation; 2) Current smoking (Past 30-day prevalence); 3) Daily smoking (at least 25 out of past 30 days)
82	Virtanen, Vahtera, Broms, et al.	2008	Baseline: 20-54, stratified with 20-24, 30-34, 40-44, 50-54, Outcome measured five years later.	Longitudinal	Finland	10,110 for entire sample; 1,201 were 20-24 at baseline	Number of cigarettes smoked daily
83	Wagenknecht, Craven, Preisser, et al.	1998	18-40	Longitudinal	United States	5,115	Current smoking
84	Weden, Astore & Bishai	2006	14-42	Longitudinal	United States	58,334 person years among 4,050 individuals who were/became daily smokers during observation	Daily smoking cessation
85	Wi, Gauger, Bachman, et al.	2016	Median 20, IQR 19.5-20.4	Cross-sectional	United States	257	Current smoking
86	Widome, Wall, Laska, et al.	2013	Mean 23.2 SD 1.1	Longitudinal	United States	1,902	Current smoking (Past 30-day prevalence)
87	Yang, Johnson, Schorpp et al.	2017	12-32	Longitudinal	United States	7,889	Current smoking (Past 30-day prevalence)
88	Yang, Lynch, Schultenberger et al.	2008	18-26, M for men 21.9, M for women 21.9	Longitudinal	United States	8,230	Current smoking: Heavy (300+ cigarettes in past 30 days) / Light-to-Moderate (Less than 300 in past 30 days) / Non-smoker
89	Zhang, Cohen, Ference, et al.	2006	20-26	Longitudinal	Canada	636	Smoking initiation over two years

years old, and 4% over 24 years old) compared to enrolled undergraduate students (10% under 19 years old, 79% 19-24 years old, and 11% over 24 years old). There were also differences in age in the 2-year sample (18% under 19 years old, 59% 19-24 years old, and 20% over 24 years old) compared to enrolled students (6% under 19 years old, 54% 19-24 years old, and 41% over 24 years old)." (Page 3)

\* Current status includes both daily and occasional smoking



**SUPPLEMENTARY TABLE 3 Findings associated with most common indicators in studies on social inequalities in smoking among young adults, with references (n = 89 records)**

Indicators	#	N (%)	Status / Frequency				Initiation / Progression / Uptake				Cessation				N/A
			+	-	Mix	NS	+	-	Mix	NS	+	-	Mix	NS	
Individual education	1	67 (75%)	0	37	1	3	1	2	1	0	5	0	0	1	20
				1, 5, 7, 8, 9, 10, 12, 16, 19, 21, 22, 23, 24, 25, 28, 35, 36, 37, 38, 41, 46, 48, 50, 51, 52, 53, 54, 58, 59, 64, 65, 68, 70, 71, 72, 81, 85, 86, 88											
Employment status	2	40 (45%)	1	11	2	9	0	2	0	1	1	0	1	2	12
				7, 14, 24, 45, 53, 64, 68, 70, 82, 86, 88		6, 43, 48, 57, 58, 59, 61, 67, 75		39, 74		69		39		84, 4, 69	13, 15, 17, 21, 26, 28, 36, 44, 49, 56, 79, 80
Household income	3	34 (38%)	0	11	0	10	0	1	0	0	3	0	0	2	10
				5, 7, 9, 10, 18		1, 21, 41, 42		39			5, 61, 66			39, 77	6, 17, 29, 44, 46, 47, 49, 55, 56, 87

Parental education	4	27 (30%)	0	5	0	9	1	1	1	0	0	1	0	0	0	10
			28, 35, 45, 66, 78, 81	59, 64, 88, 89	10, 12	21, 52, 61, 73, 79, 84, 88	20	42	67	20	9, 13, 36, 40, 44, 46, 57, 60, 63, 87					
Marital status	5	23 (26%)	0	6	0	5	0	0	0	0	0	2	0	0	0	11
			48, 50, 52, 53, 59, 68	21, 39, 57, 75, 89	21, 52, 61, 73, 79, 84, 88	61, 84	5, 9, 15, 29, 47, 49, 56, 60, 70, 79									
Family status	6	14 (16%)	0	2	1	3	0	0	0	0	2	0	0	1	0	6
			50, 68	53	6, 59, 61	75, 84	5, 21, 36, 76, 79									
Parental marital status	7	13 (15%)	0	5	0	1	0	1	0	1	1	0	0	0	2	3
			51, 52, 59, 81, 88	7	20	42	84	20, 61	18, 36, 87							
Occupational grade	8	12 (12%)	0	7	0	0	0	0	0	0	0	0	0	0	5	
			7, 28, 45, 53, 59, 70, 88	7	20	42	84	20, 61	18, 36, 87							
Financial difficulties	9-10	11 (12%)	4	0	0	1	1	0	0	0	0	0	0	2	4	
			51, 57, 58, 79	6	39	69	39, 69	9, 15, 18, 46								
Urbanization	9-10	11 (12%)	0	3	0	3	0	0	0	0	0	0	0	0	5	
			13, 45, 50	1, 60, 65	11, 12, 17, 27, 36											
Home ownership	11	9 (10%)	1	3	0	0	0	1	0	0	0	0	1	3		
			16	51, 53, 85	39	42	39	9, 15, 80								

Neighborhood disadvantage	12	8 (9%)	3	0	0	0	0	0	0	0	0	0	2
			5,18,85			6		42			2		57,62
Parental occupational grade	13-14	6 (7%)	1	2	0	1	0	0	0	0	0	0	3
			16	32,51		88							27,63
Perceived family situation	13-14	6 (6%)	1	1	0	3	0	0	0	0	0	0	1
			16	12		14,64,81							44
Personal income	15	5 (6%)	2	0	0	1	0	0	0	1	0	1	0
			6,53			71				69		84	69

NS = Non-significant; N/A = Not available. Reference numbers are detailed in Supplementary File 1.

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## **CHAPTER 3. THEORETICAL FRAMEWORK**

Up to this point, this thesis has focused on substantiating: (1) the importance of smoking among young adults as a public health issue; (2) the fundamental role that socio-economic circumstances play in the unequal progression of smoking during this period; and (3) the different research streams that have addressed social inequalities in smoking among young adults. Section 3.1 returns to the findings presented in the systematic review and introduces the research gaps that can be found in them. Section 3.2 uses these findings to describe the limitations of traditional epidemiological approaches in the study of social inequalities in smoking among young adults.

In response, sections 3.3 and 3.4 discuss, in depth, how two important theoretical concepts from the social sciences – Bourdieu’s practice theory and life-course theory – can be complementarily used to address these shortcomings. They focus on four main arguments: (1) socio-economic circumstances include, first, the economic, social, and cultural resources that young adults unequally accumulate across social groups; (2) the distribution of health practices cannot be understood only by the separate contributions of these resources but is likely to be affected by the joint configuration of each of these resources; (3) socio-economic circumstances include, second, the transition stages in studies, employment, family, and housing that young adults unequally navigate through across social groups; and (4) the role of resources in the distribution of health practices is likely to be further modified by the transition stages and the different ages in which young adults progress during this period. Developing this theoretical foundation will bring me to my specific objectives and hypotheses, set out following this chapter.

### **3.1 Revisiting findings from the systematic review**

Based on 89 studies, the findings in the systematic review demonstrate that a substantial amount of research has already explored the influence of socio-economic characteristics on smoking among young adults. Using a simple, descriptive approach, I found 39 indicators that had been used to represent young adults’ socio-economic circumstances across six broad domains associated with education, occupation, wealth, the household, the family, and transition stages (e.g., studies, work, family, and housing). This diversity is a healthy sign that

many experts are already sensitive to the wide range of circumstances that may be relevant to social inequalities in smoking during this life period.

The distribution of socio-economic characteristics used across the studies, however, disproportionately favoured traditional indicators associated with socio-economic status in the general population. Found in 75% of studies, educational attainment was by far the most common indicator. One of the important findings highlighted by the review, however, is that educational attainment also presented one of the most consistent findings across the studies: 37 out of 41 studies found a negative association with smoking status, and 5 out of 6 studies found a positive association with smoking cessation during this period.

Contrasting with the amount and consistency of the findings with regard to educational attainment, two issues emerged from the findings on the other characteristics. The first issue is that there is ample evidence for the notion that *other* indicators and domains complement the operationalization of socio-economic circumstances involved in the unequal progression of smoking during young adulthood. The review revealed two consistent findings. First, having a stable family structure and being in a higher occupational class exert a protective influence. Second, experiencing financial difficulties and living in a disadvantaged neighbourhood have a negative influence. These findings suggest that any single indicator, even a robust indicator such as educational attainment, captures neither the extent of socio-economic circumstances nor the distribution of smoking during young adulthood. This is especially important because it is in keeping with the large proportion of studies that resorted to exploring only a few characteristics: one study out of five used one indicator, and two studies out of five used three or fewer indicators to capture these circumstances.

The second issue is perhaps even more important because it shows that, beyond educational attainment, there are quite inconsistent findings with regard to the most common indicators that have been examined in association with smoking. Only up to 50% of the studies reported significant associations with smoking for employment status, household income, parents' education, marital status, and family status, respectively. With regard to household characteristics, I argued that these discrepancies suggest that they may be unreliable proxies of

socio-economic circumstances during young adulthood if living arrangements are not taken into account. Regarding transition characteristics, I also argued that these discrepancies highlighted the different operational definitions that could have been used across studies, making their comparisons difficult. These discrepancies, however, invite us to take a step back from methodological considerations, turn to our theoretical assumptions, and ask ourselves: (1) Should socio-economic characteristics have a consistent association with smoking across social groups and during the full length of this period?; and (2) If we accept that socio-economic characteristics have an heterogeneous association with smoking, can we conceptualize in which contexts we expect these characteristics to provide different effects on the uptake of smoking during the transition to adulthood?

### **3.2 Revisiting findings within the context of epidemiological approaches**

I start by challenging how social epidemiology may help address these issues. I introduced in chapter 1 the notion that this discipline had contributed to public health science by evidencing the importance of considering multiple dimensions, levels, and periods to understand the complex burden of health inequalities experienced across social groups (Adler and Stewart 2010). For instance, many models have built on the work of Dahlgren and Whitehead (1991) to define the determinants of health. In this renowned “rainbow” framework of the determinants of health, four layers influence human biology: (1) general socio-economic, cultural, and environmental conditions; (2) living and working conditions; (3) social and community networks; and (4) individual lifestyle factors (including smoking). In this model, living and working conditions include education, work environment, unemployment, and housing as well as agriculture and food production, water and sanitation, and health care services.

While over 30 models have since been created to conceptualize the determinants of health (CCSDH 2015), the 2008 WHO Commission on the Social Determinants of Health developed perhaps one of its most known iterations. It divides the social determinants of health into structural and intermediary determinants. On the structural side, socio-economic contexts (e.g., public policies, societal values) influence individuals’ position within broadly defined hierarchies of power, prestige, and access to resources. This position is then operationalized

through a combination of education, occupation, income, and wealth alongside other determinants such as gender and race/ethnicity (Solar and Irwin 2010). In turn, this position influences the exposure to intermediary material, psychosocial, and behavioural mechanisms affecting health over the life-course, ultimately transforming social inequalities into health inequalities.

Using these models, many studies have attempted to disentangle the dimensions involved in the life-long development of social inequalities in smoking. In the early 1990s, a first body of work in tobacco research started to notice the role of early social disadvantage in the risk of early smoking onset (Conrad, Flay, and Hill 1992; Tyas and Pederson 1998). In the late 1990s, a second body of work in life-course epidemiology began to report that these early experiences had an enduring effect on smoking and smoking-related outcomes long into mid-life (Lynch, Kaplan, and Salonen 1997; Gilman, Abrams, and Buka 2003; Lawlor et al. 2004; Power et al. 2005; Cohen et al. 2009; Tehranifar et al. 2009; Giesinger et al. 2014; Vohra et al. 2016).

Gilman and colleagues (2003) found in a US birth cohort study that living with unemployed parents, living under the poverty line, and having a mother with a lower level of education were independently associated with a higher risk of smoking a first cigarette and intensifying to daily smoking into adulthood. Similarly, Power and colleagues (2005) compared women in the United Kingdom (UK), Denmark, Finland, the Netherlands, Sweden, and the US and found that they systematically faced a higher risk of initiating smoking and maintaining their behaviour during adulthood if their parents had been employed in lower occupational classes.

Studies have explored how socio-economic circumstances, experienced during childhood and adulthood, contributed to the risk of smoking during young adulthood, and most have found that the influence of childhood characteristics is often explained by young adults' own adult achievements (Paavola et al. 2004; Kestilä et al. 2006; Kuntz and Lampert 2013; Bowes et al. 2013; Melchior et al. 2015; Lee et al. 2015; Motta et al. 2015). Paavola and colleagues (2004) found in a Finnish cohort no direct influence of parental characteristics or social mobility (i.e., having a higher level of education compared with parents) on the risk of smoking at age 28 once they considered young adults' education attainment. Similarly, Yang and colleagues



(2008) found in the US Add Health cohort study no influence of parental characteristics on the risk of smoking between the ages of 18 and 26 once they considered young adults' education attainment.

With regard to employment, Bowes and colleagues (2013) examined participants aged 22–35 in a French cohort study and found that those who had experienced poverty in childhood but attained a good occupational situation in adulthood (i.e., the “upwardly mobile”) had the same prevalence of smoking compared to those who had experienced a stable trajectory of advantage. These two groups had a lower risk of smoking compared to both those who were “downwardly mobile” and those who had experienced a stable trajectory of disadvantage. Similarly, Lee and colleagues (2015) examined the association between employment and daily smoking in young people between the ages of 22 and 33 in a US cohort and found that unemployment was associated with a higher risk of smoking, but only among young adults who had parents with fewer years of education and lower incomes.

### **3.2.1 Challenging traditional epidemiological approaches**

While theories in social epidemiology have contributed to stressing the long-lasting influence of socio-economic circumstances on the unequal progression of smoking among young adults, they offer relatively little insight into: (1) what might capture socio-economic circumstances beyond the traditional indicators of education, occupation, income, and wealth; and (2) how the influence of socio-economic circumstances on smoking might vary dynamically between the broad life periods of childhood and adulthood. The glossary of SEP indicators produced by Galobardes and colleagues (2006, 8) offers an example of this shortcoming. It suggests that educational attainment represents the most appropriate indicator of SEP during young adulthood because “as formal education is normally completed in young adulthood and is strongly determined by parental characteristics, it can be conceptualised within a life course framework as an indicator that in part measures early life SEP.”

This proposal does not address the progression of education still occurring during this period, in keeping with the elongation and fragmentation of education trajectories in modern systems (Clark 2007; Vespa 2017). More importantly, it reinforces the incorrect assumption that one

indicator suffices to circumscribe socio-economic circumstances. This, unfortunately, leaves us with few guidelines for understanding how the life period of young adulthood can inform their socio-economic circumstances and their contribution to social inequalities in smoking.

This largely atheoretical tradition in the operationalization of socio-economic circumstances can be traced back to sociologist Paul Lazarsfeld (1939), who said that interchangeably using socio-economic indicators was acceptable because they demonstrated similar associations with political attitudes. That is not to say, however, that social epidemiology has remained blind to this concern. For instance, in *Education, Income, and Occupational Class Cannot Be Used Interchangeably in Social Epidemiology: Empirical Evidence against a Common Practice*, Geyer and colleagues (2006) observed that these three characteristics had relatively weak correlations with one another and that each was independently associated with diabetes and mortality in adulthood. Similarly, Laaksonen and colleagues (2005) observed in the Finnish population that educational attainment, occupational grade, household income, home ownership, financial difficulties, and economic satisfaction were each independently associated with smoking.

In most of these “validation” studies, however, the arguments are often led by empiricism: that is, a wider set of indicators should be explored because they are significantly associated with the outcome in a multivariable model. Describing these limitations, Graham (2007, 61) argued that “what the review of measures makes clear is that socio-economic inequalities [are] only partly captured by the indicators used to measure it.” One of the persisting critiques of social epidemiology, therefore, is its weak theoretical foundation (Krieger 2001; Kaplan 2004; Galea and Link 2013).

### **3.2.2 Moving towards sociological approaches**

Where do we go from here to guide the study of young adults’ socio-economic circumstances? Supporting my critique, Øversveen and colleagues (2017, 108) voiced their discomfort with an “inconsistent use of measures of social status,” noting that there was “little reflection on how the use of different measures may affect findings” and how “theoretically deviating concepts ... are used overlappingly and interchangeably.” They believed that these flawed practices

continued, in part, because of the continued reliance on “materialist” and “positivist” epistemological positions, which posit that: (1) socio-economic characteristics are static and isolable from their context; and (2) their association with health outcomes are linear and predictable. The authors argued that sociological theories could help explain the contribution of socio-economic circumstances to health inequalities. As a first step, they proposed to move health inequality research from epidemiological models to the theory of fundamental causes (Link and Phelan 1995, 2009; Phelan, Link, and Tehranifar 2010).

Link and Phelan (1995, 81) theorized that some social conditions represented fundamental causes of disease. In their framework, characteristics such as education and occupation indicate a distal socio-economic position that influence health outcomes through interchanging mechanisms that were expected to alternate over time: “Thus, even if one effectively modifies intervening mechanisms or eradicates some diseases, an association between a fundamental cause and disease will re-emerge.” To explain the persistence of health inequalities over time, they suggested that fundamental causes allowed access to “flexible” resources, including money, knowledge, power, prestige, and beneficial social connections, thereby reinforcing individuals’ capacity to avoid preventable causes of diseases over time. From this perspective, socio-economic differences in health represent socio-economic differences in the means to actively pursue goals with health implications (Freese and Luftey 2011).

To illustrate this in the context of social inequalities in smoking, Link and Phelan (2009) compared the prevalence of smoking and knowledge about its association with lung cancer risk across education categories between 1954 and 1999. They showed that differences in knowledge between those who had not finished high school and those who had completed a university degree increased from a low of 5.3 percentage points (p.p.) in 1954 to a record 21.9 p.p. between 1969 and 1985. However, from 1990 to 1999, these differences across education categories decreased to 10.2 p.p., and during the 2000s, they essentially disappeared. Despite these changes in knowledge, education-based inequalities in smoking remained constant over this period.

Therefore, the researchers argued that as evidence linking smoking and lung cancer was emerging in the 1950s, the resources associated with access to knowledge became important mechanisms shaping the unequal distribution of smoking. New trends emerging in the 1990s, however, suggested that the relation between socio-economic position and smoking was increasing as a result of unequal access to other forms of resources, such as power and prestige. Supporting this, studies have found that college-educated individuals have been more receptive to changing social norms with regard to health promotion and more fearful of the stigma that has been increasingly associated with smoking (Stuber and Galea 2008).

Fundamental cause theory offers an important contribution to the study of health inequalities by highlighting the subtle differences between socio-economic position and the resources that it provides, attributing more importance to the latter in better understanding the uptake of health practices such as smoking. In the context of young adulthood, the theory also offers a strong argument for moving from the indicators traditionally associated with adult achievements and focusing on the resources that young adults might be rapidly consolidating during this period.

In their scholarship, however, Link and Phelan have been notoriously vague in further operationalizing these resources and conceptualizing the relationship between these resources and health-related outcomes (Freese and Luftey 2011; Øversveen et al. 2017). In particular, Freese and Luftey (2011) argued that their definition of resources built disproportionately on a rational theory of human action, whereby individuals are expected to actively promote their health in everyday activities. Fundamental cause theory, therefore, still offers incomplete support for the operationalization of resources and the interpretation of the relationship among social position, resources, and health outcomes (Luftey and Freese 2011; Oversveen et al. 2017; Veenstra 2018).

### **3.3 First theoretical foundation: Bourdieu's practice theory**

In this context, I turn to the work of sociologist Pierre Bourdieu (1979, 1986). Bourdieu was initially motivated to move away from economic and rational choice theories to better understand the distribution of everyday activities, which could not be explained by the pursuit

of self-interest or access to material resources (Bourdieu 1986). Many medical sociologists have turned to Bourdieu to theorize the unequal uptake of health practices across social groups (Williams 1995; Frohlich et al. 2001; Williams 2003; Cockerham 2005; Carpiano 2006; Veenstra 2007; Abel 2008; Abel and Frohlich 2012; Veenstra 2018). In this section, I focus on Bourdieu's concept of *capital* to specify the forms of resources accessed by young adults and the mechanisms by which different resources are associated with the practice of smoking. It is, however, hard to present this concept without introducing Bourdieu's scholarship. Therefore, I quickly retrace its history before applying it to health inequalities.

In his analysis of social inequalities in access to higher education in France during the 1960s and 1970s, Bourdieu critiqued the concept of human capital and the meaning of academic performance, arguing that, for the most part, the "scholastic yield from educational action depended on the capital previously invested by the family" (Bourdieu 1986, 48). He believed that the education system insidiously favoured those whose educated parents had invested their own educational resources. Because of the hidden nature of these investments, youth who succeeded in education appeared to demonstrate legitimate competence in a fair game. He argued, therefore, that the education system represented a mechanism through which the intergenerational transmission of social inequality not only did not decrease but was, in fact, fully reproduced. Lareau (2011) demonstrated this more recently, reporting that American parents who had not completed high school were likely to minimize their capacity to support their children and trust the education system to independently school them.

From this perspective, the *field* of education represents (1) the distribution of *resources* related to educational attainment, (2) the different *practices* that are pursued by children and parents to succeed in the education system, and (3) the mechanisms through which social inequalities in resources and practices related to educational attainment are reproduced over time. The concept of field can be extended to the relationships among social positions, resources, and practices in other settings, such as the financial and judicial systems (Martin 2003). While theoretically, individuals have different social positions across fields, Bourdieu posited that these fields agglomerated into one single *field of power*, ultimately shaping positions into social classes that opposed one another in power relationships.

In this context, medical sociologists have proposed using Bourdieu's theory to critique how health behaviours can be understood as social practices that are unequally reproduced across social classes in health-related fields (Veenstra 2007; Haines, Poland and Johnson 2009; Katainen 2010; Dubbin, Chang, and Shim 2013; Collyer et al. 2015). For example, Williams (1995) proposed that members of privileged groups were likely to reinforce their social position by developing distinctive preferences for cooking, exercise, and weight management. Since these practices did not have important economic barriers, they could be performed to display legitimate competence in health promotion, while hiding the necessary, underlying investment of capital.

This theoretical argument can be extended to the “non-practice” of deleterious behaviours such as smoking, which, despite having a direct economic cost, is disproportionately practised among low-income groups (Casetta et al. 2016). In this case, members of privileged groups avoid and cease smoking as a means of displaying seemingly individual traits such as self-discipline, future orientation, and interest in health, while downplaying the resources that enable them to change their behaviour.

### **3.3.1 Bourdieu's forms of capital: Economic, social, and cultural**

In its broadest definition, *capital* represents materialized and embodied resources that individuals accumulate by investing time and energy in their potential capacity to profit from their reproduction or the production of new resources (Bourdieu 1986). Bourdieu proposed to operationalize resources in three forms: (1) economic capital – the financial and material resources that can bring immediate benefit or that can be exchanged for another resource; (2) social capital – the potential resources accessible through the quality and extent of one's social network, based on the principles of recognition and reciprocity; and (3) cultural capital – the credentials and objects acquired and the knowledge, habits, and preferences embodied during one's socialization (Bourdieu 1986; Gagné et al. 2018).<sup>2</sup> While the operationalization of

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<sup>2</sup> Despite their slightly different theoretical implications, the two concepts of *resource* and *capital* are used interchangeably in this rest of the thesis (Savage, Warde, and Devine 2005).

economic capital is mostly straightforward, social capital and cultural capital represent nuanced concepts, and they are further discussed here.

### **3.3.1.1. Social capital**

*Social capital* has received a substantial amount of attention from researchers and policy-makers in Canada and other countries over the past 20 years (Bryant and Norris 2002; Franke 2005). In contrast with the large number of social epidemiologists who have conceptualized social capital as a community-based feature (Kawachi et al. 1997; Pearce and Smith 2003), Bourdieu identified it first and foremost as an individually based resource, embedded in durable social networks (Bourdieu 1986; Song 2011, 2013). Often using the metaphor of a contact book, Bourdieu proposed that social capital was identifiable by the size of the social networks with which individuals were affiliated and the configuration of other forms of capital shared by its constituent members.

Most studies have measured social capital at the individual level using emotional and instrumental support (e.g., how many friends can help you in the event of an emergency), trust in and involvement with other members, and the status of other members (Harpham, Grant, and Thomas 2002; Dahl and Malmberg-Heimonen 2010; Savage et al. 2013). In the context of smoking, studies have found that interpersonal trust and active participation in group-based activities were independently associated with a lower risk of reporting and maintaining smoking (Giordano and Lindstrom 2011; Lindstrom et al. 2014; Lindstrom and Giordano 2016). Examining tobacco bans in public spaces in Germany, Rocco and d’Hombres (2014) proposed that these policies could have a stronger influence on smoking cessation among those who reported trusting others and participating in group-based activities more.

It is important to note that social capital is likely to have a distinct composition at different ages. Canadians between the ages of 15 and 34 are more likely to report having a larger group of friends, newer friends, and more frequent contact with family members; on the other hand, they are less likely to trust and exchange favours with their neighbours (Turcotte 2015). It is also important to note that social capital is unequally distributed across social groups. Compared with those who have finished post-secondary education, Canadians who did not

finish high school are less likely to have many friends, to have frequent contact with friends and family members, and to believe that most people can be trusted (Turcotte 2015).

### **3.3.1.2 Cultural capital**

In comparison, *cultural capital* has received much less attention from public health and public policy (Abel 2008). Bourdieu argued that the cultural capital of parents and children relevant to the field of education could be understood in three forms: (1) in the *embodied* state – as long-lasting dispositions of the mind and body; (2) in the *objectified* state – as cultural goods such as pictures, books, dictionaries, instruments, etc.; and (3) in the *institutionalized* state – as academic credentials that were fully legitimized by social institutions (Bourdieu 1986). Illustrating these in the field of education, Andersen and Jaeger (2015) examined Canadian adolescents in the Programme for International Student Assessment study and found that having cultural and educational objects in the household, reporting preferences for reading, and having discussions with parents on cultural and political issues were independently associated with academic achievement after accounting for parents' education and occupation. These cultural resources were also found to provide a larger benefit among adolescents in low-achieving school environments, suggesting that disadvantaged youth face a multiplicative burden when they are in disadvantaged schools that do not offer enough support to overcome the lack of resources that their families can provide them with.

In the context of health inequalities, cultural capital represents the resources relevant to both the field of interest (e.g., health) and the overarching field of power. In their systematic review of indicators of cultural capital across 111 studies, Kamphuis and colleagues (2015) found that institutionalized cultural capital had been systematically identified through the educational attainment of individuals and their parents. They also found that objectified cultural capital had been identified through a reduced number of indicators, including the presence of books, art objects, and other educational resources (e.g., computer, place to study); having a subscription to newspapers and magazines; and having a library card.

Their review, however, identified over 80 indicators that operationalized individuals' embodied cultural capital. This discrepancy is explained, in large part, by the different



disciplines in which cultural capital theory has been applied and the different outcomes for which cultural resources are likely to be important. For instance, based on their review, Kamphuis and colleagues (2015) developed a 27-item questionnaire to capture embodied cultural capital with regard to healthy eating through participation in food-related activities, skills related to cooking and grocery shopping, and knowledge on nutrition. While consistent with cultural capital theory, these indicators are unlikely to represent the cultural resources involved in the unequal uptake of smoking.

Few quantitative studies have explored social inequalities in smoking among youth using indicators inspired by cultural capital theory. Krange and Pedersen (2001) compared recreational and regular smokers among young adult Norwegians (aged 18–24) and found that recreational smokers were more likely to perform well academically, to pursue post-secondary education, to prefer “highbrow” cultural activities, and to have been brought up in a household where there were a lot of books and where their mothers preferred similar cultural activities. Similarly, Scheffels and Lund (2005) found among young Norwegians (aged 16–19) that preferences for different forms of cultural media were independently associated with the risk of occasional smoking. More recently, two studies found that young adult Swiss men smoked fewer cigarettes and were less likely to smoke every day if their parents valued and attributed more importance to health, and if more books were present in their household during their childhood (Schori, Hofmann, and Abel 2014; Gagné, Frohlich, and Abel 2015).

### **3.3.2 Distinguishing the relations among economic, social, and cultural forms of capital**

Building on this framework, a growing number of studies have sought to illustrate the applicability of a Bourdieusian perspective by examining the distinct contribution of economic, social, and cultural forms of capital to health inequalities. Using this approach, Pinxten and Lievens (2014) found among Belgian adults that subjective financial situation, social support in one’s network, social cohesion with neighbours, educational attainment, and participation in culture-based activities were independently associated with a lower risk of reporting poor physical and mental health. Similarly, Christensen investigated among Danish adults the contribution of economic (e.g., income, number of cars, household ownership, household assets), social (having connections that could help a person find employment and a

new residence in case of emergency), and cultural (educational attainment, attending cultural activities, owning books, and having a newspaper subscription) resources to the distribution of eating, cooking, exercising, and weight-management practices (Christensen 2011; Christensen and Carpiano, 2014). With colleagues in the ISIS group, I also explored the distribution of information-seeking practices among young adult Montrealers by examining the contribution of their economic (financial difficulties, access to a vehicle), social (size of their peer network, satisfaction with this network), and cultural (educational attainment, parents' educational attainment) resources (Appendix II) (Gagné et al. 2018).

Bourdieu (1979), however, would have probably discouraged us from using such an analytical approach. He argued that the distribution of these social practices was unlikely to be understood as the influence of one resource, one form of resource, or the sum of various forms of resource; instead, it could be understood only with the *structure of relations* among these resources. That is, the ability of a socio-economic characteristic such as educational attainment to distinguish the distribution of social classes and social practices is conditional on its relationship with other social markers, which also includes non-socio-economic factors such as gender and racial identity (Bourdieu 1979). From this perspective, he explicitly rejected resorting to linear relationships and traditional, regression-based modelling to understand how social practices were distributed in the population.

To empirically demonstrate this principle, in one of his major books, *La Distinction, critique sociale du jugement* (1979), Bourdieu used *correspondence analysis*, a multivariate data-reduction technique akin to principal components analysis (Le Roux and Rouanet 2010), to situate social groups within multidimensional spaces representing the distribution of culture-based knowledge and preferences (e.g., sports, arts, music, books, and magazines). Bourdieu observed that the two most defining features structuring the resulting social space of culture-based dispositions were (1) the total stock of resources obtained through education, occupation, and income and (2) the balance of economic and cultural capital across occupational categories.

More recently, Veenstra (2007) applied a similar approach to identify in the province of British Columbia how culture-based dispositions were associated with health-related practices (e.g., smoking, drinking, running, weight training) and how coherent patterns were distributed across social groups. He argued that the two most distinctive features structuring the resulting social space were defined by the contribution of cultural capital through educational attainment, occupational grade, and parents' education as well as the contribution of economic and social capital through household income, home ownership, and, to a lesser degree, community trust, involvement in community activities, and community belonging.

While correspondance analysis is a useful tool to describe associations, it is not designed to support inferences and is not without its own limitations (Le Roux and Rouanet 2010). To attempt to capture the structure of relations among resources, I propose to build on the mechanism of "conditionality" developed by Abel (2007, 2008; Abel and Frohlich 2012). He proposed that, beyond the additive influence of resources, their implications for the uptake of health practices could be constrained or exacerbated in keeping with the range of other resources that had been accumulated. Therefore, conditionality becomes a mechanism of social inequality when individuals are unequally limited in their capacity to access the ensemble of resources that is require to pursue privileged social practices. To illustrate this, he proposed that conditionality occurred when cultural resources influenced the use of economic resources for practising health-promoting activities or when economic and cultural resources facilitated access to health-promoting social networks such as sports clubs or support groups (Abel 2007, 2008).

To test this mechanism, a growing number of studies have used statistical interaction models to examine the contribution of the interplay of economic, social, and cultural resources to social inequalities in health (Abel et al. 2011; Veenstra and Patterson 2012; Ahnquist, Wamala, and Lindstrom 2012; Veenstra and Abel 2015; De Clercq et al. 2017). Abel and colleagues (2011) compared the self-reported health of youth between the ages of 12 and 18 in Denmark, Hungary, and the UK and found that those in the UK faced a multiplicative burden when they reported having less financial means and parents with less education. Similarly, Veenstra and Abel (2015) found, among young adult Swiss men, that their lower educational

attainment was associated with an excess risk of reporting poor physical health if their parents had also not completed post-secondary education and were unable to provide their children with useful job-related contacts. No study that I know of, however, has used this theoretical approach to examine social inequalities in smoking among young adults.

### **3.3.3 Moving towards a life-course approach**

Based on the above, it seems that a Bourdieusian approach to the operationalization of socio-economic circumstances among young adults builds on the distribution of economic, social, and cultural resources that young adults have accumulated and may now access. Resources can be viewed not only as a means for the active pursuit of health-related goals but also as the representation of one's social position, reinforcing the slow embodiment of class-based practices such as smoking as individuals are socialized. I argue that Bourdieu's practice theory offers a strong foundation for capturing the relevant dimensions of the socio-economic circumstances experienced by young adults. The arguments developed by Bourdieu and his peers also explicitly address the limitations of resorting to additive models with few indicators. They highlight the importance of considering the interplay of the various forms of resources to better understand social inequalities in smoking. Empirically, this is important because it suggests that most models producing "average" estimates may provide limited interpretations.

Can this theory also appropriately inform how the influence of resources on smoking might vary between the life periods of childhood and adulthood? Since a large portion of his scholarship addressed the intergenerational transmission of social inequalities, Bourdieu conceptualized the accumulation of resources and the uptake of social practices through the slow and irreversible process of early socialization in family and school institutions. He acknowledged that age was likely to contribute to the distribution of practices across social groups, for both biological and social reasons (Bourdieu 1979). Despite this, he did not seek to question the possibility of changes in the relation between the accumulation of resources and the uptake of practices over relatively short periods of time. In fact, Bourdieu (1979) borrowed from physics the concept of *hysteresis* – that is, the retardation of an effect when the forces acting upon a body are changed – to highlight the immutable influences of early socialization processes. Demonstrating this using social mobility, Friedman (2016) observed that

individuals who experienced upward mobility were likely to maintain long-lasting emotional and cognitive difficulties in developing their identity and social, familial, and intimate relationships.

### **3.4 Second theoretical foundation: Life-course theory**

This leads us to a theoretical impasse. Beyond early socialization processes, should we expect resources to have the same influence on young adults' social position and the intensification of smoking during the full length of the transition to adulthood? Should we expect associations to remain the same between those leaving mandatory schooling or continuing post-secondary education, navigating part-time jobs or entering full-time employment, and staying with their parents or leaving them to start their own families? In response, I turn to life-course theory as a second theoretical foundation for the nuanced study of social inequalities in smoking during the transition to adulthood.<sup>3</sup>

Missinne (2015) was among the first to explore potential bridges between Bourdieu's theory and life-course studies in the context of health inequalities. She examined with colleagues the distinct influence of economic and cultural resources (e.g., number of books in the household and the practice of preventive behaviours such as having frequent dental checkups) during childhood on the initiation of mammography-screening practices in early old age (Missinne, Niels, and Bracke 2014). Building on the principle that human development and aging are lifelong processes, the researchers found that following preventive practices during childhood was associated with a higher chance of practising appropriate mammography-screening procedures after the age of 50, after accounting for participants' other resources present in childhood. Since the practices measured in childhood were not directly related to the outcome, the researchers argued that they likely reflected the long-lasting influence of the cultural importance attributed to health that is unequally transferred by parents across social groups during early socialization.

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<sup>3</sup> In comparison to life-course epidemiology, *life-course theory* refers to the broader scientific field that addresses the development of individuals across the social sciences (Elder, Johnson, and Crosnoe 2003).

Other life-course principles, however, can further support the application of Bourdieu's theory for addressing our concern with regard to young adults. Missinne (2015) addressed this by exploring the antecedents and consequences of transition stages, events, and practices and the ways in which they vary according to their *timing* in a person's life. To operationalize this, she examined with colleagues whether socio-economic circumstances influenced the moment when women initiated mammography-screening practices, and she hypothesized that disadvantaged women were not only less likely to initiate but also less likely to initiate at the appropriate time of 50 years of age (Missinne, Niels, and Bracke 2014). In this thesis, I focus on the life-course principle of timing in keeping with my independent variables – that is, I explore whether the implications of young adults' resources can be better understood through their timing during the transition to adulthood.

Outside of health inequality research, a much larger scholarship has worked to disentangle the social processes underlying the transition to adulthood (Hogan and Astone 1986; Shanahan 2000; Settersten, Rumbaut, and Furstenberg 2005; Parsons and Bynner 2002; Bynner 2005; Côté and Bynner 2008; Settersten and Ray 2010; Côté 2014; Furstenberg 2015). As with Bourdieu's theory, I argue that it is necessary to provide a fulsome account of the trajectories, determinants, and implications of the modern transition to adulthood. Therefore, I expand on the contribution of life-course theory by describing first the trajectories of the current generations of young adults and the main theoretical approaches that have conceptualized its determinants and its consequences on health practices. This allows me to then develop how life-course theory may contextualize the role of resources for social inequalities in smoking in keeping with their timing across the transition stages and the different ages in which young adults progress.

### **3.4.1 The trajectories of the current generations of young adults**

Life periods essentially represent social constructions that are historically and culturally situated (Elder, Johnson, and Crosnoe 2003). In this sense, they can be differentiated as much by psychological and biological processes as by the social standards that mark age, such as rites and events, laws, and social norms. Life periods become institutionalized through laws and government services relating to issues such as child labour, mandatory schooling, and

retirement; examples in young adulthood are laws governing the ages of criminal liability, consent, and majority (Gaudet 2007; Furstenberg 2015). Therefore, while some neurological and psychological development is still occurring after the age of 18, what makes the transition to adulthood unique is the complete reversal of biological and social explanations for the major transition stages that are experienced after adolescence (Hogan and Astone 1986; Shanahan 2000; IOM 2014).

Conceptualizing young adulthood as a distinct life period is a relatively new phenomenon (Furstenberg 2008, 2015). Historically, transitions in employment and family formation occurred more quickly during the Industrial Revolution, slowed down during the Great Depression, and accelerated again following the end of the Second World War with a marriage rush and an ensuing baby boom (Furstenberg 2008, 2015). The “classic” transition (e.g., finishing education, finding a full-time job, leaving your parents, getting married, and having children over a short period of time) that occurred in the late 1940s to early 1960s represents, therefore, an anomalously standardized experience in modern history (Fussell, Gauthier and Evans 2007; Furstenberg 2015). In comparison, since the 1960s, two major changes characterize the transition to adulthood: all transitions are experienced later, and an increasing number of young adults will never experience these transitions, leading them into increasingly “de-standardized” and seemingly “individualized” trajectories (Shanahan 2000; Furlong and Cartmel 2006; Côté and Bynner 2008; Furstenberg 2015).

#### **3.4.1.1 Education and employment**

Four key institutions circumscribe the major transitions to adulthood: education, employment, family, and housing. The trajectories in education and employment have received the most attention because of the recent conjuncture experienced by young adults beginning in the 1980s, including the globalization of markets, the restructuring of staff (e.g., downsizing), and the saturation of the labour market as older workers delayed retirement (Gaudet 2007). Compared to past decades, employment during young adulthood is characterized by precarious positions lacking benefits (e.g., temporary work, unionization, and pension coverage), fewer jobs in the manufacturing and agricultural sectors, and a job market increasingly focused on information technologies and knowledge-based economies (Côté and Bynner 2008; Marshall

2012; Furstenberg 2015). Along with decreasing pensions, which have forced some workers to stay in employment, young adults now represent a smaller proportion of the active population and are at a disadvantage in negotiating job conditions (Coté and Bynner 2008; Galarneau et al. 2013).

It is, however, the longer trajectories in education and increased access to post-secondary education that represent the most important changes for young adults. Between 1961 and 2001, the proportion of Canadians aged 20–24 in post-secondary education jumped from 8% to nearly 50% (Beaujot and Kerr 2007). Today, the proportion of young adult Canadians who continue studying after adolescence progresses from 71% at age 18, 56% at age 20, 40% at age 22, and 26% at age 24, and it stabilizes at 10% between the ages of 26 and 29 (Statistics Canada 2017). During this period, the proportion of young adult Canadians who are studying in university increases from 32% at age 18 to approximately 66% between the ages of 21 and 29 (Statistics Canada 2017). In keeping with current employment trends, the massive entry into post-secondary education implies that an increasing proportion of the young adult population is working in positions for which they are overqualified. In 2011, 58% of Canadians between the ages of 25 and 34 with a university degree were employed in jobs that did not require that level of education (Uppal and Larochelle-Côté 2014).

This situation has diminished the employment prospects for those without post-secondary education as their chances of finding a full-time job, a higher salary, and advancement opportunities decrease (Müller 2005). In response, many more high school dropouts are returning to adult education. Raymond (2009) estimated that the proportion of young adult Canadians aged 20–24 without a high school diploma who had returned to studies increased from 10% to 22% among women and 12% to 16% among men between 1990 and 2005. She also found that the proportion of these young adults who returned to complete their secondary education had dropped from 51% to 33% during this period, indicating that an increasing number were instead seeking vocational training, which leads directly to employment.

Among the most vulnerable young adults, however, are those who are outside of education and employment – “Not in Employment, Education, or Training” (NEET) – who represent



nearly 15% of Canadians between the ages of 20 and 29 (Côté & Bynner 2008; Marshall 2012). This status disproportionally counts the most socially disadvantaged: young adult Canadians without a high school diploma are five times more likely to become NEET compared with those with a university degree (Marshall 2012). NEET status is a powerful determinant of social exclusion, with fewer employment prospects and more mental health problems, substance abuse, concerns about crime and violence, delays in relationship commitments, and early pregnancy and parenthood among women compared with the rest of the population (Côté and Bynner 2008; Henderson et al. 2017).

#### **3.4.1.2 Family and housing**

In line with changes in education and employment, family and housing trajectories have also fundamentally changed in the last 50 years (Gaudet 2007). As women have entered the job market in increasing numbers and used contraceptive methods to secure their career choices, there has been a strong decline in fertility rates: women now have fewer children and do so later. As the average lifetime fertility rate has remained steady, around 1.6, since the 1980s, important changes have occurred across age groups. Fertility has decreased by 50% for women 15–24 years old and by 25% for women 25–29 years old. On the other hand, fertility has increased by 60%, 170%, and 220% among women 30–34, 35–39, and 40–44 years old, respectively (Milan 2013).

Following a similar trend, young adult Canadians now also establish fewer partnerships and do so later. Between 1981 and 2011, the proportions of 20-to-24-year-olds and 25-to-29-year-olds who were married or in a common-law union have decreased from 36% to 16% and from 68% to 46%, respectively (Milan and Bohnert 2015). Changes in marriage rates explain much of this decrease. Since the late 1970s, the average age at first marriage has jumped from 23 to 29, and the proportion of married young adults between the ages of 25 and 29 has dropped from 74% to 27% (Cross and Mitchell 2014). This trend is also explained, in part, by the expansion of reproductive technology because unplanned parenthood used to be an important predictor of early marriage (Furstenberg 2015).

As with trajectories in education and employment, differences in parenthood and partnership during young adulthood have also increased across social groups. While before the 1980s, there was no association between household income and the timing of the first birth after the age of 25, career-oriented couples are now more likely to delay the birth of their first child until the age of 30 and even after 35 (Wheeler, Lochhead, and Tudiver 2006). Compared with the 1980s, the average mother, at the birth of her first child, is also now more likely to have a university degree, enjoy a higher household income, and temporarily leave full-time employment (Wheeler, Lochhead, and Tudiver 2006). In fact, educated women are more likely to have children, but less likely to have *many* children (DeCicca and Krashinsky 2016). This trend is also associated with increasing social inequalities in the formation of marriages and common-law unions during young adulthood. Since the late 1970s, the proportion of young adult Canadians under 35 years of age who were married or in a common-law union has decreased by 16% in the top income quartile, 44% in the two middle income quartiles, and 58% in the bottom income quartile (Cross and Mitchell 2014).

Finally, changes in education, employment, and family makeup have contributed to new housing arrangements. More young adults are living with their parents, and fewer are living with families of their own (Statistics Canada 2017). In 2011, 42% of young adults were living with their parents, and 30% were living with families of their own, between the ages of 20 and 29 (Milan and Bohnert 2015). While the proportion of single parents has remained stable in this age group, the number of young adults living outside families increased slightly, to 25% in 2011 (Milan and Bohnert 2015). Young adults living with their parents are more likely to be found among those who are immigrants, visible minorities, living in rural areas or large metropolitan areas where the cost of living is high, and attending school (Milan 2016).

The elongation of the education and employment trajectories has also led to a novel housing arrangement: moving back in with parents after moving out a first time (i.e., the “boomerang children”) (Gaudet 2007). Since 2001, the proportion of young adults between the ages of 20 and 34 who are living with their parents after having moved out once has increased from 25% to 35% (Statistics Canada 2017). Finishing school, having financial difficulties, and experiencing the breakup of early unions are the primary reasons for returning home (Beaupré,

Turcotte and Milan 2008; Furstenberg 2015; Warner and Houle 2015). Illustrating this, while full-time employment is more prevalent among young adults who have left their parental household, the proportion of young adults living with their parents while working full time has increased from 20% to 30% since the 1980s (Milan 2016).

### **3.4.2 Making sense of the transition trajectories**

What can be gleaned from the description of population patterns related to the transition to adulthood? Two opposing research streams have explored why these new trajectories are happening and what their implications are for the new socialization processes occurring during this period. First, Arnett (2000) proposed to understand the transition trajectories between the ages of 18 and 25 as a distinct, new developmental period, “emerging adulthood”. In keeping with the elongation of the transitions, the de-standardization of the trajectories, and the decrease in marriage and fertility rates, Arnett argued that traditional milestones were losing their relevance for the psychological development of young adults and were being replaced by subjective assessments of autonomy and independence (Arnett 1998).

In response, he proposed that the new, developmental challenges pursued by young adults could be understood as five individual processes: identity exploration, trying out possibilities in love and work, instability, self-focus, and feeling in between (adolescence and adulthood) (Arnett 2000). Arnett (2000) posited that emerging adults are developing themselves today by postponing commitment and exploring opportunities in and out of education, employment, relationship, and housing arrangements. Young adults who flounder and delay transitions after their mid-twenties are then considered to be failing to complete the developmental tasks that should be acquired over this period (Côté and Bynner 2008).

The theory of emerging adulthood has since been vigorously challenged in the social sciences (Bynner and Parsons 2002; Côté and Bynner 2008; Côté 2014). Côté and Bynner (2008) argue that equating the emergence of a new, developmental period with the elongation of the transition to adulthood is likely to underestimate the role of societal changes and social circumstances. For Oesterle (2013), the evidence of the social underpinnings of these new trajectories is clear. Young adults who are advantaged with educated and affluent parents are

the most likely to pursue post-secondary education, explore occupational opportunities, and delay family formation. In turn, disadvantaged young adults with younger parents and experiences of family disruption (e.g., a single-parent household) are more likely to leave education early and form families.

Youth policies focused on those who can delay transitions, therefore, are likely to miss those who are the most deprived (Côté and Bynner 2008; Settersten and Ray 2010). In keeping with the ever-growing popularity of Arnett's theory, Côté (2014, 178) argued, "His formulation is seriously skewed by assumptions that do a disservice to many of the young people currently facing serious social structural obstacles and poor economic opportunities during this prolonged transition to adulthood. ... The myth of emerging adulthood is a dangerous one, with the potential to seriously undermine the well-being of many young adults of the current generation, and generations to follow."

In contrast with a developmental approach that has diminished the role of transition stages, scholars from the social sciences have demonstrated that secular trends have not decreased the importance of the milestones of education, employment, family, and housing for socialization processes. Studies have found that being a parent and cohabiting with a partner have remained the most important predictors of identifying as an adult and that there is only weak evidence for the role of subjective independence (Shanahan et al. 2005; Benson and Furstenberg 2006). Benson and Furstenberg (2006) also found that "failed" transitions (e.g., leaving one's partner, returning to live with parents, leaving full-time work, returning to studies) represented strong predictors of not identifying as an adult, highlighting the importance of considering dynamic non-linear transition trajectories.

Scholars have also argued that the importance of these transitions was likely to vary with social context and family background. Young adults are more likely to adhere to adult roles and identities when they are with their partner, with their children, and in their work environment than when they are with parents or friends (Shanahan et al. 2005). Young adults are also likely to measure their progress against that of their peers and assess the nature of their trajectory in relation to what they perceive to be "normal" in their network (Panagakis

2015). Aronson (2008a, 2008b) observed that some transition stages could also have different meanings regarding adult identities across social groups, finding that young women who were school dropouts were more confident in the independence they gained from completing high school than were educated women who graduated college or university during this period. Similarly, other studies have found that young adults who grew up in an affluent household with a stable family structure were less likely to feel independent in their early twenties compared to their disadvantaged counterparts because parents were more likely to continue to support them with college and other expenses (Benson and Elder 2011; Kendig, Mattingly, and Bianchi 2014).

### **3.4.3 Making sense of the transition stages for the unequal uptake of health practices**

The new pattern of transition to adulthood is late, protracted, and complex (Billari and Liefbroer 2010). Young adults now feel compelled to take more time to secure educational credentials and employment opportunities, leading those who can afford it to delay family formation and develop novel arrangements with parents and partners. A first key feature of the transition to adulthood is the sheer intensity of the stages in and out of education, employment, family, and housing that are displayed in comparison to other life periods. A second key feature is the increased roles that risk and social advantage play in achieving a “normative” transition to adulthood (Furlong and Cartmel 2006; Côté and Bynner 2008; Swartz et al. 2011; Hamilton et al. 2018).

Beyond their role in the progression of social inequalities, do these trajectories contribute to the practice of smoking during young adulthood? Three main theoretical approaches have sought to capture the associations between these transitions and the uptake of health practices over the past three decades: role theory, stress theory, and life-course theory (George 1993).

#### **3.4.3.1 Role and stress theories**

In the 1980s, social scientists began to explore the importance of social roles (i.e., worker, spouse, parent) associated with traditional adult milestones to disentangle the contributions of selection mechanisms (health behaviours influencing transition stages) from socialization mechanisms (transition stages influencing health behaviours) (Staff et al. 2010). Exploring this

with marijuana use, Yamaguchi and Kandel (1985) found evidence for both: (1) marijuana use was associated with the postponement of marriage and parenthood and a higher risk of marriage dissolution; and (2) marriage was associated with a lower risk of continuing use among women while parenthood was associated with a lower risk of continuing use among men.

Following this perspective, Newcomb and Bentler (1987) found that, in the four years after graduation from high school, young adults who went on to cohabit with roommates and other relatives were more likely to intensify cigarette, alcohol, and marijuana use compared with those who went on to live with a spouse. Similarly, they found higher increases in cigarette use among those who transitioned into full-time work during this period. Illustrating this more recently, Staff and colleagues (2010) observed that changes in family roles were more strongly associated with health behaviour uptake than changes in school and work roles during the transition to adulthood. To explain this, they argued that marriage and parenthood were likely to be associated, in the short term, with larger changes in relationships and environments (e.g., spending fewer evenings out) and in social norms with positive health implications.

At the end of the 1980s, studies shifted their focus away from role explanations and began to explore young adults' adaptive capacity to deal with transitions that were increasingly conceptualized as stress-inducing experiences (Schulenberg and Maggs 2002; Masten et al. 2004; Staff et al. 2010). Examining this with college drinking, Schulenberg and Maggs (2002) synthesized five theoretical pathways linking young adult transitions to risk-taking behaviour: (1) a series of rapid, multiple transitions produce a stress overload; (2) developmental mismatches between young adults' cognitive resources and their new social environments set them back; (3) transitions becoming more difficult after adolescence, setting individuals who were already behind even further back; (4) young adults using risk-taking behaviours as a means to catalyze certain transitions, such as the formation of relationships; (5) young adulthood becoming a period of higher vulnerability, which is supported by fewer social institutions compared with adolescence.

#### **3.4.3.2 Life-course theory**

In the early to mid-2000s, however, scholars began to challenge the influence of role and stress mechanisms on the increasing heterogeneity in transition experiences. To address this, they turned to life-course theory and explored the influence of the timing of transitions at different ages. The majority of studies examined this principle using mental health outcomes (Bell and Lee 2008; Sacker and Cable 2010; Amato and Kane 2011; Oesterle 2013). Bell and Lee (2008) followed young Australian women (aged 18–23) over a five-year period and found a decrease in stress among women who had married and no significant changes among those who had experienced other normative transitions, such as moving out of the parental home, starting full-time work, and becoming a mother. On the other hand, they found a significant increase in stress among those who had not further transitioned and those who had experienced non-normative transitions, such as moving back to live with parents, going back to school, and becoming single after a relationship.

Echoing these findings, Sacker and Cable (2010) found in the UK that young adults were more likely to report psychological distress at ages 30–33 if they had left school before the age of 17, had left their parents and had their first child before the age of 19, but not yet moved in with a partner. Partially supporting the intergenerational transmission of social inequalities in health through these transition stages, they found that parents' occupational class was associated with the age at which young adults had left education and had their first child, but not with the age at which they had moved out or started cohabiting with a partner.

A growing number of studies support the idea that timing may also help better explain the role of transition stages in the progression of smoking during young adulthood. This has been best demonstrated by the experience of early childbearing among women, which has been associated with a higher risk of maintaining smoking during pregnancy and continuing afterwards (Graham et al. 2006; Crozier et al. 2009; Schoenaker et al. 2017). For instance, Crozier and colleagues (2009) estimated in the UK that there was a 6% lower risk of smoking during late pregnancy for each additional year in the mother's age at childbirth. Supporting the argument that precocious transitions subsequently increase social inequalities in smoking, Mollborn, Woo, and Rogers (2018) found in the US that a substantial portion of the association between giving birth before the age of 20 and smoking during young adulthood

was explained by the fewer opportunities in education and income associated with this early transition.

The influence of timing on smoking is likely to extend to the transitions in education, employment, partnership, and housing. Wickmara and Baltimore (2010) found in the US that moving out from parents and moving into cohabitation before the median age of 24 were associated with a higher risk of smoking between the ages of 24 and 32. Among young Australian women aged 24–29, Bell and Lee (2006) found that the ages at which women finished studying and started working full time, living with a partner, and having their first child were associated with the risk of smoking after adjusting for family background. In the UK, Green and colleagues (2017) found that, adjusting for the unequal selection of social groups into different trajectories, young adults who had pursued university at age 21 had the lowest odds of smoking, while those who had rapidly transitioned into employment, partnership, and parenthood at age 21 had the highest risk of smoking in their mid-twenties.

### **3.5 Summary**

This chapter set out to address the limitations of the current evidence on social inequalities in smoking among young adults and of the theories in social epidemiology to support this work. Despite its robustness as a marker of social inequalities in smoking, I argued that educational attainment could not account for the other socio-economic circumstances contributing to social inequalities in smoking during young adulthood. I also argued that the inconsistency of the findings about other circumstances was likely to hide the diversity of contexts in which socio-economic characteristics may influence smoking outcomes during young adulthood. I proposed that common epidemiological approaches were inadequate to address these questions because of their focus on achievements in education, occupation, and income and their lack of conceptualization with regard to the rapid moments of change occurring during the transition to adulthood.

To support the study of social inequalities in smoking among young adults, I proposed a new theoretical framework building on Bourdieusian and life-course theories. This proposal argued that the socio-economic circumstances of young adults could be better understood by



investigating the interplay of the economic, social, and cultural resources that have been unequally accumulated by young adults across social groups over the course of their lives. Amending a life-course approach to the operationalization of socio-economic circumstances led me to highlight both the role of transition stages in education, employment, family, and housing and of a nuanced age-graded approach to better understand social inequalities in smoking during young adulthood. Using these guiding principles, I hope to develop a better understanding of young adults' socio-economic circumstances and their contribution to social inequalities in smoking during the transition to adulthood in the Canadian population. This is what the heart of the thesis will now seek to describe.

## **SPECIFIC OBJECTIVES AND HYPOTHESES**

This section outlines the specific objectives and hypotheses to be tested in the main empirical portion of this thesis. In keeping with the presence of educational attainment in traditional epidemiological approaches, its importance in the social distribution of smoking, and its role as an indicator of cultural capital in Bourdieu's practice theory, I use it as a starting point to demonstrate the benefit of my proposed framework in the nuanced study of social inequalities in smoking during young adults' transition to adulthood. The application of my proposed framework, therefore, seeks to illustrate the contribution of:

- Other forms of economic and social resources.
- Conditional relations between education and other forms of resources.
- Transition stages in education, employment, family, and housing.
- Conditional relations between resources and transition stages.
- Conditional relations between resources and different ages.
- Conditional relations between transition stages and different ages.
- The interplay among resources, transitions stages, and different ages.

I use only educational attainment to test the conditional relations between resources and transition stages to maintain a coherent analytic strategy in the empirical portion of this thesis.

Three articles will develop this exploration. Articles 2 and 3 use a cross-sectional data set of young adults between the ages of 18 and 25 surveyed in Montreal, Canada. Article 4 uses a longitudinal, prospective cohort data set of young adult Canadians between the ages of 18 and 25.

Article 2 examines what resources and transition stages are associated with smoking status and whether their associations with smoking status differ according to educational attainment. Specifically, I examine:

- The distribution of smoking status and socio-economic characteristics (e.g., economic and social resources and transitions in education, employment, partnership, parenthood, and living arrangements) across education-based categories.

- The direction and degree of association between young adults' socio-economic characteristics and smoking status in multivariate models, partially adjusting for age and sex and fully adjusting for age, sex, and other socio-economic characteristics.
- Whether the fully adjusted associations between socio-economic characteristics and smoking status are modified by educational attainment (i.e., interaction).
- The degree and direction of the associations between socio-economic characteristics and smoking status for variables that have significantly different associations with smoking across education-based categories.

I hypothesize that I will find social inequalities in smoking according to a wider range of circumstances beyond educational attainment, whereby (1) those who access fewer economic and social resources will be more likely to report smoking; and (2) those who remain in education will be less likely to report smoking, while those who have completed transition stages (i.e., leaving parents, entering full-time employment, establishing a spousal relationship, and having children) will be more likely to report smoking. I also hypothesize that social inequalities will be exacerbated across education-based categories, whereby (1) those who did not pursue post-secondary education will experience a much higher risk of smoking if they also access fewer resources and have transitioned out of education into new transition stages; and (2) those who did complete post-secondary education will experience a much lower risk of smoking if they also access more resources and if they have transitioned out of education into these new transition stages.

Article 3 examines whether resources and transition stages have different associations with smoking status at different ages between 18 and 25. Specifically, I examine:

- The bivariate distribution of smoking status and socio-economic characteristics (e.g., economic and social resources and transitions into education, employment, partnership, parenthood, and living arrangements) across age categories (18–19, 20–21, 22–23, 24–25).
- Whether the fully adjusted associations between socio-economic characteristics and smoking status are modified at different ages (i.e., interaction).
- The degree and direction of the associations between socio-economic characteristics and smoking status for variables that have significantly different associations with smoking at

different ages.

I hypothesize that I will find differences in the size and direction of social inequalities in smoking at different ages during the transition to adulthood, whereby differences in smoking by education and other forms of resources will increase with age because young adults with fewer resources are more likely to intensify and maintain smoking between the ages of 18 and 25. On the other hand, I hypothesize two sets of associations between transition stages and smoking with age: that the exit out of education into new transition stages is associated with a much higher risk of smoking around ages 18–19 and a much lower risk of smoking around ages 24–25.

In article 4, I examine, in a second sample, whether transition stages are associated with smoking status and whether they have different associations with smoking across education groups and at different ages. I now also examine whether the different associations of transition stages with smoking across education-based groups are emerging specifically during young adulthood, rapidly changing between the ages of 18 and 25. Specifically, I examine:

- The bivariate distribution of smoking status and socio-economic characteristics (e.g., educational attainment and transitions in education, employment, partnership, and living arrangements with parents and children) across age time points (18–19, 20–21, 22–23, 24–25).
- The direction and degree of association between socio-economic characteristics and smoking status in multivariate models, partially adjusting for age and sex and fully adjusting for age, sex, and other socio-economic characteristics.
- Whether the associations between transition stages and smoking status are modified by educational attainment, age, and *both* educational attainment and age (i.e., two- and three-way interactions between and among educational attainment, transition stages, and age time points).
- The degree and direction of the associations between transition stages and smoking status for variables that have different associations across education-based categories, age-based categories, or education-based *and* age-based categories.

Building on the hypotheses developed in articles 2 and 3, I hypothesize that (1) educational attainment will be associated with a lower risk of smoking, which will increase between the ages of 18 and 25; (2) transition stages out of education into new transition stages will be associated with a higher risk of smoking around ages 18–19 and a lower risk of smoking around ages 24–25. I also develop the new hypothesis that the associations between transition stages and smoking around ages 18–19 and 24–25 will be different across education-based categories, whereby (1) young adults with less education will experience a much higher risk of smoking if they also experience transition stages around ages 18–19; and (2) young adults with more education will experience a much lower risk of smoking if they also experience transition stages around ages 24–25.

## **CHAPTER 4. METHODS**

To investigate my thesis objectives, I use two data sets. The first data set comes from the baseline of the ISIS, a two-point, longitudinal cohort study of young adults aged 18 to 25, recruited in 2011–2012 on the Island of Montreal. In keeping with its multidisciplinary research objectives, the ISIS data set benefits from having collected an extensive range of items related to young adults' socio-economic circumstances. The second time point, collected two years later, in 2013–2014, will not be used in this thesis because of the differences in certain key measures administered across cycles (Frohlich et al. 2017).

The second data set comes from the NPHS, a nationally representative, longitudinal prospective cohort that has followed Canadians aged 12 and older every two years between 1994–1995 and 2010–2011. While benefiting from a stronger design and larger sample of observations, this health-related dataset has collected less socio-economic information on its participants.

I discuss the methods used in the remaining three empirical articles by focusing on each data set. Each description will address, in order, the study population and sampling strategy, ethical considerations, sample characteristics, data collection methods, measures, statistical analyses, and specific considerations.

#### **4.1 Data set 1 : Interdisciplinary Study of Inequalities in Smoking**

The overall goal of the ISIS study was to investigate the joint influence of individual and contextual characteristics on social inequalities in smoking, combining self-reported individual data with environmental data using administrative- and observation-based geographical tools. The project took place in Montreal, Canada, at the École de Santé Publique de l'Université de Montréal and the Institut de recherche en santé publique de l'Université de Montréal. The project received pilot funding from the Canadian Tobacco Control Research Initiative (2008) and the Public Health Agency of Canada (2011) to develop a questionnaire and a neighbourhood observation grid. It also received four-year funding (2011–2015) through an operating grant from the Canadian Institutes of Health Research for the first two waves of data



collection. More information on purpose, methodology, and sample characteristics is available in Appendix III (Frohlich et al. 2017).

#### **4.1.1 Study population and sampling strategy**

The study population consisted of non-institutionalized men and women, aged 18–25 at the time of recruitment, who had been living at their current address on the Island of Montreal for at least one year, who were proficient in French or English, and who had the physical and mental health to complete the questionnaire. For the initial sampling list, authorization was requested from the provincial information access committee (Commission d'Accès à l'Information) to have the provincial health insurance agency (Régie de l'Assurance Maladie du Québec, or RAMQ) provide the research team with the name, sex, and residential address of a sample of 172 individuals (50% women), chosen randomly from all eligible individuals living in each of the 35 health and social services territories<sup>4</sup> on the Island of Montreal, for a total of 6,020 individuals.

Potential participants were sent a single-page letter, by mail, presenting the study's objectives and inviting them to complete an online questionnaire using a unique token identifier or with a research coordinator in a telephone or face-to-face interview. Participants could also request a paper copy of the questionnaire, which would be mailed to them along with a pre-stamped envelope in which to return the completed questionnaire.

The consent form was included in the documents mailed to potential participants and was also available on the study website (Appendix IV).<sup>5</sup> Young adults who agreed to participate in the study were offered a \$10 gift certificate redeemable at one of two book and music store chains (Renaud-Bray, Archambault Musique), and online at iTunes, as financial compensation for their participation. Up to two reminder letters were mailed, and between 1 and 10 follow-up phone calls were made, to potential participants.

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<sup>4</sup> These territories were associated with local community service centres (Centre Local de Services Communautaires), free clinics provided by the provincial government. More information is available on the Santé Montréal website at <https://santemontreal.qc.ca/en/public/montreals-institutions-at-a-glance/>.

<sup>5</sup> At [www.isis-montreal.ca](http://www.isis-montreal.ca).

To improve the response rate, potential participants' residential addresses had been geocoded when we received their address from the RAMQ. This allowed the research team to classify individuals according to the quartile level of material deprivation of their residential area; this is a score, based on census data, that combines the proportions of residents who do not have a high school diploma and who are unemployed as well as the residents' mean household income (INSPQ 2015). As data collection proceeded, the research team could track participation according to residential deprivation level and adjust its recruitment and recall strategies accordingly. This ensured that the final sample would, as much as possible, include individuals residing in areas of different deprivation levels, thereby maximizing the response rate and minimizing selection bias. The research team also tested pre-emptively sending out reminder letters, enclosing a copy of the questionnaire and a pre-stamped envelope, to reduce any financial and technological barriers to online administration, but found that it did not improve the response rate (Appendix V) (Gagné et al. 2014).

#### **4.1.2 Ethical considerations**

Ethical approval for the ISIS study (#11-019-CERFM-D) was obtained from the Research Ethics Committee of the Université de Montréal's Faculty of Medicine (Comité d'éthique de la recherche de la Faculté de Médecine). Ethics approval for this doctoral research (#16-162-CERES-D) was obtained from the Health Research Ethics Committee of the Université de Montréal (Comité d'éthique de la recherche en santé) (Appendix VI). Written or verbal informed consent was obtained from participants before they completed the questionnaire.

#### **4.1.3 Sample**

Data collection took place between October 2011 and August 2012. Of the 6,020 young adults invited to take part in the ISIS study, 458 (7.6%) were declared to be ineligible because they had not lived at the same address for a year or more, were not between 18 and 25 years old at the time of recruitment, lacked spoken proficiency in French or English, were physically or mentally unable to participate, or lived off the Island of Montreal. By August 2012, 2,102 individuals had completed the questionnaire. Nine of these participants were excluded at this point because they had completed only the first section of the questionnaire.

A total of 2,093 participants were included in the final ISIS sample. Of these respondents, 90.0% completed their questionnaire online, 4.2% on paper, and 5.8% over the phone with a research assistant. The response rate was 37.6% when adjusting for ineligibility. While relatively low response rates are increasingly common in epidemiological studies (Galea and Tracy 2007; Morton et al. 2012), this response rate was likely underestimated for two reasons. First, at least 20% of the young adults in the initial sampling list had likely moved in the previous year, thereby violating a first eligibility criterion (Clark 2007; Fry 2017). Second, approximately 5% of the young adults in the initial sampling list were expected to turn 26 by the time they were contacted by the research team, thus violating a second eligibility criterion.

#### **4.1.4 Questionnaire**

A self-administered, 21-page questionnaire was used to collect the study participants' demographic, socio-economic, and smoking-related information. The questionnaire consisted of 98 questions, divided into nine sections: your neighbourhood, your health, your cigarette use, your life and your social network, your cultural background and religious beliefs, your work and your studies, your housing, your expenses, and places where you spend time (Appendix VII). The questionnaire was tested for content validity with a panel of experts from public health, geography, tobacco control, and sociology as well as for face validity among young adults of low and high education level over the summer of 2011.

#### **4.1.5 Description of variables**

*Current smoking status* was used as the dependent variable. It was derived from the question "Currently, do you smoke cigarettes every day, sometimes or never?" This question was asked of participants who had smoked an entire cigarette at least once in their lifetime. *Current smokers* were defined as participants who were smoking every day or occasionally at the time they took the survey (Yes/No). *Non-smokers* were participants who had never smoked and those who reported not smoking at the time of survey, even if they had in the past. This definition follows the most common definition of smoking status used by Health Canada. Smoking-related items used in the ISIS questionnaire were taken from standardized questionnaires developed by Statistics Canada and Health Canada (Gilmore 2002).

For independent variables, in addition to educational attainment, I measured participants' own economic resources through their personal income in the previous year and experience of financial difficulties in the previous year. I measured participants' economic and social resources in the social network using their capacity to receive financial aid from family and peers, their capacity to receive a job-related contact from their family, and the size of their social support network. Finally, I measured participants' transition stages using their student status, full-time work status, relationship status, and living arrangements with parents and with children.

Participants' *educational attainment* was measured by asking, "What is the highest level of education you have completed?" Respondents had 12 choices, ranging from *No school* to *Earned doctorate*. Article 2 recodes the participants' educational attainment into three categories: *High school completed or less*, *CEGEP completed*,<sup>6</sup> and *Some university completed*. Article 3 recodes the participants' educational attainment into two categories: *High school completed or less* and *Post-secondary education received* because only 10 participants reported having completed some university between the ages of 18 and 20.

It should be mentioned here that assessing educational attainment during young adulthood is limited by the fact that young adults are in the process of finishing their studies. In response to the variability of the level of education that is completed during this period, some studies have begun employing "expected" measures of educational attainment based on student status. Two other studies using the ISIS data set have also used this approach based on student status and study location to investigate social inequalities in mobility practices (Shareck et al. 2014, 2016). I examined, in another publication, how these two measures (the level of education that is completed and that is expected) differed in their associations with smoking status and found no clear advantages of using this approach in the context of this thesis (Appendix VIII) (Gagné et al. 2016). Since I specifically investigate the role of young adults' student status

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<sup>6</sup> CEGEP (Collège d'enseignement général et professionnel) is a post-secondary educational institution between high school and university that provides mandatory pre-university education or vocational training in Quebec.

across education-based categories, I used the level of education that young adults have completed at the time of recruitment as the measure of educational attainment in this thesis.

Participants' *personal income in the previous year* was obtained by asking, "Approximately what was your total personal income LAST YEAR, before tax deductions? Please include any financial aid you may have received (e.g., a scholarship, employment insurance benefits, CSST or other insurance benefits, etc.)."<sup>7</sup> Personal income was measured using 10 response possibilities: *No personal income, \$1 to \$4,999, \$5,000 to \$9,999, \$10,000 to \$14,999, \$15,000 to \$19,999, \$20,000 to \$29,999, \$30,000 to \$39,999, \$40,000 to \$49,999, \$50,000 to \$99,999, and \$100,000 or more*. In article 2, personal income was recoded into eight categories by combining participants who had made \$40,000 or more; the goal was to prevent outlier bias because only 34 (1.6% of the sample) participants reported making \$50,000 or more. In article 3, personal income was further recoded into six categories by combining participants who had made \$20,000 and more because only four participants reported making \$30,000 or more between the ages of 18 and 20.

Participants' *experience of financial difficulties in the previous year* was obtained by asking, "In the past 12 months, did you, or the person responsible for this expense, ever not have enough money to ..." for three items (Yes/No): (1) rent or mortgage; (2) electricity, hot water, or heating; and (3) food. Participants were categorized as having experienced financial difficulties if they reported Yes to at least one of the three categories (Cronbach's alpha = 0.74). These items were taken from a larger scale used to measure young parents' lack of money for basic needs in the Quebec Longitudinal Study of Child Development (Séguin et al. 2005).

Participants' *capacity to receive financial aid from their family and social network* was obtained by asking, "If you needed money urgently, could you borrow \$500 quickly from the following persons?" There were eight response categories (Yes/No): *your mother, your father, your partner or spouse, a brother or sister, a grandparent, a friend, a co-worker, someone*

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<sup>7</sup> CSST (Commission de la santé et de la sécurité au travail) refers to work-related health insurance benefits.

*else*. I used separately the variables for the mother and the father and the variables for the partner and the friend to represent the participants' family and social network, respectively.

Participants' *capacity to receive a job-related contact from their family* was obtained by asking, "If needed, can anyone in your family put you in contact with people who can help you improve your employment situation?" The responses were ranked on a 4-point Likert scale (from *Not at all* to *Most probably*). This item was taken from the Young Adults Swiss Survey, a repeated, cross-sectional survey of young men entering mandatory military service, which has been used as a proxy for parental social capital to predict self-rated health among young men (Veenstra and Abel 2015).

Participants' *social support network size* was obtained by asking, "Is there anyone in your social circle (your family, your friends, or other people you trust) ...?" Respondents could choose one of three items (Yes/No): (1) that you could confide in and talk openly about your problems? (2) who can help you if you have a problem? (3) that you feel close to and is affectionate toward you? Participants were then asked, "How many people?" and given five response choices from 1 to 5 or more. I recoded ordinal items to include those who did not have anyone and computed a composite score from the three items to measure the size of the participants' social support network (range = 0–15, median = 11, mean = 10.4, standard deviation = 3.9, Cronbach's alpha = 0.74). These items were taken from a larger scale, used to measure social support, first used in the 1992–1993 Social and Health Survey (Enquête Sociale et de Santé) and developed by the health division of the Quebec provincial statistics agency (Institut de la Statistique du Québec 2001).

For participants' transition stages, *student status* was obtained by asking, "Are you currently a student?" (Studying/Not studying). Full-time employment status was obtained by asking, "Are you currently in paid employment?" and "If you are currently in paid employment, are you working ...," with the responses *Part-time*, *Full-time*. Participants who were currently unemployed and who worked part time were recoded into a single category (Working full-time/Not working full-time). Relationship status was obtained by asking, "What is your marital status?" and providing the responses *single*, *married*, *common-law* or *in couple*,

*separated or divorced, widowed.* Participants were considered to be in a relationship if they were in a couple or married (In a relationship/Not in a relationship).

*Living arrangements with parents and children* was obtained by asking the questions, “Who do you currently live with? Choose all the answers that apply to you ...” and providing eight responses: *with both my parents; with one of my parents; with my brothers and sisters; with grandparents and other members of my family; with my partner/spouse; with my children or my partner/spouse’s children; with roommates, friends, or other people I know; other.* I considered participants who lived with one or both parents to be living with parents (Living with parents/Not living with parents). I considered participants who lived with their children or their partner’s children to be living with children (Living with children/Not living with children).

For the confounding variables, *age* (18–25) was recoded using the date of birth reported by participants at the time of recruitment. *Sex* (M/F) was taken from the RAMQ initial sampling list during the recruitment process.

Two variables were finally used to improve the multiple imputation procedure (see section 4.1.6.5). Data on overcrowding was obtained by asking, “Including yourself, how many people currently live or reside at your address?” and “How many rooms are there in the home you live in?” A composite score was recoded as the result of the division between the responses to these two questions. Data on having a public transit pass was obtained by asking, “Do you have a monthly public transit pass (bus, metro, and/or train)?” (Yes/No).

#### **4.1.6 Statistical analyses**

All analyses described in this section were performed using Stata 14 (StataCorp 2015). Article 2 stratified the sample characteristics by educational attainment (i.e., High school completed or less, CEGEP completed, Some university complete). Article 3 stratified the sample characteristics by age group (18–19, 20–21, 22–23, 24–25). Before main analyses, I performed and reported standard bivariate analyses (Chi-Square or Fisher’s exact test, Student’s *t* or ANOVA) to examine differences by education-based categories in article 2 and age-based

categories in article 3. I then followed a three-step analytic strategy in each article. After introducing these three steps, I conclude the section on the ISIS data set with general considerations.

#### **4.1.6.1 Developing a full model**

I first examined the associations between the participants' socio-economic circumstances and smoking status using a series of Poisson regression models with robust variance estimation (for details, see section 4.1.6.4). I did so in two steps: (1) I examined the association of each socio-economic characteristic with smoking, controlling only for age and sex; and (2) I examined the association of each socio-economic characteristic with smoking, controlling for the participants' other socio-economic characteristics, thereby representing the full model. Age, personal income, capacity to receive a job-related contact from family, and social support network size were modelled as continuous variables. In each case, I present the point estimates and 95% confidence intervals produced by these models.

#### **4.1.6.2 Modelling interactions**

In the second analytic step, I examined whether there were statistical interactions between socio-economic characteristics and smoking status, by education and age. Building on the full model, I estimated a series of new models, in which I added interaction terms to examine interactions for each socio-economic characteristic separately. Interaction terms represent here dummy variables (0/1) that are the multiplicative product of two variables: in the special case where two dichotomous variables were coded "0" and "1," their product term would be coded "1" only when both conditions were met.

In article 2 for educational attainment, I used two interaction terms referring to *High school completed or less* and *CEGEP completed*, using *Some university completed* as the reference category. In article 3 for age, I used three interaction terms referring to *18–19*, *20–21*, and *22–23*, using *24–25* as the reference category. In both articles, I present the point estimates, 95% confidence intervals, and *p*-values of the interaction terms produced from these models. I did not examine interactions for the variable *living with children* because too few participants



lived with children in the ISIS data set ( $n = 51$ , 2.3% of sample), and this precluded me from producing reliable estimates across education- and age-based groups.

#### **4.1.6.3 Modelling predicted probabilities**

In the third analytic step, I produced predicted probabilities from the models with interaction terms to better interpret the statistical significance of the interactions. This procedure helps surpass the limitations associated with using only the statistical significance of interaction terms in non-linear models to interpret effect modification (Karaca-Mandic, Norton, and Dowd 2012). Predicted probabilities are produced using marginal standardization, which provides predicted probabilities, summed to a weighted average, that reflect the distribution of covariates in each category of the independent variable, using the Stata command *margins* (Muller and McLarose 2014).

In this case, marginal effects represent the average change in the predicted probability of smoking for a corresponding 1-unit change in the independent variable. I assess the statistical significance of differences in predicted probabilities by examining whether the null is found in the 95% confidence interval of the marginal effect. Therefore, I describe the results in articles 2 and 3 by reporting: (1) the statistical significance of the interaction terms; (2) the absolute and relative differences in the predicted probabilities of smoking across education- and age-based groups; and (3) the statistical significance of the marginal effects.

#### **4.1.6.4 Risk estimation**

Logistic regression, and associated odds ratios, is by far the most popular modelling approach to examine the distribution of dichotomous outcomes in public health and the social sciences (Cramer 2002). However, odds cannot be as readily interpreted as risks and become increasingly poor proxies as the prevalence of the outcome increases in size. Some have proposed the guideline of 10% for the prevalence of the outcome as the limit at which studies should stop using odds ratios as a measure of association (McNutt et al. 2003). Since approximately 23% of the ISIS participants were current smokers, I argue that it was more appropriate to estimate prevalence ratios (PRs) (i.e., risk ratios in cross-sectional settings) to discuss the degree of association between independent variables and smoking status.

There are two common modelling alternatives to measure prevalence ratios: log-binomial regression and Poisson regression with robust variance estimation. While both produce similar estimates, each has limitations: robust variance estimation is a conservative method that may lower statistical power (i.e., the ability to reject a null hypothesis when it is false), and log-binomial regression is vulnerable to the inability to converge (Barros-Hirataka et al. 2003; McNutt et al. 2003). I found that log-binomial regression failed to converge in some models during preliminary analyses. Therefore, I produced Poisson regression models with robust variance estimation to keep the methods consistent across the empirical parts of this thesis.

#### **4.1.6.5 Multicollinearity**

Multicollinearity occurs when two or more independent variables are highly correlated, causing standard errors to artificially increase (Vatcheva et al. 2016). This issue arises in social epidemiology when investigating multiple related characteristics (Leal et al. 2012). I tested the presence of multicollinearity by regressing self-rated mental health (i.e., a five-point likert-type scale) on each of the independent variables in a linear regression and examining Variance Inflation Factors (VIF). VIF values ranged from 1.15 to 1.87, which are well below the recommended threshold values of five and ten (Vatcheva et al. 2016). This suggests that multicollinearity is not likely to be a substantial issue in the analyses.

#### **4.1.6.6 Missing data**

The number of missing cases on variables ranges from 0% to 10.5%, with six variables having more than 5% of missing cases: living with parents (5.0%), living with children (5.0%), the capacity to receive a job-related contact from family (7.0%), the capacity to receive financial aid from a partner/spouse (6.9%), having experienced financial difficulties in the last year (8.9%), and personal income in the last year (10.5%). Given the large number of covariates and the resulting smaller sample size associated with a listwise deletion approach, I used a multiple imputation (MI) approach, assuming data missing at random (MAR) to make full use of the sample. In MI, each missing value is replaced by a list of  $m > 1$  simulated values. Each of the  $m$  data sets is analyzed in the same fashion by a complete-data method. The results are

then combined to obtain overall estimates and standard errors that reflect missing-data uncertainty as well as sampling variation (Schafer and Graham 2002).

MI can adjust for scenarios only where missingness is completely random or correlated with covariates, but not where it is causally associated with variables of interest. In keeping with best practices, I performed the MI procedure on the full sample but restricted my main analyses to those participants who had valid answers on the dependent variable ( $n = 2,083$ ) (Von Hippel 2007). I used Stata's implementation of MI with chained equations to create 20 imputed sets, with 100 burn-in iterations using study variables (Royston and White 2011). I also used two auxiliary variables, crowding and having a public transit pass, to improve the imputation model.

#### **4.1.6.7 Non-response and weighting**

The ISIS sample is only partially representative of the Montreal population (Frohlich et al. 2017). Before the main analyses, I examined correlates of participation based on three characteristics available from the initial sampling list: sex, language of preference, and quartile of material deprivation. Using a logistic regression to model the correlates of participation in the initial sample list ( $n = 6,020$ ), I found that women had 49% higher odds of participating (95% CI 1.34–1.66), French speakers had 39% higher odds of participating (95% CI 1.23–1.56) compared to English speakers, and those in the least deprived residential areas had 21% higher odds of participating (95% CI 1.05–1.41) compared to those in the most deprived residential areas. These variables, however, explained only a negligible portion of participation (Nagelkerk  $R^2 = 0.02$ ).

Sampling weights can be used to account for differential non-response. This procedure is likely to reduce bias when non-response is strongly correlated with independent and dependent variables (Weuve et al. 2012). However, when this is not the case, this procedure may decrease statistical power, while providing no significant gains. Therefore, there is no consensus about the necessity of weighting in the context of multivariable analyses (Platt and Harper 2013). To test this, I produced a sampling weight using the predicted probability to participate, using the results from the model described above. Using another logistic

regression to model current smoking status in the ISIS sample ( $n = 2,083$ ), I found that the association between the non-response weight and smoking was not significant (OR for a 1-unit increase = 1.11, 95% CI 0.91–1.36,  $p = 0.30$ ). I also examined whether my main analyses significantly changed once weighted and found no differences during preliminary analyses. I therefore produced the analyses without using this weighting procedure.

## **4.2 Data set 2 : National Population Health Survey**

In the fall of 1991, the Canadian National Health Information Council recommended that an ongoing, national survey of population health be conducted. This recommendation was based on the consideration of the economic and fiscal pressures on the health care system and the requirement for information with which to improve the health status of the Canadian population. Beginning in April 1992, Statistics Canada received funding to develop the NPHS. The objectives of the NPHS were, among others, to aid in the development of public policy by providing measures of the health status of the population; to provide data for analytic studies that would assist in understanding the determinants of health; to collect data on the economic, social, demographic, occupational, and environmental correlates of health; and to provide information on a panel of people who would be followed over time to reflect the dynamic process of health and illness. More information on its purpose, methodology, and sample characteristics is available online (Statistics Canada 2012).

### **4.2.1 Study population and sampling strategy**

The target population for the NPHS was household residents of the 10 provinces; it excluded residents of health institutions, those living on Canadian Forces bases, and those living on First Nations reserves and Crown lands and in remote areas of Ontario and Quebec (Statistics Canada 2012). The first wave of data was collected in 1994–1995, and biennial surveys have been carried out since then, resulting in 16 years of follow-up (nine waves: 1994–1995, 1996–1997, 1998–1999, 2000–2001, 2002–2003, 2004–2005, 2006–2007, 2008–2009, and 2010–2011). The households were selected in the first cycle (1994–1995), and one individual over the age of 12 was randomly selected from each household to be the longitudinal respondent

for all future waves of the survey (they were traced for all subsequent waves). Detailed information on the NPHS sampling design is available elsewhere (Tambay and Catlin 1995).

#### **4.2.2 Ethical considerations**

Ethical approval for this research (#16-162-CERES-D) was obtained from the Health Research Ethics Committee of the Université de Montréal (Comité d'éthique de la recherche en santé). In keeping with the 2014 Canadian Tri-Council Policy Statement, research that relies exclusively on publicly available information does not require ethics review when the information is legally accessible to the public and appropriately protected by law. Access to NPHS data was facilitated through Professor Amélie Quesnel-Vallée's "Health Policy and Health Inequalities in Canada: Evidence from the NPHS" project (3152-s003). I accessed the full NPHS confidential microdata file at the McGill University branch of the Statistics Canada Research Data Centre Network, housed in the Quebec Inter-University Centre for Social Statistics (Centre interuniversitaire québécois de statistiques sociales). The contract for microdata access is available in Appendix IX (in French).

#### **4.2.3 Sample**

The NPHS initial longitudinal panel consisted of all 17,276 individuals recruited in 1994–1995. The response rate for cycle 1994–1995 was 83.6%; the cumulative retention rates for cycles 1996–1997, 1998–1999, 2000–2001, 2002–2003, 2004–2005, 2006–2007, 2008–2009, and 2010–2011 were 92.8%, 88.3%, 84.9%, 80.8%, 77.6%, 77.0%, 70.7%, and 69.7%, respectively. From the full sample, I selected participants who were aged 18 or 19 at one survey cycle and had been followed three other times in subsequent cycles to create four time points, at which participants were aged approximately 18–19, 20–21, 22–23, and 24–25. I also selected only NPHS participants who had valid data on smoking status on each of the four observation points. The analytic sample, therefore, represents the subset of 1,243 participants and their 4,972 ( $1,243 \times 4$ ) observations.

#### **4.2.4 Questionnaire**

The NPHS questionnaire includes content related to health status, use of health services, health behaviours, and a range of demographic and economic information. For example, the

health status information includes self-perception of health, a health status index, chronic conditions, and activity restrictions. The use of health services was probed through visits to health care providers, both traditional and non-traditional, and the use of drugs and other medications. Health behaviours include smoking, alcohol use, and physical activity. In the second cycle, emphasis has been placed on the collection of information related to access to health services through questions on preventive tests and examinations which probe for frequency, reason for use or non-use and barriers encountered. The demographic and economic information includes age, sex, education, ethnicity, household income, and labor force status (Yeo, 2001).

Each NPHS cycle questionnaire was conceived in collaboration with specialists from Statistics Canada, Health Canada, provincial ministries of health and researchers from various academic fields. The questionnaire development involved an elaborate literature research and numerous consultations between specialists to adapt existing survey instruments from other well-known sources, or to create new ones especially for the NPHS. Every questionnaire was approved by Statistics Canada, members of the expert committees and the Advisory Committee, which included representatives from the provincial ministries of health, Health Canada, Public Health Agency of Canada, Statistics Canada, other government departments and specialists.

Data collection was performed using a computer-assisted interview application. The logical flow of the questions was programmed to reflect the skip pattern associated with certain variables, such as age. Before collecting data from the respondents, the application was tested extensively to identify any errors in the flow and text. Furthermore, field tests were conducted during each cycle. The main objectives were to observe the respondents' reactions to the survey, to test the questionnaire with the changing focus content from one cycle to another, to obtain time estimates for the various sections of the questionnaire, to study the response rates, and to test field operations and procedures, such as interviewer training and data transmission. From cycles 1 to 6, two field tests were conducted, while for cycles 7 and 8, only one field test was conducted. Statistics Canada interviewers conducted the interviews in Statistics Canada's regional offices. In Cycle 9, no field test was conducted since changes to the questionnaire were minimal. Instead, additional in-house testing was performed (Statistics Canada 2012).

#### 4.2.5 Description of variables

*Current smoking status* was our main dependent variable (Y/N). It was assessed by asking respondents who had smoked at least one entire cigarette in their lifetime whether they currently smoked “every day,” “occasionally,” or “never.” Those who smoked daily or occasionally were considered to be current smokers, while non smokers consisted of never smokers and former smokers. This definition follows the operationalization of smoking status used in the ISIS data set. Smoking items were taken from standardized questionnaires developed by Statistics Canada and Health Canada (Gilmore 2002).

The main independent variables were *educational attainment* and four variables representing participants’ transition stages: *employment status*, *student status*, *relationship status*, and *living arrangements with parents and children*. Information on all variables except student status was taken from derived variables produced by Statistics Canada using responses to questionnaires for all waves of the survey. Derived variables are described in Appendix X.

For participants’ *educational attainment*, NPHS derives four categories: *less than secondary school graduation*, *secondary school graduation*, *some post-secondary*, and *post-secondary graduation*. It does this using the following three questions: “Excluding kindergarten, how many years of elementary and high school have you successfully completed?,” “Have you graduated from high school?,” and “What is the highest level of education that you have ever attained?” The category *some post-secondary* represents participants who reported having attained some trade, technical, or vocational schooling or business college, some community college, CEGEP or nursing school, or some university. I recoded this variable into two categories, *Secondary school graduation or less* and *Post-secondary education received or completed* because too few participants had completed university at ages 18–19 and had not finished high school at ages 24–25.

For participants’ transition stages, *student status* was obtained by asking, “Are you currently attending a school, college or university?” (Studying/Not studying). Participants’ *employment status* was obtained by asking, “Last week, did you work at a job or business? Please include

part-time jobs, seasonal work, contract work, self-employment, babysitting, and any other paid work, regardless of the number of hours worked” (Employed/Not employed). Those who reported being “permanently unable to work” were considered to not be in employment. Participants’ *relationship status* was obtained by asking, “What is your marital status?” and providing the responses *single and never married, married, living in common law, widowed, separated, and divorced*. Participants were considered to be in a relationship if they were married or in a common-law union (In a relationship/Not in a relationship).

Participants’ *living arrangements with parents and children* was obtained from information about the relationships between the selected respondent and the rest of the household, which was based on the reported relationship of each person to the selected respondent. Based on the initial NPHS derived variable, I recoded participants’ living arrangements into four categories, focusing on participants’ relations with parents and children: *living with parents, living without parents and without children, living without parents and with children, and other*. The *other* category represents atypical living arrangements not covered by the initial NPHS classification, such as participants living with parents and persons other than siblings (e.g., relatives, partners, and children), participants living with a partner and persons other than a child, and participants living with their children and persons other than a partner. For instance, a small number (2.5%) of young adults reported living with both their parents and their own family (e.g., a partner and/or children) (Census Canada 2016).

Participants’ *overcrowding* was used as a control variable to account for other socio-economic circumstances in their household. This variable was computed from derived variables representing the number of bedrooms and members in the household; participants were categorized to be in overcrowded households if there was more than one member per bedroom (Yes/No). I examined a measure of income inadequacy in the household (which includes both crowding and household income) in preliminary analyses, but found that it did not influence my findings. I chose to use only overcrowding to maximize the sample size because of the significant amount of missing data (> 10%) on household income.

#### **4.2.6 Statistical analyses**



All analyses described in this section were performed using Stata 14 (StataCorp 2015). I start by describing the sample characteristics, stratified by age time point (18–19, 20–21, 22–23, 24–25). Article 4 follows a similar analytic strategy as articles 2 and 3.

#### **4.2.7.1 Developing a full model**

I first examined the associations between participants' socio-economic circumstances and smoking status using a series of Poisson regression models with robust variance estimation, now using a generalized estimating equations (GEE) approach (for details, see section 4.2.7.4). I did so in two steps: I first examined the association of each socio-economic characteristic with smoking, controlling only for time, sex, and overcrowding. I then examined the association of each socio-economic characteristic with smoking, also controlling for participants' other socio-economic characteristics, representing the full model. I controlled for time using three dummy variables for ages *20–21*, *22–23*, and *24–25*, using the baseline *18–19* as the reference category. I present the point estimates and 95% confidence intervals produced by the full model.

#### **4.2.7.2 Modelling interactions**

In the second analytic step, I examined, in sequential steps, whether there were statistical interactions between transition stages and smoking status across education- and age-based categories using a series of new models, building on the full model. First, I produced a series of new models, where I added one interaction term to examine the interaction of transition stages with educational attainment, each time separately. Second, I produced a series of new models where I added interaction terms for the interaction between each socio-economic characteristic and age, each time separately. I modelled three dummy interaction terms for *20–21*, *22–23*, and *24–25*, using the baseline *18–19* as the reference category. Finally, I produced a series of new models, where I added to the full model well-ordered second- and third-order interaction terms to test the three-way interaction among transition stages, educational attainment, and age for each transition stage. For each of these interactions, I present the point estimates, 95% confidence intervals, and *p*-values of the interaction terms produced from these models.

#### **4.2.7.3 Modelling predicted probabilities**

In the third analytic step, I produced predicted probabilities from the models with interaction terms to interpret the statistical significance of interactions. Predicted probabilities are produced using marginal standardization, which produces predicted probabilities summed to a weighted average, reflecting the distribution of covariates in each category, using the Stata command `margins` (Muller and McLarose 2014). I assessed the statistical significance of differences in predicted probabilities by examining whether the null was found in the 95% confidence interval of the marginal effect. I presented the results by describing: (1) the statistical significance of the interaction terms; (2) the absolute and relative differences in the predicted probabilities of smoking across education- and age-based groups; (3) and the statistical significance of the marginal effects.

#### **4.2.7.4 Modelling associations with clustered data**

Standard regression models do not consider the clustered nature of observations within participants. When analyzing longitudinal data, these produce artificially smaller standard errors that have a higher risk of not covering the true population parameter. We used a GEE approach with an exchangeable correlation structure to account for this auto-correlation. In GEE, *generalized* refers to the unified approach to the modelling of the distribution of the dependent variable (as with generalized linear models); *estimating equations* refers to the estimation process, which attributes weights to the standard errors based on within-cluster correlation (Hanley et al. 2003). This iterative process starts by supposing a within-cluster correlation of zero (i.e., that observations are not correlated within individuals) and is repeated using new estimates of the correlation structure until the estimation reaches a convergence criterion. The “exchangeable” correlation structure refers to this model-based (i.e., estimated) correlation structure. While other correlation structures are available, GEE-based estimates remain consistent (i.e., unbiased) when the correlation structure is mis-specified (Zeger, Liang and Albert 1988).

#### **4.2.7.5 Considering period and cohort effects**

In preliminary analyses, I examined whether *period* (eight dummy variables for 1996–1997, 1998–1999, 2000–2001, 2002–2003, 2004–2005, 2006–2007, 2008–2009, and 2010–2011,

using the 1994–1995 survey cycle as the reference category) and *cohort* (five dummy variables for 1996–1997, 1998–1999, 2000–2001, 2002–2003, 2004–2005, using the 1994–1995 cohort as the reference category) variables confounded the associations between young adults’ socio-economic circumstances and smoking by entering them separately as covariates into the full model. While period and cohort variables were independently associated with smoking status, in keeping with decreasing trends in smoking during this period, adding them in my models did not influence the associations between socio-economic characteristics and smoking status. To prevent known estimation issues that would be associated with the joint study of age, period, and cohort effects (Reither et al. 2015), I did not control for period or cohort effects in the main analyses.

#### **4.2.7.6 Missing data**

There were only up to 1.6% missing cases among variables used in the NPHS. I produced models using a listwise deletion approach given the small amount of missing cases.

#### **4.2.7.7 Non-response and weighting**

To ensure that estimates are representative of the Canadian population, Statistics Canada provides a sampling weight, which adjusts estimates in keeping with the distribution of age, sex, and population size across Canadian provinces. The complex sampling procedure in the NPHS is integrated into estimation procedures by implementing a second set of 500 bootstrap replicate weights, also provided by Statistics Canada. Accounting for the complex sampling procedure allows researchers to appropriately estimate variance, which can be influenced by stratification, clustering, and other sampling methods. One of the main advantages of replicate weighting over other forms of design adjustments is that they integrate sampling information without permitting the identification of participants by data analysts or users (Kolenikov 2010).

There are, however, no statistical packages that we know of that can accommodate replicate weighting when producing predicted probabilities and their confidence intervals based on clustered-data analyses. Since Statistics Canada does not provide alternatives to bootstrap replicate weights, we could not integrate design effects into our main analyses. The main

analyses apply only the sampling weight and should, therefore, be interpreted accordingly. Information about the decision by Statistics Canada to use bootstrap replicate weights in the NPHS is discussed elsewhere (Yeo, Mantel, and Liu 1999).

## **CHAPTER 5. RESULTS**

**ARTICLE 2. Uncovering Social Inequalities in Health During  
Young Adulthood: Insights from Bourdieusian and Life-Course  
Theories**

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**TITLE**

Uncovering Social Inequalities in Health During Young Adulthood: Insights from Bourdieusian and Life-Course Theories

**AUTHORS**

Thierry Gagné<sup>1,2</sup>, Amélie Quesnel-Vallée<sup>3,4</sup>, Katherine L. Frohlich<sup>1,2</sup>

<sup>1</sup> Institut de Recherche en Santé Publique de l'Université de Montréal (IRSPUM), Canada

<sup>2</sup> Département de médecine sociale et préventive, École de santé publique de l'Université de Montréal (ESPUM), Canada

<sup>3</sup> Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Canada

<sup>4</sup> Department of Sociology, McGill University, Canada

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## **ABSTRACT**

Few have questioned the implications of the dynamic processes underlying the transition towards adulthood for studying social inequalities in health among young adults. We challenge this by revisiting Bourdieusian and life-course theories and illustrate this with social inequalities in smoking among 2,083 young adults in the Montreal *Interdisciplinary Study of Inequalities in Smoking*. We operationalize their socioeconomic circumstances through economic, social, and cultural resources and transition stages (i.e., studying, working full-time, living arrangements with parents/children, and being in a relationship). Building on the “education-smoking” association, we find that 1) resources and transition stages each influence smoking, 2) educational attainment and other resources influence smoking through their conditional presence and/or absence, and 3) education attainment influences smoking to varying degrees across transition stages. Our results support the development of a resource-based life-course approach to studying young adults’ socioeconomic circumstances and the unequal uptake of health practices during this period.

## **KEYWORDS**

Canada; Young Adults; Life-Course; Socioeconomic Factors; Smoking; Health Inequalities



## **TITLE**

Uncovering Social Inequalities in Health During Young Adulthood: Insights from Bourdieusian and Life-Course Theories

## **BACKGROUND**

The last decade has seen an increasing amount of attention devoted by public health to young adulthood in keeping with the rise in prevalence and incidence of multiple health outcomes such as smoking, alcohol and substance abuse, physical inactivity, and overweight/obesity after the end of adolescence (PHAC 2011, IOM 2014). In response, an increasing number of studies has emerged to understand the development of social inequalities in health during the transition towards adulthood (Pampel et al. 2014, Daw, Margolis & Wright 2017, Lawrence 2017, Hargrove 2018). Despite this, the majority of the literature in this age group has built on the social epidemiology scholarship developed to measure and analyze socioeconomic status in the adult population (Krieger, Williams & Moss 1997, Braveman et al. 2005, Galobordes et al. 2006a, 2006b).

Despite its contribution to life-course research, the persistence of a positivist epistemology and the absence of sociological theory in social epidemiology have downplayed the role of life stages' context in nuancing how socioeconomic circumstances contribute to the unequal uptake of health practices within each period (Øversveen et al., 2017). As a case in point, young adults are in a distinct developmental process characterized by a wide range of transitions in and out of education, employment, family, and housing arrangements (Hogan & Astone 1986, Shanahan 2000, Settersten, Furstenberg & Rumbaut 2005). These include finishing studies, entering full-time employment, leaving parents, making one's own household, establishing romantic relationships, and having children (Clark 2007, Vespa 2017). These dynamic circumstances cast doubt on the capacity of traditional approaches to appropriately explore social inequalities in health during the transition towards adulthood.

In response, we present a theoretical proposal and an empirical application to guide the future operationalization of young adults' socioeconomic circumstances and the analysis of their influence on the unequal uptake of health practices during this period. First, we draw on Bourdieu's practice theory to define young adults' socioeconomic circumstances through the interplay of economic, social, and cultural resources that they accumulate and access during young adulthood. Second, we turn to life-course theory to further contextualize the implications of these resources using the transition stages in education, employment, family, and housing where young adults progress during this period. Finally, we empirically illustrate these arguments by examining how young adults' resources and transition stages intertwine to produce social inequalities in health using smoking as a case example.

### **Using Bourdieu's practice theory to understand socioeconomic characteristics in young adults**

Young adults access resources such as money, knowledge, social connections, power, and prestige, shaping how they behave (Phelan, Link & Tehranifar 2010, Veenstra 2017). Epidemiological studies have challenged the applicability of traditional indicators such as educational attainment, occupational grade, and household income to capture the extent of these resources (Laaksonen et al. 2005, Geyer et al. 2006, Villanti et al. 2017). Few, however, have offered theoretically informed proposals to support their operationalization. We argue that Bourdieu's practice theory offers a strong starting point (Bourdieu 1986, Abel 2008, Abel & Frohlich 2012, Veenstra 2018).

Resources can be understood as taking three overarching forms: 1) *economic*, i.e., the financial and material resources that can bring immediate benefit or that can be exchanged against another resource; 2) *social*, i.e., the potential resources that are accessible through the quality and extent of one's social network based on the principles of recognition and reciprocity; 3) *cultural*, i.e., the credentials and objects that are acquired and the knowledge, habits, and preferences that are embodied during one's socialization (Bourdieu, 1986, Gagné et al. 2018). The distribution of these resources occurs through three main mechanisms of social inequality: the accumulation of resources over time, the transmission of resources between group members and generations, and the convertibility of resources between its economic, social,

and cultural forms (Savage et al. 2005, Abel 2008). In turn, the unequal distribution of resources informs the embodiment of distinctive social (health-related) practices across socioeconomic groups, a process which is posited to occur primarily during individuals' early socialization in family and school institutions (Bourdieu 1986, Cohn 2014).

Educational attainment is often understood as the most salient indicator of individuals' cultural resources given its central role in socialization processes, the institutionalized value of educational credentials for increasing employment opportunities, and its power in discriminating health-related practices (Gagné, Frohlich & Abel 2015). However, educational attainment does not fully account for 1) the distribution of economic, social, and other cultural resources and 2) the associations of these resources with the unequal uptake of health practices. For instance, studies have shown that educational attainment does not fully account for the influence of parents' education and cultural preferences and young adults' own cultural preferences towards the risk of smoking (Schori, Hofmann & Abel 2014, Gagné, Frohlich & Abel 2015). Multiple studies, therefore, have turned to Bourdieu's typology to support that addressing the unequal distribution of health practices requires integrating a comprehensive range of economic, social, and cultural resources beyond educational attainment (Abel et al. 2011, Christensen & Carpiano 2014, Pinxten & Lievens 2014, Veenstra & Abel 2015, De Clercq et al. 2017, Gagné et al. 2018). Illustrating this, Gagné and colleagues (2018) examined the distribution of health information seeking behaviours among young adult Canadians and found that, adjusting for their educational attainment, participants' mother's education (cultural), financial difficulties (economic), and their social support network (social) were each independently associated with the capacity to seek different sources of information when necessary.

The explicative power underlying Bourdieu's practice theory lies not only in defining the extent of different forms of resources but also in conceptualizing how these interact to produce social inequalities in health. Building on the three mechanisms of social inequality, Abel (2007, 2008) proposed that the health implications of individuals' resources could also be constrained or exacerbated in keeping with the range of other resources available to them. He argued that this "conditionality" mechanism occurred, for instance, when cultural resources

(e.g., knowledge and preferences towards a healthy lifestyle) influenced the use of economic resources towards health-promoting activities or when economic and cultural resources together facilitated access to health-promoting social networks such as sports clubs or support groups (Abel 2007, 2008). Empirically, a growing number of studies have used statistical interaction models to examine this interplay between economic, social, and cultural resources (Abel et al. 2011, Veenstra & Patterson 2012, Ahnquist, Wamala & Lindstrom, 2012, Veenstra & Abel 2015, De Clercq et al 2017). Illustrating this among young adults, Veenstra and Abel (2015) found among young Swiss men that a lower educational attainment was associated with an excess risk of reporting poor health if their parents also had not completed post-secondary education (cultural) and were unable to provide their children with useful job-related contacts (social).

### **Using life-course theory to contextualize the implications of resources for the unequal uptake of health practices during young adulthood**

While Bourdieu has much to offer regarding the operationalization of social inequalities, he offers little in relation to moments of potential change in these inequalities or on the role of life stages in shaping these inequities. On the contrary, he borrowed the physics concept of *hysteresis*, i.e., the retardation of an effect when the forces acting upon a body are changed, to highlight the immutability of the influences of early socialization processes on the social practices of individuals who experienced new circumstances during adulthood (Bourdieu 1984).

To understand the relation between resources present in childhood and the uptake of preventive practices during midlife and old age, Missinne (2014, 2015) suggested that life-course theory could shed new light on the mechanisms underlying Bourdieu's theoretical foundation. In particular, the life-course principle of timing posits that circumstances and events are likely to have a different influence on socialization processes in keeping with the temporality in which they occur (Settersten, Furstenberg & Rumbaut 2005). To identify this principle across the entire life-course, a significant portion of studies has focused on age gradients (Sacker et al. 2005). Within the life stage of young adulthood, however, we argue that timing should also be operationalized through their transition stages in education,

employment, family and housing arrangements. A key aspect of successful transitions lies in young adults' capacity to transition "in time" across normative timetables (Vespa 2017). Correspondingly, studies have found that precocious (e.g., leaving studies, having children) and belated (e.g., entering full-time employment, getting married after having children) transitions are associated both with social disadvantage and smoking in young adulthood and midlife (Bell & Lee 2006, Graham et al. 2006, Conger, Conger & Martin 2010, Penman-Aguilar et al. 2013, Pampel et al. 2014).

We develop on two fronts the interface of Bourdieusian and life-course theories to better understand social inequalities in health among young adults. First, we argue that operationalizing young adults' circumstances requires including in addition to economic, social, and cultural resources their transition stages in education, employment, family, and housing arrangements. Transition stages uniquely contribute to the uptake of social practices through the integration of distinctive social practices associated with adult roles such as worker, husband/spouse, or parent (Yamaguchi & Kandel 1985, Staff et al. 2010, Green et al. 2017). Illustrating this, Green and colleagues (2017) found that, adjusting for the selection of socioeconomic groups into different transition sequences, young British adults who delayed transitions out of education in employment, partnership, and parenthood roles at age 21 were less likely to smoke at age 26.

Second, we argue that the implications of young adults' economic, social, and cultural resources are likely to be "conditionally" constrained or exacerbated in keeping with the transition stages in which young adults progress during this period. Few studies, however, have explicitly examined how transition sequences further modify social inequalities in health behaviour uptake during young adulthood. One study in the US examined the influence of precocious transitions in sexual activity, leaving home, co-habitation, marriage, and childbearing on smoking and found no interactive effects with parents' income, education, and marital status (Wickrama & Baltimore 2010). Further supporting our argument, two studies found that unemployment experiences during young adulthood led to an excess risk of smoking, but only among young adults who did not pursue post-secondary education, and

whose parents were less educated and had a lower income (Melchior et al. 2015, Lee et al. 2015).

### **Empirical application**

Uncovering social inequalities in health during young adulthood requires integrating young adults' economic, social, and cultural resources, their transition stages in education, employment, family, and housing, and the interplay of resources among themselves and with transition stages. To illustrate our proposal, this paper now examines two sets of questions among young adults between the ages of 18 and 25: 1) are resources and transition stages each independently associated with smoking? and 2) beyond these main effects, are the associations of resources with smoking further modified by the configuration of other resources and transition stages? To limit the number of interactions examined in our second question, we build on one key resource, educational attainment, as a central dimension of young adults' cultural resources and by far the most common measure of socioeconomic status in studies of social inequalities in smoking (Schaap & Kunst 2009).

## **METHODS**

### **Data**

We analyzed cross-sectional data from the 2011-2012 panel of the *Interdisciplinary Study of Inequalities in Smoking* (ISIS), a study developed with the objective of better understanding the joint contribution of individual and contextual factors in shaping social inequalities in smoking among young adults in an urban context (Frohlich et al. 2017). The target population was non-institutionalized young adults aged 18 to 25 living in Montreal, Canada who had resided at their current address for at least one year at the time of the first contact. From an initial sample of 6,020 randomly selected individuals from the Quebec provincial health insurance program, 349 had refused to participate, 458 were declared ineligible, and 3,111 could not be reached, for a total sample size of 2,093 participants. Full details on sampling and survey procedures are available elsewhere (Frohlich et al. 2017). This study received ethics approval from the Université de Montréal health research ethics board.

## Measures

Our main dependant variable is current smoking status (Y/N), assessed by asking respondents who had smoked at least one entire cigarette in their lifetime whether they currently smoked ‘every day’, ‘occasionally’ or ‘never’. Those who smoked daily or occasionally were considered to be ‘current smokers’ while ‘non-smokers’ consisted of never smokers and former smokers.

For our main independent variables, we used educational attainment to operationalize participants’ cultural resources and thirteen other indicators to operationalize participants’ economic and social resources as well as their transition stages in education, employment, family, and housing. Young adults’ educational attainment was measured asking ‘What is the highest diploma you have ever obtained?’ into three categories: ‘High school completed or less’, ‘CEGEP completed’ and ‘Some university completed’. CEGEP (*Collège d’enseignement général et professionnel*) is a post-secondary educational institution between high school and university that provides mandatory pre-university education or vocational training in Quebec, Canada.

To operationalize participants’ economic resources, we used six indicators related to their personal income, their financial difficulties, and the capacity of their father, mother, friend, and/or partner to provide money in case of emergency. Personal income was measured by asking participants’ income over the last year and was recoded from ten to eight categories to prevent outliers (No income, \$1 to \$4,999, \$5,000 to \$9,999, \$10,000 to \$14,999, \$15,000 to \$19,999, \$20,000 to \$29,999, \$30,000 to \$39,999, and \$40,000 or more). Participants were categorized as having financial difficulties based on three items asking if their household encountered difficulties in paying for rent, utilities, or food in the last year ( $\alpha = .74$ ) (Y/N). Participants were categorized as having a father, mother, friend, or partner who could provide money in case of emergency based on the question “If you needed money urgently, could you borrow \$500 quickly from the following persons?” (Y/N).

To operationalize participants' social resources, we used two indicators related to the capacity of their family to provide a job-related contact and the size of their social support network. Family's capacity to provide a job-related contact was measured by asking "If needed, can anyone in your family put you in contact with people who can help you improve your employment situation?" using a 4-point Likert scale ('Not at all' to 'Most probably'). Social support network size is a continuous score computed as the sum of three items asking participants how many friends they could confide in, could receive help from, and felt close to ( $\alpha = .74$ , range = 0 – 15).

To operationalize participants' transition stages, we examined five indicators related to their living arrangements with parents and children, their student status, their full-time employment status, and their relationship status. Information on these variables was measured based on the questions: "Who do you currently live with?" (with one of or both my parents, Y/N; with my children or my partner's children, Y/N), "Are you currently a student?" (Y/N), "If you are currently in paid employment, are you working full-time?" (Y/N), "What is your marital status?" (married or in couple, Y/N).

### **Statistical analyses**

First, we examined the unadjusted and fully adjusted associations of resources and transition stages with smoking status using prevalence ratios (PR) estimated with Poisson regression models with a robust variance estimator controlling for age (18-25) and sex (M/W) (McNutt et al. 2003). Personal income, family's capacity to provide a job-related contact, social support network size, and age were modelled as continuous variables.

Second, we examined whether the association of educational attainment with smoking status was modified by other independent variables by introducing interaction terms in the full model. Interaction terms were entered separately for each education-resource and education-transition pair. We then examined marginal effects, i.e., the change in the predicted probability of smoking for a corresponding change in the independent variable, using the Stata command *margins* (Muller & McLehose 2014). We discuss statistical interactions when both the product term and marginal effect are statistically significant. We did not examine interactions for



‘living with children’ because an insufficient number of participants lived with children ( $n = 51$ ) to produce reliable estimates.

Given the large number of covariates, we used a multiple imputation approach assuming data missing-at-random (MAR) to make full use of the sample. We used Stata’s implementation of multiple imputation with chained equations (MICE) to create 20 imputed sets. We restrict our analyses to participants with valid answers on the dependent variable ( $n = 2,083$ ). We use a  $\alpha = .05$  threshold to interpret results as statistical significant. All analyses were performed using Stata 14 (StataCorp 2015).

## RESULTS

**TABLE 1 Sample characteristics. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( $n = 2,083$ )**

Variables	Whole sample ( $n = 2,083$ ) N (%)	High school or less ( $n = 807$ ) N (%)	CEGEP completed ( $n = 833$ ) N (%)	Some university completed ( $n = 434$ ) N (%)	Missing N (%)
Current smoking status					0
Smoker	477 (22.9)	239 (29.6)	163 (19.6)	71 (16.4)	
Non-smoker	1,606 (87.1)	568 (70.4)	670 (80.4)	363 (84.6)	
Age					0
Mean (SD)	21.5 (2.3)	20.2 (2.2)	21.6 (1.9)	23.5 (1.4)	
Sex					0
M	904 (43.4)	405 (50.0)	332 (39.9)	163 (37.1)	
F	1,179 (56.6)	408 (50.0)	502 (60.1)	273 (62.9)	
Personal annual income					219 (10.5)

\$0	186 (10.0)	109 (15.4)	54 (7.1)	26 (6.4)	
1 – \$5,000	417 (22.3)	206 (29.8)	157 (20.6)	55 (13.2)	
5,000 – \$10,000	442 (23.7)	154 (22.2)	208 (27.3)	80 (19.6)	
10,000 – \$15,000	303 (16.3)	104 (15.1)	138 (18.0)	61 (14.9)	
15,000 – \$20,000	145 (7.8)	45 (6.5)	62 (8.1)	38 (9.3)	
20,000 – \$30,000	178 (9.5)	42 (6.1)	75 (9.8)	62 (14.9)	
30,000 – \$40,000	93 (5.0)	18 (2.6)	35 (9.8)	40 (9.8)	
\$40,000 or more	100 (5.4)	15 (2.2)	35 (4.6)	49 (12.0)	
Financial difficulties					187 (8.9)
No	1,586 (83.6)	552 (77.8)	677 (87.8)	362 (86.6)	
Yes	310 (16.4)	158 (22.2)	94 (12.2)	57 (13.4)	
Father's capacity to lend 500\$ in case of emergency					28 (1.3)
No	629 (30.6)	323 (40.3)	216 (26.2)	91 (21.0)	
Yes	1,426 (69.4)	477 (59.7)	611 (73.8)	340 (79.0)	
Mother's capacity to lend 500\$ in case of emergency					29 (1.4)
No	543 (26.4)	288 (36.0)	181 (21.9)	74 (17.2)	
Yes	1,511 (73.6)	509 (64.0)	646 (78.1)	359 (82.8)	
Friend's capacity to lend 500\$ in case of emergency					92 (4.4)
No	1,128 (56.7)	510 (66.5)	433 (54.1)	188 (43.9)	
Yes	863 (43.3)	256 (33.5)	367 (45.9)	238 (56.1)	
Partner's capacity to lend 500\$ in case of emergency					144 (6.9)
No	1,358 (70.0)	578 (77.9)	532 (68.1)	251 (59.7)	
Yes	581 (30.0)	163 (22.1)	249 (31.9)	168 (40.3)	
Family's capacity to provide a job-related contact					146 (7.0)

Not at all...	234 (12.1)	101 (14.0)	80 (10.0)	54 (13.0)	
Not very...	315 (16.3)	92 (12.4)	146 (18.5)	78 (18.8)	
Probably	809 (41.8)	327 (45.0)	307 (38.8)	174 (41.3)	
Most probably	579 (29.9)	209 (28.6)	259 (32.7)	112 (26.9)	
Social network size					0
Mean (SD)	10.4 (3.9)	9.8 (4.1)	10.4 (3.8)	11.3 (3.7)	
Living with parents					106 (5.0)
No	396 (20.0)	90 (11.5)	153 (19.4)	152 (38.0)	
Yes	1,581 (80.0)	702 (88.5)	636 (80.6)	247 (62.0)	
Living with children					106 (5.0)
No	1,926 (97.4)	769 (97.1)	765 (97.0)	396 (99.2)	
Yes	51 (2.6)	23 (2.9)	24 (3.0)	3 (0.8)	
Studying					22 (1.1)
No	621 (30.1)	250 (31.1)	198 (24.0)	169 (39.1)	
Yes	1,440 (69.9)	556 (68.9)	628 (76.0)	263 (60.9)	
Working full-time					64 (3.1)
No	1,595 (79.0)	681 (86.0)	646 (79.8)	272 (64.5)	
Yes	424 (21.0)	110 (14.0)	163 (20.2)	150 (35.5)	
Being in a relationship					4 (0.1)
No	1,427 (68.6)	588 (72.5)	555 (66.9)	282 (64.7)	
Yes	652 (31.4)	224 (27.5)	276 (33.1)	154 (35.3)	

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*Each characteristic was significantly associated with educational attainment at the .05 level in standard bivariate analyses.*

### **Sample characteristics**

Table 1 presents the distribution of participants' smoking and socioeconomic characteristics. Participants were on average 21.5 years old (SD = 2.3), with 23% current smokers, 57% women, 40% having completed CEGEP, and 21% having completed some university. Regarding participants' economic resources, 90% reported having a personal income, 16% experienced financial difficulties in the last year, and 71%, 75%, 43%, and 30% of participants

reported that they could borrow \$500 from their father, their mother, a friend, and a partner, respectively, in case of an emergency. About participants' social resources, 72% reported that their family were 'probably' or 'most probably' able to provide them with a job-related contact. With regard to transition stages, 80% of participants were living with their parents and 70% were studying. Finally, the majority of participants was not working full time (79%), did not live with children (97%) and were not in a relationship (69%).

### **Associations between young adults' circumstances and smoking**

Table 2 presents the associations of participants' socioeconomic characteristics with smoking status. In the models controlling only for age and sex (Column 1), five resources and three transition stages were associated with smoking. Participants who only completed high school or less and those who only completed CEGEP were 138% (95%CI 1.84–3.10) and 42% (95%CI 1.09–1.84) more likely to report smoking when compared to those who completed some university. A one-bracket increase in participants' personal income was associated with an 11% (95%CI 1.06–1.17) increased risk of reporting smoking. On the other hand, having a father and a mother who could provide money in case of an emergency were each associated with a 24% (95%CI 0.65–0.90) and 17% (95%CI 0.70–0.99) lower risk of reporting smoking, respectively. Having experienced financial difficulties in the last year was also associated with a 45% higher risk of reporting smoking (95%CI 1.19–1.76). Regarding transition stages, living with parents and being a student were also associated with a 24% (95%CI 0.62–0.94) and 25% (95%CI 0.63–0.99) lower risk of reporting smoking, respectively. On the other hand, being employed full-time was associated with a 24% (95%CI 1.01–1.50) increased risk of reporting smoking.

In the full model (Column 2), four variables remained significantly associated with smoking: educational attainment ( $PR_{HS/less} = 2.37$ , 95%CI 1.79–3.12;  $PR_{CEGEP} = 1.45$ , 95%CI 1.11–1.89), personal income (PR per bracket = 1.11, 95%CI 1.05–1.17), financial difficulties (PR = 1.24, 95%CI 1.01–1.53), and living with parents (PR = 0.75, 95%CI 0.60–0.95). One new transition stage, living with children, became significantly associated with smoking. Adjusting for other socioeconomic circumstances, participants who lived with children were 46% (95%CI 0.32–0.94) less likely to report smoking.

**TABLE 2 Associations between resources, transition stages, and current smoking status among young adults. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. (n = 2,083)**

Variable	Model 1		Model 2	
	Association + Age/Sex		Full model	
	PR	95% CI	PR	95% CI
Education				
High school or less	<b>2.38</b>	<b>(1.84-3.10)</b>	<b>2.37</b>	<b>(1.79-3.12)</b>
CEGEP completed	<b>1.42</b>	<b>(1.09-1.84)</b>	<b>1.45</b>	<b>(1.11-1.89)</b>
Some university completed (ref.)	---	---	---	---
Personal annual income *	<b>1.11</b>	<b>(1.06-1.17)</b>	<b>1.11</b>	<b>(1.05-1.17)</b>
Financial difficulties	<b>1.45</b>	<b>(1.19-1.76)</b>	<b>1.24</b>	<b>(1.01-1.53)</b>
Father's capacity to provide \$500	<b>0.76</b>	<b>(0.65-0.90)</b>	0.88	(0.73-1.07)
Mother's capacity to provide \$500	<b>0.83</b>	<b>(0.70-0.99)</b>	1.07	(0.87-1.32)
Partner's capacity to provide \$500	0.90	(0.74-1.08)	0.83	(0.67-1.04)
Friends' capacity to provide \$500	1.01	(0.86-1.19)	1.07	(0.90-1.27)
Family's capacity to provide a job contact *	1.02	(0.94-1.11)	1.07	(0.98-1.16)
Social network size *	0.99	(0.97-1.01)	0.99	(0.98-1.02)
Living with your parents	<b>0.76</b>	<b>(0.62-0.94)</b>	<b>0.75</b>	<b>(0.60-0.95)</b>
Studying	<b>0.75</b>	<b>(0.63-0.89)</b>	0.89	(0.72-1.09)
Working full-time	<b>1.24</b>	<b>(1.01-1.50)</b>	0.95	(0.75-1.21)
Being in a relationship	1.00	(0.85-1.20)	1.02	(0.83-1.26)
Living with children	0.90	(0.53-1.53)	<b>0.54</b>	<b>(0.32-0.94)</b>

\* Modelled as a continuous variable. PR = Prevalence ratio. CI = Confidence Interval.

Models were Poisson regressions with a robust variance estimator on 20 imputed datasets. Models also controlled for age and sex. Bolded coefficients are statistically significant at the .05 level.

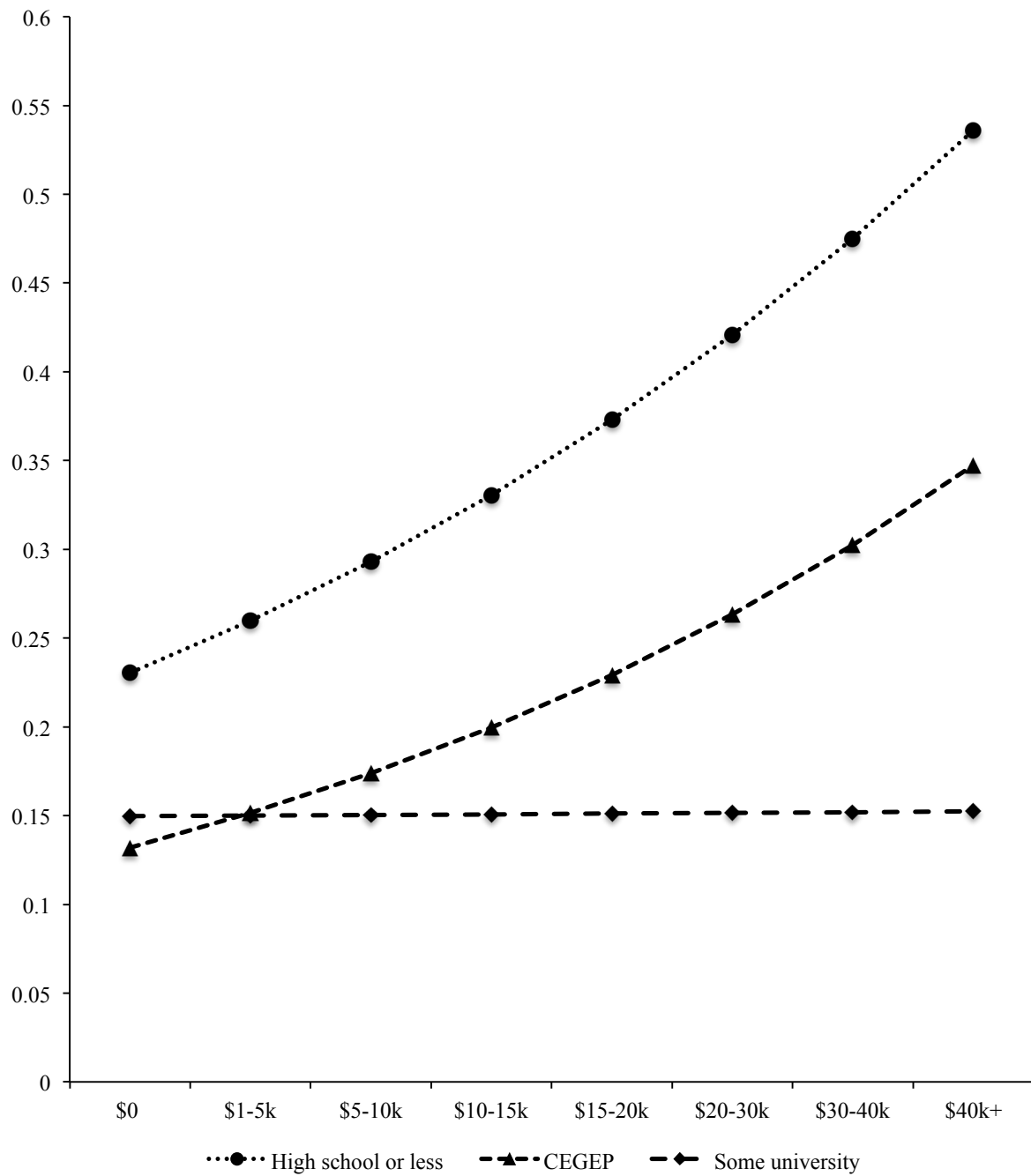
### **Changes in the associations between young adults' circumstances and smoking: educational attainment as a case example**

After examining the main associations of young adults' resources and transition stages with smoking, we then examined whether the association between participants' educational attainment and smoking was further modified in keeping with other resources and transition stages. Examining the statistical significance of interaction terms and predicted probabilities, we found that the association of four socioeconomic characteristics modified the association of education with smoking: personal income, partner's capacity to provide money in case of emergency, student status, and relationship status. Detailed results are available in Supplementary Tables 2 and 3.

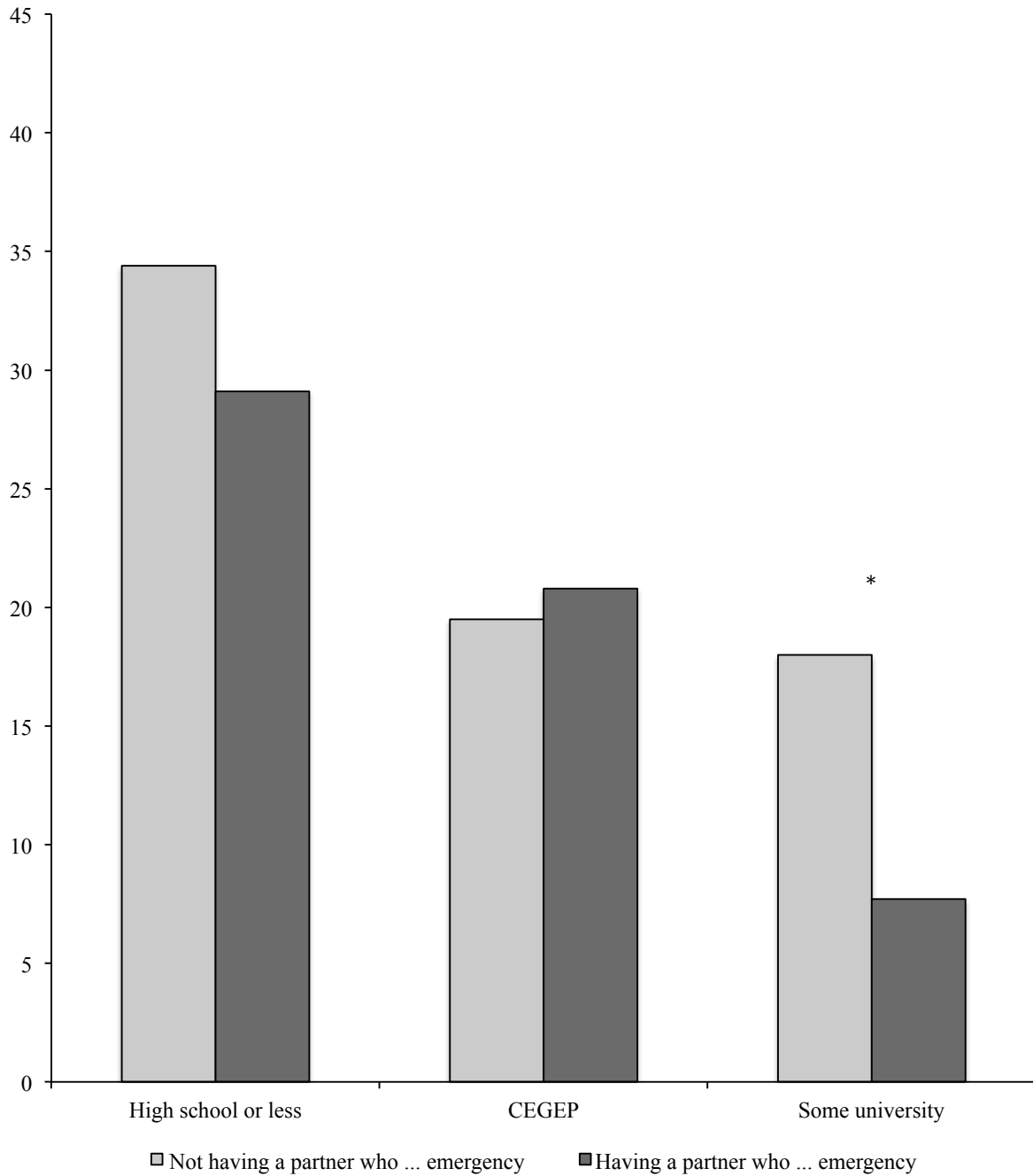
We first found that the association between personal income and smoking was strong among participants who did not pursue post-secondary education and among those who completed CEGEP, but absent among those with some university completed (see Figure 1). Among participants who completed high school or less, those without income had a 22.8% (95% CI 17.5–28.2) probability of reporting smoking while those earning \$40,000 or more per year had a 54.0% (95%CI 38.3–69.6) probability of reporting smoking (relative  $\Delta = 2.3$ ; marginal effect per bracket = 4.0 p.p.,  $p < .001$ ). Among those who had completed CEGEP education, those without income had a 13.2% (95%CI 9.2–17.1) probability of reporting smoking and those earning \$40,000 or more per year had a 34.8% (95%CI 23.2–46.5) probability of reporting smoking (relative  $\Delta = 2.6$ ; marginal effect per bracket = 2.8 p.p.,  $p = .001$ ). Among participants who completed some university, those without income had a 15.0% (95%CI 9.0–21.0) probability of reporting smoking and those earning \$40,000 or more per year had a 15.4% (95%CI 8.7–22.0) probability of reporting smoking (relative  $\Delta = 1.0$ ; marginal effect per bracket = 0.0 p.p.,  $p = .93$ ).

Regarding participants' partner's capacity to provide money in case of emergency, while there was no significant association in the first analytic step, we found that it was significantly associated with smoking among participants who had completed some university (see Figure 2). In this group, participants who reported having a partner who could provide them money

**FIGURE 1 Predicted probabilities of smoking: Interaction between education and personal income. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( $n = 2,083$ )**

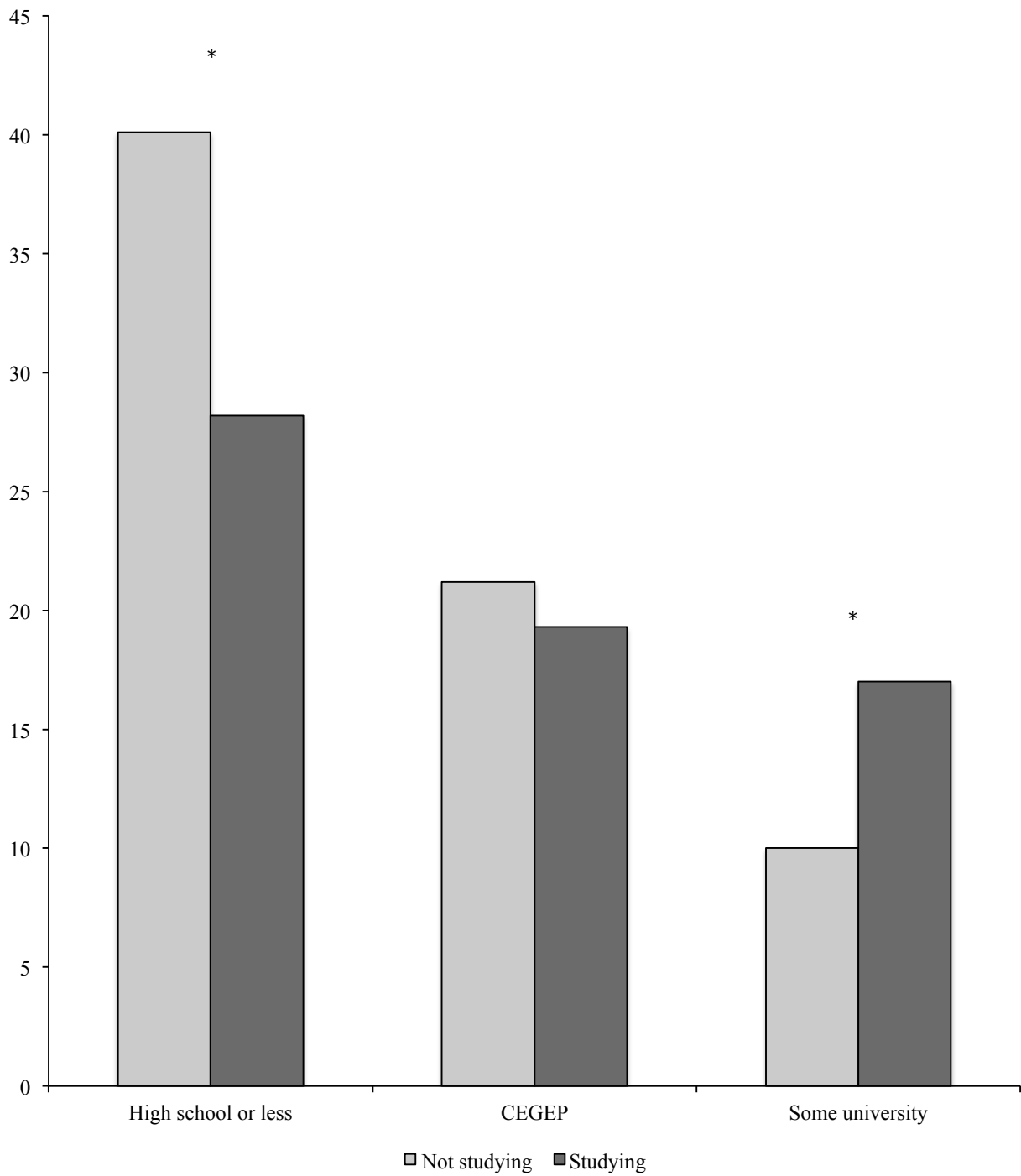


**FIGURE 2 Predicted probabilities of smoking: Interaction between education and partner's capacity to provide money in case of emergency. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. (*n* = 2,083)**

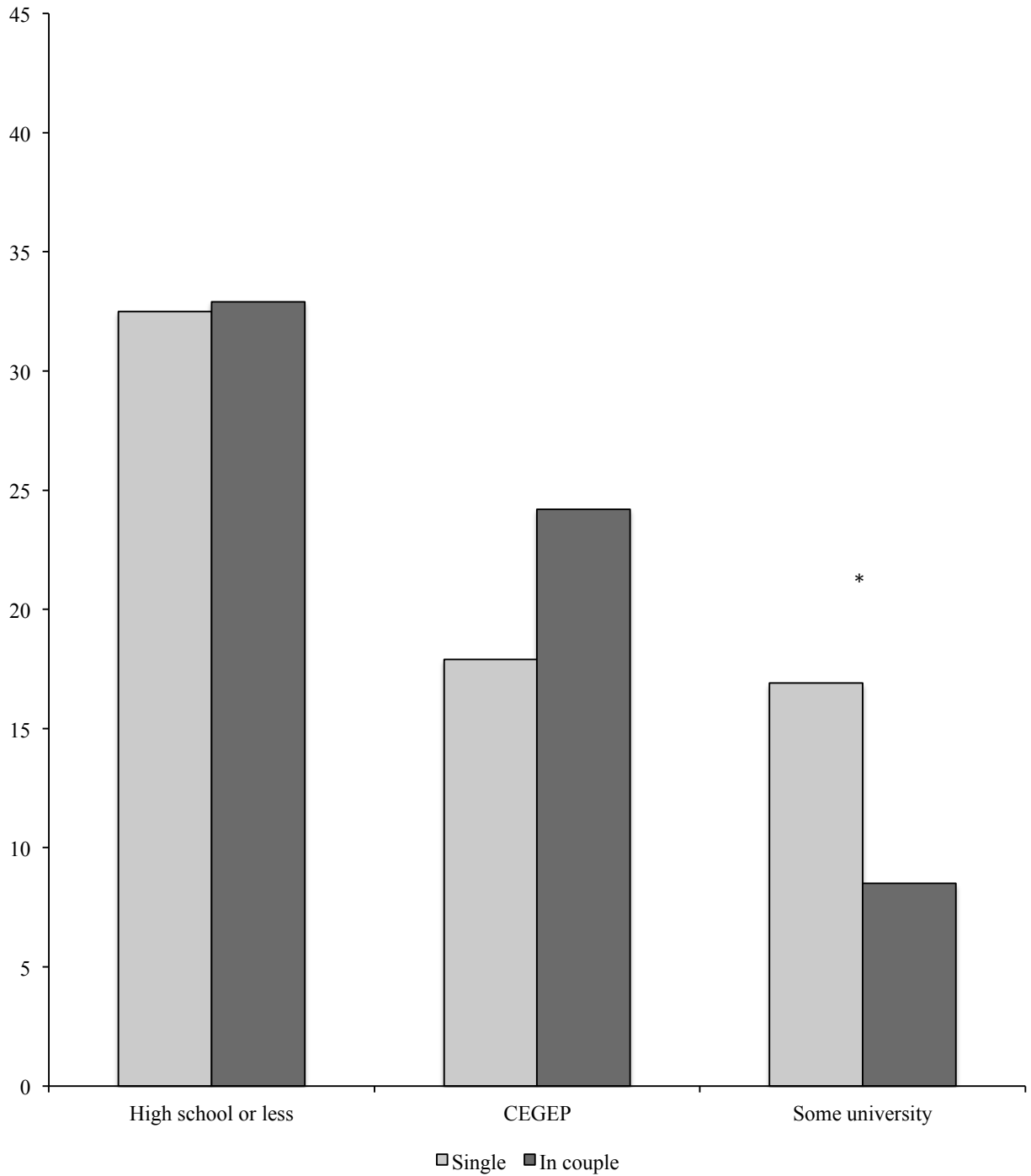




**FIGURE 3 Predicted probabilities of smoking: Interaction between education and student status. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012 (n = 2,083)**



**FIGURE 4 Predicted probabilities of smoking: Interaction between education and relationship status. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. (*n* = 2,083)**



had a 7.7% (95%CI 4.0–11.4) probability of reporting smoking while those who did not report having a partner who could provide them money had a 18.0% (95%CI 13.5–22.5) probability of reporting smoking (relative  $\Delta = 2.3$ ; marginal effect = -10.3 p.p.,  $p < .001$ ).

With regard to student status, while there was no significant association in the full model in the first analytic step, we found that it was associated with smoking in opposite directions among participants who completed high school or less and those who completed some university (see Figure 3). Among participants who completed high school or less, those who were not studying had a 40.1% (95%CI 33.5–46.6) probability of reporting smoking while those who were still studying had a 28.2% (95%CI 23.4–33.0) probability of reporting smoking (relative  $\Delta = 0.7$ ; marginal effect = -11.9 p.p.,  $p = .005$ ). Among participants who completed some university, those who were not studying had a 10.0% (95%CI 5.8–14.3) probability of reporting smoking while those who were still studying had a 17.0% (95%CI 12.6–21.4) probability of reporting smoking (relative  $\Delta = 1.7$ ; marginal effect = 7.0 p.p.,  $p = .02$ ).

Finally, we found a similar result between educational attainment and relationship status to the result found with participants' partner's capacity to provide money in case of emergency. While there was no significant association of relationship status on smoking in the first analytic step, we found that it was significantly associated with smoking among participants who completed some university (see Figure 4). In this group, participants who reported being in a relationship had a 8.5% (95%CI 4.4–12.7) probability of reporting smoking while those who did not had a 16.9% (95%CI 12.7–21.2) probability of reporting smoking (relative  $\Delta = 2.0$ ; marginal effect = -8.4 p.p.,  $p = .005$ ).

## **DISCUSSION**

We argued that the study of social inequalities in health during young adulthood faced a dearth of theoretical foundations and methodological guidelines. In response, we proposed a theoretically informed operationalization of young adults' socioeconomic circumstances

through the configuration of economic, social, and cultural resources and the transition stages through education, employment, family, and housing that young adults experience. Our findings support that 1) young adults' economic, social, and cultural resources and transition stages are each associated with health behaviour uptake and 2) socioeconomic characteristics are unlikely to have only a direct influence on health behaviour uptake because their influence is likely to be modified in keeping with the other resources and transition stages concurrently experienced.

Congruent with the scholarship on the mechanisms linking education and health behaviours (Cutler & Muney-Llunas 2010, Pampel, Denney & Krueger 2010), we found that educational attainment was one of the strongest characteristics associated with smoking in our sample. Furthermore, this association was not attenuated by adjusting for participants' other resources and transition stages. This supports that educational attainment retains a strong and distinct influence on health behaviour uptake beyond its financial, occupational, and social benefits during young adulthood (Lawrence 2017). Findings, however, support our argument that multiple other facets of young adults' socioeconomic circumstances are relevant in better understanding the unequal distribution of smoking during the transition towards adulthood.

In our "main effects" model, critical explanatory variables included having a higher personal income, financial difficulties, and living arrangements with parents and children, most of which have already been related to smoking uptake during young adulthood (Mendel et al. 2012, Stone et al. 2012, Widome et al. 2015). However, our study found a positive relationship between young adults' personal income and smoking status, likely because those who have a higher disposable income are more likely to be able to access and purchase cigarettes during this period. Thus, the established negative association between household income and smoking in the general population (Casetta et al. 2016) does not appear to hold for personal income during young adulthood, as was suggested previously (Blakely et al. 2014, Pampel et al. 2014). There is, however, no study that we know of that has specifically investigated this inversion across the life-course.

Squarely leading us into our second objective, we found that the results in our “main effects” model had masked important differences across education groups. Our capacity to disentangle the importance of young adults’ resources and transition stages was strengthened by examining how these contribute to modify the influence of educational attainment on smoking. Our study underlined this principle by finding that as young adults’ educational attainment increased, it suppressed the negative influence of having a higher income on their risk of smoking, changed the direction of the influence of being a student on their risk of smoking from positive to negative, and enabled the positive influence of having a partner who could provide money and being in a serious relationship on their risk of smoking.

This finding was best exemplified by the interaction between participants’ personal income and educational attainment, where those in lower education categories showed an income gradient in smoking that was completely absent among those who completed some university. This highlights that, while directly enabling young adults’ capacity to purchase cigarettes, the importance of having a higher disposable income is also strongly conditioned on young adults’ cultural disposition towards smoking as a social practice. From a public health perspective, this theoretically informed approach to understanding the influence of economic resources is likely to inspire better-targeted interventions towards curbing inequalities in smoking during young adulthood.

We also observed ‘conditional’ associations with regard to the interactions of two relationship characteristics with educational attainment, finding that participants who completed some university reported an excess lower risk of smoking if they reported being in a serious relationship or having a partner who could financially support them when compared to those in lower education categories. Other studies have found similar results in the adult population. For instance, Christakis & Fowler (2008) found that American adults were more likely to cease smoking if a peer had previously quit, but only if both of them had completed high school. Similarly, Takagi and colleagues (2014) found that married Japanese women were more likely to quit smoking if their husband had previously quit, but only if both of them had completed college. This suggests that higher education and homogamy might further enable young adults’ capacity to use their partner (or seek a new partner) to promote their health. This

finding also reinforces the argument that young adults who transition out of education at this point might be more willing to pursue a long-term relationship and adhere to adult family roles, which are associated with smoking cessation (Bricard et al. 2017).

Finally, the interaction between education and student status adds support to the limitations that measure of the highest diploma obtained represents for studying the influence of the dynamic education trajectories during this period (Gagné et al. 2016). Our results suggest that it is young adults who transition away from education at the end of compulsory schooling that suffer the highest risk of smoking. On the other hand, we also found that student status was inversely associated with a higher risk of smoking among those who completed some university, suggesting that delaying the transition out of education might also be associated with a higher risk of smoking. Tobacco experts have also suggested that young adults who do not initiate before the age of 18 could be more likely to experiment during post-secondary education as they interact in new leisure settings with positive smoking norms and seek new peers and relationships (Green et al. 2007, Terry-McElrath & O'Malley 2015).

### **Limitations**

Before concluding, three main limitations are addressed here. First, cross-sectional designs cannot disentangle reverse causality or unobserved confounding, meaning that we cannot claim causal relations from our results. Second, whereas results may be representative of urban areas similar to Montreal (i.e regions in developed countries with similar education systems and outcomes), they may not be generalizable to other regions with different contexts. Finally, our sample was found to be slightly more educated than the average in Montreal, Canada (Frohlich et al. 2017), meaning that our results might underestimate the importance of educational attainment and other socioeconomic characteristics on smoking.

### **Conclusion**

Young adulthood is increasingly recognized as a distinct period uniquely contributing to the development of social inequalities in health across the life-course. Conventional approaches to the study of socioeconomic circumstances in the general population are limited when attempting to understand social inequalities in health in this age group. Our findings support

the idea that young adults' resources and transition stages are intertwined in producing the unequal distribution of health behaviours such as smoking during the transition towards adulthood. We hope that our work inspires others to study the extent of young adults' socioeconomic circumstances and to better understand how they may be jointly contributing to the unequal uptake of health practices during this period.

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**SUPPLEMENTARY TABLE 1 Results from models with interaction terms. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. (n = 2,083)**

Variable	Interaction term		
	PR	95% CI	<i>p</i>
<b>Personal annual income * Less than High School</b>	<b>1.13</b>	<b>(1.01-1.26)</b>	<b>.03</b>
<b>Personal annual income * CEGEP</b>	<b>1.14</b>	<b>(1.02-1.29)</b>	<b>.02</b>
Financial difficulties * Less than High School	0.76	(0.43-1.36)	.36
Financial difficulties * CEGEP	0.74	(0.39-1.42)	.37
Father's ability to provide \$500 * Less than High School	0.79	(0.44-1.41)	.43
Father's ability to provide \$500 * CEGEP	1.03	(0.55-1.91)	.93
Mother's ability to provide \$500 * Less than High School	1.28	(0.75-2.19)	.38
Mother's ability to provide \$500 * CEGEP	1.84	(0.99-3.40)	.05
<b>Partner's ability to provide \$500 * Less than High School</b>	<b>1.97</b>	<b>(1.10-3.52)</b>	<b>.02</b>
<b>Partner's ability to provide \$500 * CEGEP</b>	<b>2.50</b>	<b>(1.39-4.49)</b>	<b>.002</b>
Friends' ability to provide \$500 * Less than High School	1.01	(0.62-1.64)	.98
Friends' ability to provide \$500 * CEGEP	0.96	(0.57-1.60)	.86
Family's ability to provide a job contact * Less than High School	0.85	(0.65-1.11)	.23
Family's ability to provide a job contact * CEGEP	0.85	(0.64-1.13)	.28
Social network size * Less than High School	1.03	(0.96-1.10)	.42
Social network size * CEGEP	1.04	(0.97-1.12)	.30
Living with your parents * Less than High School	0.91	(0.54-1.54)	.72
Living with your parents * CEGEP	0.71	(0.42-1.21)	.21
<b>Studying * Less than High School</b>	<b>0.41</b>	<b>(0.25-0.70)</b>	<b>.001</b>
<b>Studying * CEGEP</b>	<b>0.54</b>	<b>(0.31-0.94)</b>	<b>.03</b>
Working full-time * Less than High School	1.62	(0.95-2.75)	.08
Working full-time * CEGEP	1.74	(1.00-3.02)	.05
<b>Being in a relationship * Less than High School</b>	<b>2.01</b>	<b>(1.14-3.56)</b>	<b>.02</b>
<b>Being in a relationship * CEGEP</b>	<b>2.68</b>	<b>(1.50-4.81)</b>	<b>.001</b>

*Interaction terms were added for each 'education-resource' and 'education-transition' after the full model in Table 2.*



**SUPPLEMENTARY TABLE 2 Predicted probabilities from models with interaction terms. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. (n = 2,083)**

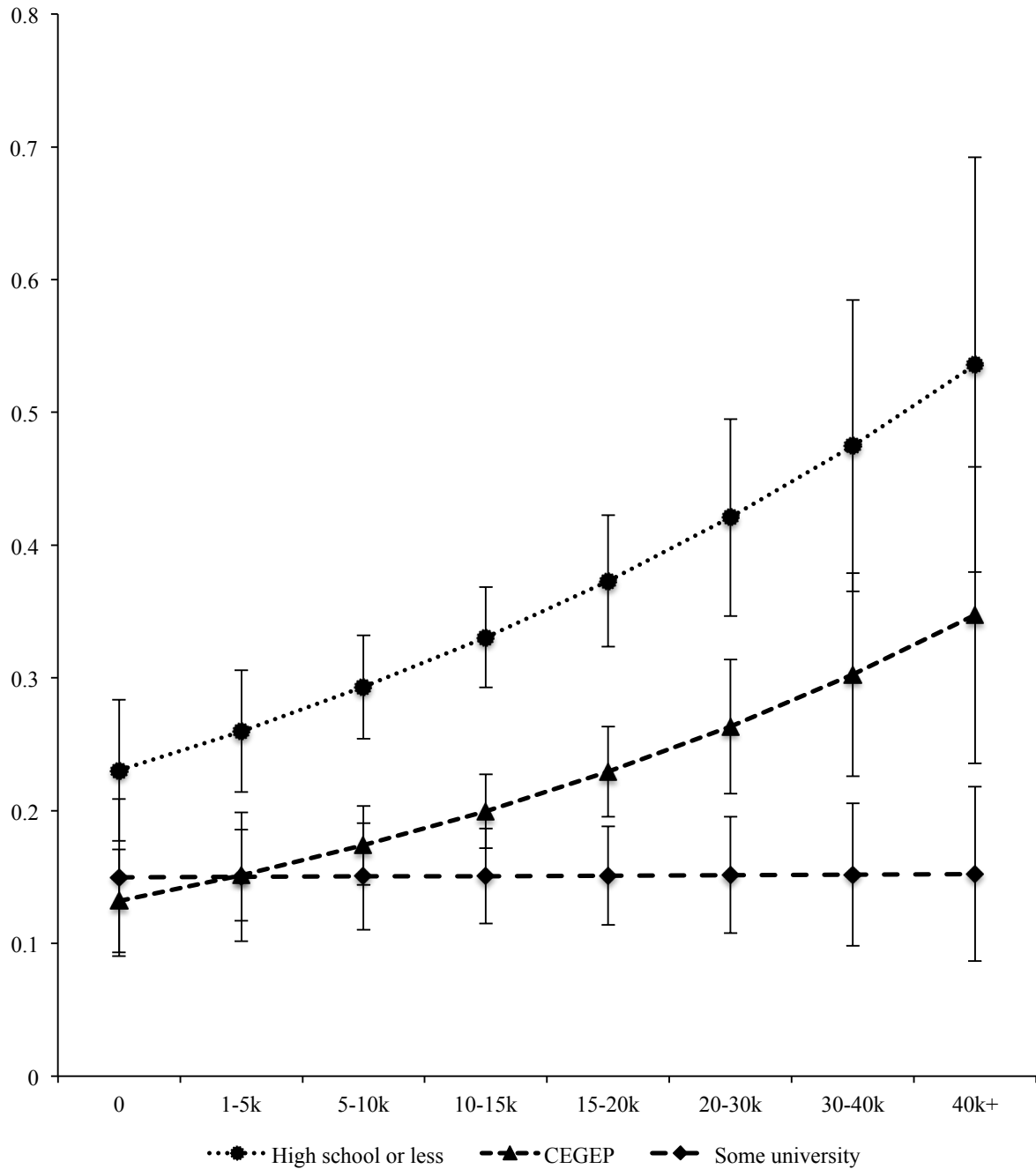
Variable	High school or less		CEGEP		Some university	
	%	95% CI	%	95% CI	%	95% CI
<b>Personal annual income *</b>						
\$0 (minimum)	<b>22.8</b>	<b>(17.5-28.2)</b>	<b>13.2</b>	<b>(9.2-17.1)</b>	15.0	(9.0-21.0)
\$40,000 or more (maximum)	<b>54.0</b>	<b>(38.3-69.6)</b>	<b>34.8</b>	<b>(23.2-46.5)</b>	15.4	(8.7-22.1)
<i>Average marginal effect (p-value)</i>	<b>4.0 (&lt;.001)</b>	<b>(1.8, 6.3)</b>	<b>2.8 (.001)</b>	<b>(1.1, 4.4)</b>	0.0 (.93)	(-1.4, 1.6)
<b>Financial difficulties</b>						
No	31.6	(27.2-35.9)	19.4	(16.5-22.3)	12.6	(9.4-15.9)
Yes	37.9	(29.8-46.1)	22.6	(14.8-30.5)	19.9	(10.5-29.3)
<i>Marginal effect (p-value)</i>	6.3 (.18)	(-2.8, 15.5)	3.3 (.45)	(-5.2, 11.7)	7.3 (.15)	(-2.5, 17.1)
<b>Father's capacity to provide \$500</b>						
No	37.7	(31.0-44.4)	19.5	(14.2-24.9)	13.6	(7.0-20.2)
Yes	29.7	(25.0-34.4)	20.1	(16.8-23.3)	13.6	(10.1-17.0)
<i>Marginal effect (p-value)</i>	-8.0 (.06)	(-16.1, 0.0)	0.1 (.87)	(-5.9, 7.0)	0.0 (.99)	(-7.4, 7.3)
<b>Mother's capacity to provide \$500</b>						
No	32.6	(26.2-39.1)	15.2	(10.1-20.4)	16.9	(9.4-24.5)
Yes	32.2	(27.5-36.9)	21.7	(18.3-25.0)	13.1	(9.7-16.5)
<i>Marginal effect (p-value)</i>	-0.4 (.92)	(-8.4, 7.5)	6.4 (.05)	(0.1, 12.7)	-3.8 (.35)	(-12.0, 4.3)
<b>Partner's capacity to provide \$500</b>						
No	34.4	(29.4-39.4)	19.5	(16.0-23.0)	<b>18.0</b>	<b>(13.5-22.5)</b>
Yes	29.1	(22.1-36.1)	20.8	(15.9-25.8)	<b>7.7</b>	<b>(4.0-11.4)</b>
<i>Marginal effect (p-value)</i>	-5.3 (.25)	(-14.4, 3.7)	1.4 (.68)	(-5.1, 7.8)	<b>-10.3 (&lt;.001)</b>	<b>(-16.0, -4.5)</b>
<b>Friends' capacity to provide \$500</b>						
No	31.2	(26.5-36.0)	19.6	(15.8-23.4)	13.2	(8.6-17.8)
Yes	34.3	(28.2-40.4)	20.5	(16.4-24.5)	14.4	(10.2-18.6)
<i>Marginal effect (p-value)</i>	3.1 (.43)	(-4.5, 10.6)	0.8 (.78)	(-4.9, 6.5)	1.2 (.70)	(-4.8, 7.1)
<b>Family's capacity to provide a job contact *</b>						

Not at all... (minimum)	29.9	(22.5-37.2)	18.3	(12.4-24.3)	9.3	(4.4-14.3)
Most probably (maximum)	34.2	(28.3-40.1)	21.2	(16.6-25.7)	17.3	(11.5-23.1)
<i>Average marginal effect (p-value)</i>	1.5 (.43)	(-2.2, 5.2)	1.0 (.54)	(-2.1, 4.0)	2.9 (.10)	(-0.6, 6.3)
 Social network size *						
0 (minimum)	33.9	(24.3-43.5)	18.6	(10.9-26.3)	19.5	(10.9-26.3)
15 (maximum)	32.1	(26.6-37.6)	20.7	(16.3-25.1)	12.1	(7.9-16.4)
<i>Average marginal effect (p-value)</i>	-0.1 (.78)	(-9.5, 7.1)	0.1 (.71)	(-6.0, 8.8)	-0.4 (.34)	(-13.6, 4.7)
 Living with your parents						
No	37.9	(28.1-47.7)	<b>27.9</b>	<b>(20.8-35.1)</b>	15.5	(10.0-21.1)
Yes	30.6	(26.4-34.7)	<b>17.6</b>	<b>(14.6-20.7)</b>	13.8	(9.6-17.9)
<i>Marginal effect (p-value)</i>	-7.3 (.19)	(-18.2, 3.5)	<b>-10.3 (.01)</b>	<b>(-18.4, -2.3)</b>	-1.7 (.62)	(-8.6, 5.1)
 Studying						
No	<b>40.1</b>	<b>(33.5-46.6)</b>	21.2	(15.6-26.7)	<b>10.0</b>	<b>(5.8-14.3)</b>
Yes	<b>28.2</b>	<b>(23.4-33.0)</b>	19.3	(16.0-22.6)	<b>17.0</b>	<b>(12.6-21.4)</b>
<i>Marginal effect (p-value)</i>	<b>-11.9 (.005)</b>	<b>(-20.2, -3.6)</b>	-1.9 (.58)	(-8.6, 4.8)	<b>7.0 (.02)</b>	<b>(1.1, 12.9)</b>
 Working full-time						
No	32.5	(27.9-37.1)	19.5	(16.1-22.9)	16.4	(11.9-20.8)
Yes	33.1	(25.0-41.2)	21.3	(15.6-27.1)	10.3	(6.0-14.6)
<i>Marginal effect (p-value)</i>	0.6 (.90)	(-9.1, 10.3)	1.8 (.61)	(-5.2, 8.9)	-6.0 (.05)	(-12.2, 0.8)
 Being in a relationship						
No	32.5	(27.9-37.2)	17.9	(14.5-21.2)	<b>16.9</b>	<b>(12.7-21.2)</b>
Yes	32.9	(25.9-40.0)	24.2	(18.7-29.6)	<b>8.5</b>	<b>(4.4-12.7)</b>
<i>Marginal effect (p-value)</i>	0.4 (.92)	(-8.1, 8.9)	6.3 (.07)	(-0.4, 13.0)	<b>-8.4 (.005)</b>	<b>(-14.2, -2.5)</b>

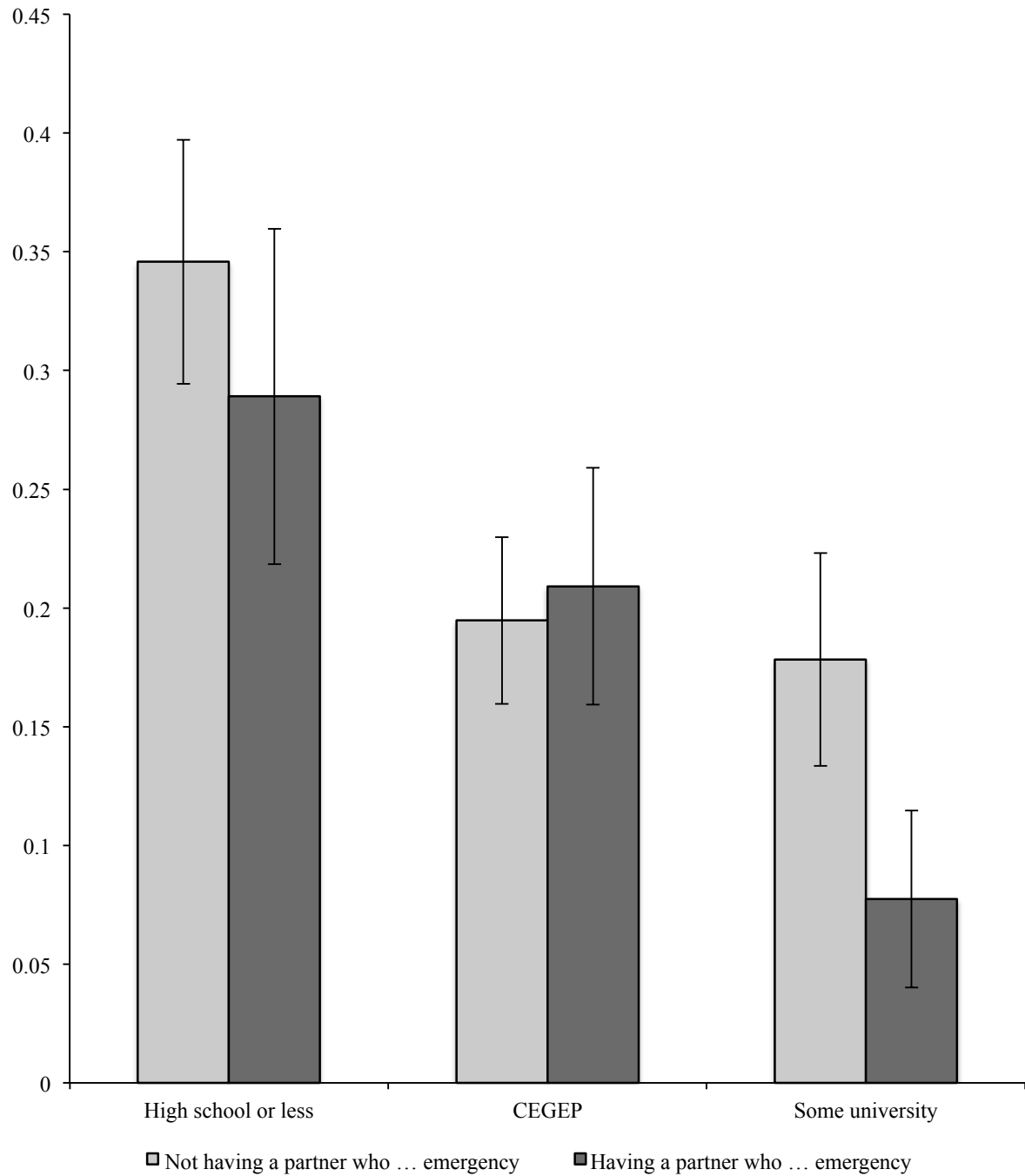
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\* *Continuous variables*

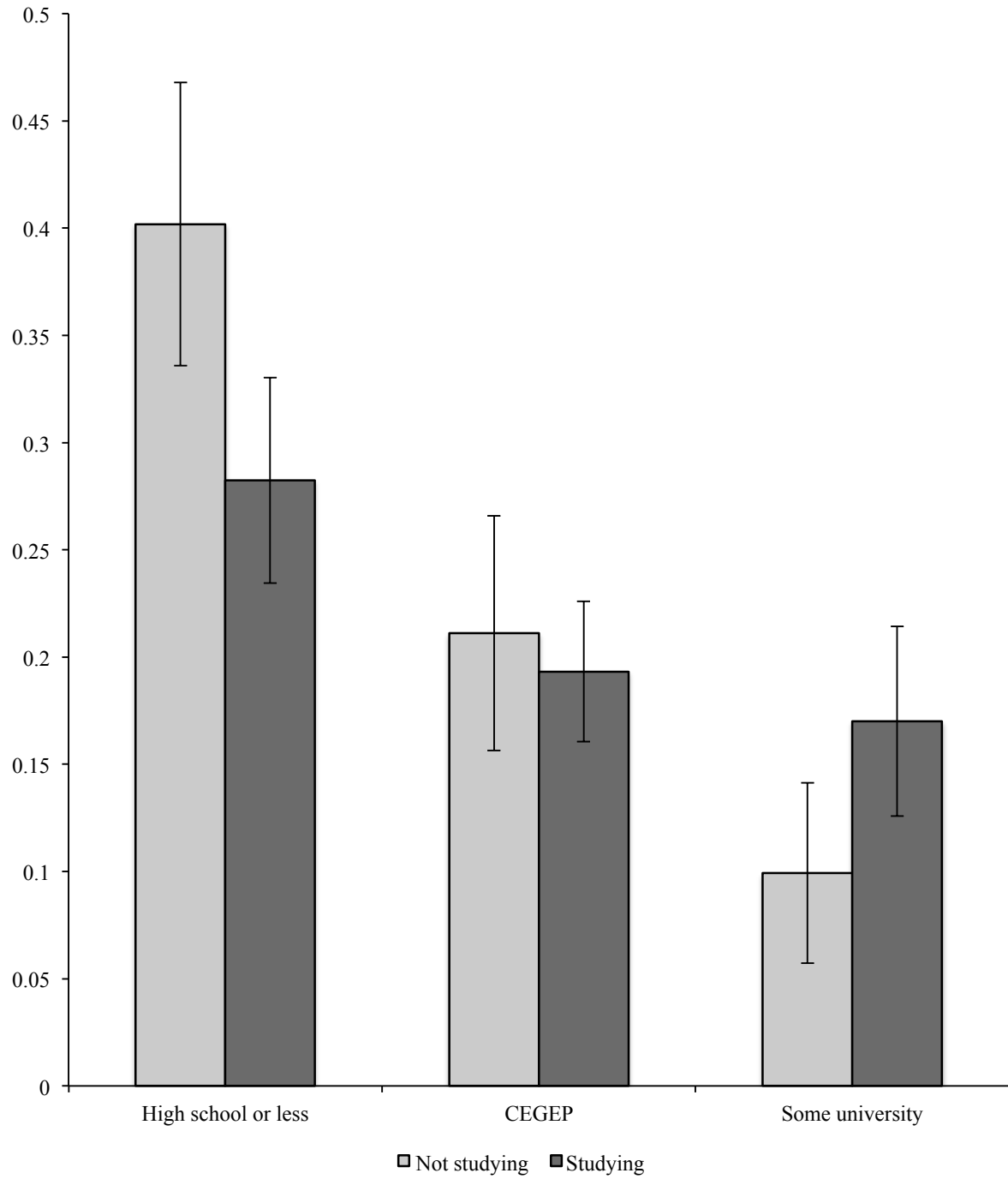
**SUPPLEMENTARY FIGURE 1 Predicted probabilities of smoking: Interaction between education and personal income (with 95% confidence intervals). Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. ( $n = 2,083$ )**



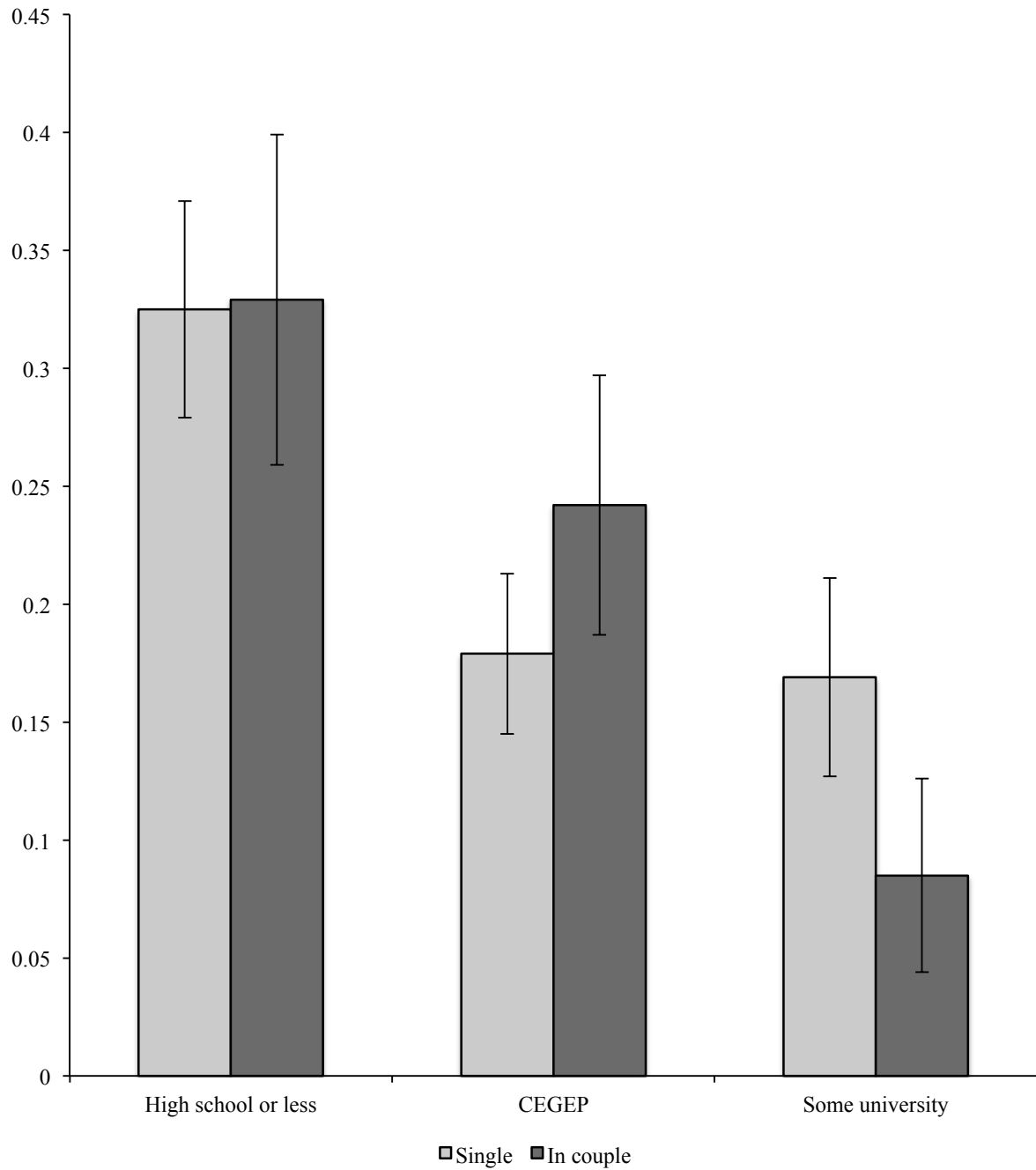
**SUPPLEMENTARY FIGURE 2 Predicted probabilities of smoking: Interaction between education and partner's capacity to provide money in case of emergency (with 95% confidence intervals). Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. (*n* = 2,083)**



**SUPPLEMENTARY FIGURE 3 Predicted probabilities of smoking: Interaction between education and student status (with 95% confidence intervals). Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. (*n* = 2,083)**



**SUPPLEMENTARY FIGURE 4** Participants' probabilities of smoking: Interaction between education and relationship status (with 95% confidence intervals). Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. (*n* = 2,083)



**ARTICLE 3. Considering the Age-Graded Nature of Associations  
Between Socioeconomic Characteristics and Smoking During the  
Transition Towards Adulthood**

**Under review in Preventive Medicine**

**TITLE**

Considering the Age-Graded Nature of Associations Between Socioeconomic Characteristics and Smoking During the Transition Towards Adulthood

**AUTHORS**

Thierry Gagné<sup>1,2</sup>, Amélie Quesnel-Vallée<sup>3,4</sup>, Katherine L. Frohlich<sup>1,2</sup>

<sup>1</sup> Institut de Recherche en Santé Publique de l'Université de Montréal (IRSPUM), Canada

<sup>2</sup> Département de médecine sociale et préventive, École de santé publique de l'Université de Montréal (ESPUM), Canada

<sup>3</sup> Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Canada

<sup>4</sup> Department of Sociology, McGill University, Canada

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**NUMBER OF FIGURES:** 4

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## ABSTRACT

**Background.** Young adulthood is a sensitive period characterized by the accumulation of resources and transitions in and out of education, employment, family, and housing arrangements. Associations between these characteristics and smoking are likely to vary by age yet few studies address its dynamic age-graded nature. **Methods.** We examined 2,083 young adults ages 18–25 from the Montreal *Interdisciplinary Study of Inequalities in Smoking*. We operationalized participants' socioeconomic characteristics using their resources (e.g., education, income, financial difficulties) and transition stages (i.e., studying, working full-time, living arrangements with parents and children, and being in a relationship). We examined differences in associations across two-year categories (18–19, 20–21, 22–23 and 24–25) by comparing marginal probabilities from models with age-based interaction terms. **Results.** Four characteristics, i.e., education, income, studying, and working full-time, had significant differences in associations with smoking across age categories. The influence of having completed post-secondary education on smoking increased from -8.9 p.p. to -21.0 p.p. between the ages of 18–19 and 24–25. The influences of a \$5,000 increase in income, studying, and working full-time on smoking were strong between the ages of 18 and 21 but disappeared between the ages of 22 and 25, varying from 3.6 p.p. to 1.2 p.p., from -10.1 p.p. to 1.0 p.p., and from 6.0 p.p. to -5.2 p.p., respectively. **Conclusions.** Associations between young adults' socioeconomic characteristics and smoking vary substantially during the second and third decades of life. Addressing this has critical implications for identifying vulnerable populations and developing appropriate age-based policies in this age group.

## KEYWORDS

Canada; Young Adults; Transition towards adulthood; Socioeconomic Factors; Smoking

## **TITLE**

Considering the Age-Graded Nature of Associations Between Socioeconomic Characteristics and Smoking During the Transition Towards Adulthood

## **INTRODUCTION**

Young adulthood represents a distinct public health target.<sup>1,2</sup> As a case example, smoking prevalence is higher among young adults than in any other age group in Canada.<sup>3</sup> Despite successes among youth and adult populations, smoking initiation and cessation rates in this age group have been stagnating in the last fifteen years.<sup>3,4</sup> Smoking is also disproportionately distributed among disadvantaged young adults in keeping with their family background, trajectory in education and occupation, and family and housing arrangements.<sup>4-6</sup> In turn, young adulthood and equity considerations have been considered as two key priority areas for future tobacco control initiatives.<sup>7,8</sup>

Few studies, however, question the implications of the deeply dynamic nature of the transition towards adulthood. In comparison to those who have just turned eighteen, young adults who end their third decade of life are likely to experience substantially different circumstances with regard to education, employment, family, and housing.<sup>9,10</sup> Despite this, multiple expert reports and peer-reviewed publications examine the unequal distribution of smoking in this age group using average estimates across broad age categories (e.g., 18–29), obfuscating the important and quickly changing processes occurring during this period. These processes hold important implications for our capacity to detect the most vulnerable groups and support appropriate age-based public health policies during this period.<sup>2,11</sup> A critical issue in understanding the unequal distribution of young adult smoking outcomes, therefore, resides in our capacity to appropriately demonstrate its age-graded distribution.

A large scholarship has already investigated these age-based changes during young adulthood by focussing on the implication of transition stages for risk-taking behaviour uptake.<sup>12-14</sup>

These include finishing studies, entering full-time employment, leaving parents, establishing relationships, and having children.<sup>9,10</sup> On one hand, transition stages have been conceptualized as difficult, complex, and stress-inducing events that influence those with the least resources to seek deleterious coping strategies.<sup>12,14</sup> On the other hand, transitions stages have also been conceptualized to represent adult roles (e.g., worker, husband/spouse, parent) associated with the uptake of beneficial health practices.<sup>12-15</sup>

In both cases the health implications of these transition stages have been shown to depend in large part on their age-graded timing.<sup>13,16,17</sup> Demonstrating this in the US Add Health study, Wickrama & Baltimore (2010) found that transitions before the median age in education, full-time work, sexual activity, leaving home, cohabitation, and pregnancy were each independently associated with a higher risk of smoking between the ages of 24 and 32.<sup>18</sup> Further supporting this, Green and colleagues (2017) found that, adjusting for the selection of socioeconomic groups into different transition trajectories, young British adults who delayed their transition out of education until the age of 21 had the lowest risk of smoking at age 26 while those who already transitioned in employment, partnership, and parenthood had the highest risk of smoking at this age.<sup>14</sup> While most studies have focused on the determinants and implications of precocious transitions,<sup>19,20</sup> these transitions also negatively influence smoking uptake when they occur later than average. Illustrating this, Pampel and colleagues (2014) found that young American adults who delayed employment after finishing their studies and delayed marriage after having children faced an excess risk of smoking upon ending their third decade of life.<sup>13</sup> In each case, socially disadvantaged young adults are disproportionately likely to experience these transition stages precociously or belatedly.<sup>21,22</sup>

These life-course principles are likely to extend to the age-graded nature of social inequalities in smoking during young adulthood. To understand how the “SES-smoking” association vary over time, Link & Phelan (2009) proposed that socioeconomic status provides access to different resources (e.g., knowledge, money, power, prestige, and beneficial social connections) reinforcing individuals’ capacity to avoid smoking.<sup>23</sup> To operationalize these, studies on social inequalities in smoking have predominantly focused on indicators such as education, occupation, income, and wealth.<sup>24</sup> As individuals become autonomous and

accumulate their own resources after the end of adolescence, we expect these to become more important in shaping their behaviour. Illustrating this, Siegel (2014) examined in Germany income-based inequalities in smoking across the life-course and found that these increased among men during the third decade of life.<sup>25</sup> Similarly, studies in France and the United States examined education-based inequalities in smoking across the life-course and found that these increased rapidly at the end of adolescence to stabilize during the third decade of life.<sup>26-28</sup> Few studies, however, have examined in finer detail the age-graded nature of the associations between these traditional indicators and smoking during the transition towards adulthood.

### **Objective**

Social inequalities in smoking are likely to rapidly vary with age as socially disadvantaged young adults face repeated obstacles to transitioning “in time” and accumulating resources into adulthood. This paper, therefore, seeks to demonstrate the age-graded nature of associations between socioeconomic circumstances and smoking in relation to the transition towards adulthood. To do so, we examine differences across two-year categories in the associations of young adults’ transition stages and socioeconomic resources with smoking in a large sample of young adults aged 18-25 in Montreal, Canada.

## **METHODS**

### **Data**

We analyzed cross-sectional data from the 2011–2012 panel of the *Interdisciplinary Study of Inequalities in Smoking* (ISIS), a study developed with the objective of better understanding the joint contribution of individual and contextual factors in shaping social inequalities in smoking among young adults in an urban context.<sup>29</sup> The target population was non-institutionalized young adults aged 18 to 25 living in Montreal, Canada who had resided at their current address for at least one year at the time of the first contact. From an initial sample of 6,020 randomly selected individuals from the Quebec provincial health insurance program, 349 had refused to participate, 458 were declared ineligible, and 3,111 could not be reached, for a total sample size of 2,093 participants. Full details on sampling and survey procedures

are available elsewhere.<sup>29</sup> This study received ethics approval from the Université de Montréal health research ethics board.

### **Measures**

Our main dependant variable is current smoking status (Y/N), assessed by asking respondents whether they currently smoked ‘every day’, ‘occasionally’ or ‘never’. Those who smoked daily or occasionally were considered to be ‘current smokers’ while ‘non-smokers’ consisted of never smokers and former smokers.

Our main independent variables represent participants’ resources and transition stages. To operationalize participants’ resources, we used nine indicators related to their education, personal income, financial difficulties, the capacity of their father, mother, friend, and/or partner to provide money in case of emergency, the capacity of their family to provide a job-related contact, and the size of their social support network. Educational attainment was measured asking ‘What is the highest diploma you have ever obtained?’ and was subsequently divided into two categories: ‘High school completed or less’ and ‘post-secondary education completed’. Personal income was measured by asking participants’ income over the last year and was recoded into six categories to prevent outliers (No income, \$1 to \$4,999, \$5,000 to \$9,999, \$10,000 to \$14,999, \$15,000 to \$19,999, \$20,000 or more). Financial difficulties was measured based on three items asking if participants’ household encountered difficulties in paying for rent, utilities, or food in the last year ( $\alpha = .74$ ) (Y/N). Participants were categorized as having a father, mother, friend, or partner who could provide money in case of emergency based on the question “If you needed money urgently, could you borrow \$500 quickly from the following persons?” (Y/N). Family’s capacity to provide a job-related contact was measured by asking “If needed, can anyone in your family put you in contact with people who can help you improve your employment situation?” using a 4-point Likert scale (‘Not at all’ to ‘Most probably’). Social support network size is a continuous score computed as the sum of three items asking participants how many friends they could confide in, could receive help from, and felt close to ( $\alpha = .74$ , range = 0 – 15).

To operationalize participants' transition stages, we examined five indicators related to their living arrangements with parents and children, their student status, their full-time employment status, and their relationship status, based on the following questions: "Who do you currently live with?" (with one of or both my parents, Y/N; with my children or my partner's children, Y/N), "Are you currently a student?" (Y/N), "If you are currently in paid employment, are you working full-time?" (Y/N), and "What is your marital status?" (married or in couple, Y/N).

### **Statistical analyses**

We used a three-step approach to examine differences in associations between participants' socioeconomic characteristics and smoking status between the ages of 18–19, 20–21, 22–23, and 24–25. First, we estimated a Poisson regression model with a robust variance estimator where we regressed smoking status on the fourteen socioeconomic variables, controlling also for age and sex.<sup>30</sup> Second, from this base full model, we entered interaction terms with age for each socioeconomic variable separately. Finally, from each of these interaction models, we estimated their predicted marginal probabilities using the STATA command *margins*.<sup>31</sup>

The description of results focuses on significant interactions but the full results from models with interaction terms and marginal probabilities are made available in Supplementary Tables 1 and 2. Family's capacity to provide a job-related contact, personal income, and social support network size were modeled as continuous variables. We did not test age-based differences in the association of 'living with children' with smoking because an insufficient number of participants ( $n = 51$ ) were living with children to produce reliable estimates.

Given the large number of independent variables, we used a multiple imputation approach assuming data missing-at-random (MAR) to make full use of the sample. We used STATA's implementation of multiple imputation with chained equations (MICE) to create 20 imputed sets using aforementioned variables. We restricted our analyses to participants with valid answers on smoking status ( $n = 2,083$ ). We used  $\alpha = .05$  and  $\alpha = .10$  thresholds to interpret statistical interactions as statistically and marginally significant, respectively. All analyses were performed using STATA 14.<sup>32</sup>

**TABLE 1 Sample characteristics. Interdisciplinary Study of Inequalities in Smoking, Montreal, Canada, 2011-2012. (n = 2,083)**

	Whole sample (n = 2,083)	Ages 18-19 (n = 541)	Ages 20-21 (n = 515)	Ages 22-23 (n = 527)	Ages 24-25 (n = 500)	Missing
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Smoking status						0
Non-Smoker	1,606 (77.1)	426 (78.7)	403 (78.3)	401 (76.1)	376 (75.2)	
Current smoker	477 (22.9)	115 (21.3)	112 (21.7)	126 (23.9)	124 (24.8)	
Sex						0
M	904 (43.4)	<b>263 (51.4)</b>	<b>218 (57.7)</b>	<b>206 (60.9)</b>	<b>217 (56.6)</b>	
F	1,179 (56.6)	<b>278 (48.6)</b>	<b>297 (42.3)</b>	<b>321 (39.1)</b>	<b>283 (43.4)</b>	
Educational attainment						9 (0.4)
High school or less	813 (39.0)	<b>408 (75.6)</b>	<b>185 (36.0)</b>	<b>121 (23.0)</b>	<b>93 (18.8)</b>	
Post-secondary education	1,270 (61.0)	<b>132 (24.4)</b>	<b>329 (64.0)</b>	<b>405 (77.0)</b>	<b>401 (81.2)</b>	
Personal annual income						219 (10.5)
0\$	186 (10.0)	<b>88 (19.0)</b>	<b>52 (11.5)</b>	<b>30 (6.2)</b>	<b>16 (3.4)</b>	
\$1 – \$4,999	417 (22.3)	<b>200 (43.1)</b>	<b>107 (23.6)</b>	<b>73 (15.1)</b>	<b>37 (8.0)</b>	
\$5,000 – \$9,999	442 (23.7)	<b>110 (23.7)</b>	<b>149 (32.9)</b>	<b>119 (24.6)</b>	<b>64 (13.8)</b>	
\$10,000 – \$14,999	303 (16.3)	<b>46 (9.9)</b>	<b>85 (18.8)</b>	<b>101 (20.9)</b>	<b>71 (15.3)</b>	
\$15,000 – \$19,999	145 (7.8)	<b>10 (2.2)</b>	<b>34 (7.5)</b>	<b>56 (11.6)</b>	<b>45 (9.7)</b>	
\$20,000 or more	371 (19.9)	<b>10 (2.2)</b>	<b>26 (5.7)</b>	<b>104 (21.5)</b>	<b>231 (49.8)</b>	
Financial difficulties						187 (8.9)
No	1,586 (83.6)	<b>406 (86.2)</b>	<b>388 (86.0)</b>	<b>399 (80.8)</b>	<b>393 (81.9)</b>	
Yes	310 (16.4)	<b>65 (13.8)</b>	<b>63 (14.0)</b>	<b>95 (19.2)</b>	<b>87 (18.1)</b>	
Father's capacity to provide money in case of emergency						28 (1.3)
No	629 (30.6)	156 (29.3)	152 (29.7)	156 (30.2)	165 (33.3)	
Yes	1,426 (69.4)	377 (70.7)	359 (70.3)	360 (67.8)	330 (66.7)	
Mother's capacity to provide						29 (1.4)

money in case of emergency						
No	543 (26.4)	148 (27.8)	125 (24.5)	129 (25.0)	141 (28.5)	
Yes	1,511 (73.6)	385 (72.2)	286 (75.5)	387 (75.0)	353 (71.5)	
Friends' capacity to lend 500\$ in case of emergency						92 (4.4)
No	1,128 (56.7)	<b>352 (68.8)</b>	<b>287 (58.2)</b>	<b>255 (51.0)</b>	<b>234 (48.1)</b>	
Yes	863 (43.3)	<b>160 (31.2)</b>	<b>206 (41.8)</b>	<b>245 (49.0)</b>	<b>252 (51.9)</b>	
Partner's capacity to lend 500\$ in case of emergency						144 (6.9)
No	1,358 (70.0)	<b>417 (83.4)</b>	<b>342 (72.0)</b>	<b>325 (67.4)</b>	<b>274 (56.8)</b>	
Yes	581 (30.0)	<b>83 (16.6)</b>	<b>133 (28.0)</b>	<b>157 (32.6)</b>	<b>208 (43.2)</b>	
Family's capacity to provide a job-related contact						149 (7.0)
Not at all...	234 (12.1)	<b>45 (9.1)</b>	<b>55 (11.3)</b>	<b>63 (12.9)</b>	<b>71 (15.0)</b>	
Not very...	315 (16.3)	<b>60 (12.2)</b>	<b>69 (14.2)</b>	<b>94 (19.3)</b>	<b>92 (14.2)</b>	
Probably	809 (41.8)	<b>212 (43.1)</b>	<b>209 (43.0)</b>	<b>190 (39.0)</b>	<b>198 (39.0)</b>	
Most probably	579 (29.9)	<b>175 (35.6)</b>	<b>153 (31.5)</b>	<b>140 (28.7)</b>	<b>111 (23.5)</b>	
Size of social support network						0
Mean (SD), range 0-15	10.4 (3.9)	10.2 (3.9)	10.2 (4.0)	10.5 (3.9)	10.6 (3.9)	
Living with parents						106 (5.0)
No	396 (20.0)	<b>10 (1.9)</b>	<b>49 (9.9)</b>	<b>126 (25.5)</b>	<b>211 (46.7)</b>	
Yes	1,581 (80.0)	<b>525 (98.1)</b>	<b>446 (90.1)</b>	<b>369 (74.5)</b>	<b>241 (53.3)</b>	
Studying						22 (1.1)
No	621 (30.1)	<b>79 (14.8)</b>	<b>105 (20.5)</b>	<b>174 (33.5)</b>	<b>263 (53.1)</b>	
Yes	1,440 (69.9)	<b>456 (85.2)</b>	<b>406 (79.5)</b>	<b>346 (66.5)</b>	<b>232 (46.9)</b>	
Working full-time						64 (3.1)
No	1,595 (79.0)	<b>489 (93.1)</b>	<b>450 (90.2)</b>	<b>389 (76.7)</b>	<b>267 (54.7)</b>	
Yes	424 (21.0)	<b>36 (6.9)</b>	<b>49 (9.8)</b>	<b>118 (23.3)</b>	<b>221 (45.3)</b>	
Being in a relationship						4 (0.1)
No	1,427 (68.6)	<b>400 (74.1)</b>	<b>386 (75.1)</b>	<b>361 (68.6)</b>	<b>280 (56.1)</b>	
Yes	652 (31.4)	<b>140 (25.9)</b>	<b>128 (24.9)</b>	<b>165 (31.4)</b>	<b>219 (43.9)</b>	



Living with children						106 (5.0)
No	1,935 (97.4)	<b>540 (100.0)</b>	<b>488 (98.0)</b>	<b>484 (97.8)</b>	<b>423 (93.4)</b>	
Yes	51 (2.6)	<b>0 (0.0)</b>	<b>10 (2.0)</b>	<b>11 (2.2)</b>	<b>30 (6.6)</b>	

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*Differences between bold numbers are statistically significant at the .05 level.*

## RESULTS

### Sample characteristics

Table 1 presents the distribution of participants' smoking status and socioeconomic characteristics. Participants were on average 21.5 years old (SD = 2.3), with being 23% current smokers and 57% women. Smoking status did not significantly vary across age groups (range = 21.3–24.8%). The majority of participants' socioeconomic circumstances, however, varied across age categories ( $p < .05$ ). Compared to participants ages 24-25, those who were ages 18-19 were more likely to have only finished high school or less (75.6% vs 18.8%). Regarding economic resources, they were less likely to have a personal income (81.0% vs 96.6%) and to have a friend (31.1% vs 51.9%) or a partner (16.6% vs 43.2%) from whom they could borrow \$500 in case of an emergency, but also less likely to have experienced financial difficulties in the last year (13.8% vs 18.1%). With regard to transition stages, they were more likely to be living with parents (98.1% vs 53.3%) and studying (85.2% vs 46.9%), and less likely to be working full-time (6.9% vs 45.3%), being in a relationship (25.9% vs 43.9%), and living with children (0% vs 6.6%).

### Age-based differences in associations between young adults' socioeconomic circumstances and smoking

In the base full model, four socioeconomic characteristics were significantly associated with smoking status: not having completed post-secondary education (PR = 1.77, 95%CI 1.48–2.12), having experienced financial difficulties in the last year (PR = 1.24, 95%CI 1.01–1.52), having a higher personal income (PR for one-bracket increase = 1.14, 95%CI 1.07–1.22), and living with parents (PR = 0.78, 95%CI 0.62–0.97) (see Supplementary Table 1). Interpreting the statistical significance of interaction terms and differences between predicted probabilities,

we found significant differences in the associations of two resources and two transition stages with smoking status across age categories. Using ages 24–25 as the reference category, we found differences for educational attainment at ages 18–19 ( $p_{\text{interaction}} = .10$ ) and 22–23 ( $p_{\text{interaction}} = .07$ ), personal income at ages 20–21 ( $p_{\text{interaction}} = .01$ ), student status at ages 18–19 ( $p_{\text{interaction}} < .01$ ) and 20–21 ( $p_{\text{interaction}} = .05$ ), and full-time employment status at ages 20–21 ( $p_{\text{interaction}} < .01$ ). Figures 1 to 4 present the marginal probabilities produced by the models with interaction terms (a \* denotes a significant difference at the .05 level and a † denotes a marginal difference at the .10 level; Supplementary Figures 1 to 4 present these probabilities with 95% confidence intervals).

Figure 1 presents participants' probability of reporting smoking by educational attainment. Among participants who only completed high school or less, the risk of reporting smoking varied between 27.7% (95%CI 22.3–33.0) at ages 18–19, 34.6% (95%CI 27.6–41.6) at ages 20–21, 31.1% (95%CI 23.0–39.3) at ages 22–23, and 37.1% (95%CI 28.1–46.1) at ages 24–25. Among participants who had completed post-secondary education, the risk of reporting smoking varied between 18.8% (95%CI 11.1–26.5) at ages 18–19, 17.9% (95%CI 13.3–22.5) at ages 20–21, 20.1% (95%CI 16.3–23.9) at ages 22–23, and 16.1% (95%CI 12.6–19.6) at ages 24–25. The marginal effect of not having completed post-secondary education on the probability of reporting smoking varied between 8.9 p.p. (95%CI -0.1; 17.8) at ages 18–19, 16.7 p.p. (95%CI 8.5; 25.0) at ages 20–21, 11.1 p.p. (95%CI 2.1; 20.1) at ages 22–23, and 21.0 p.p. (95%CI 11.8; 30.2) at ages 24–25.

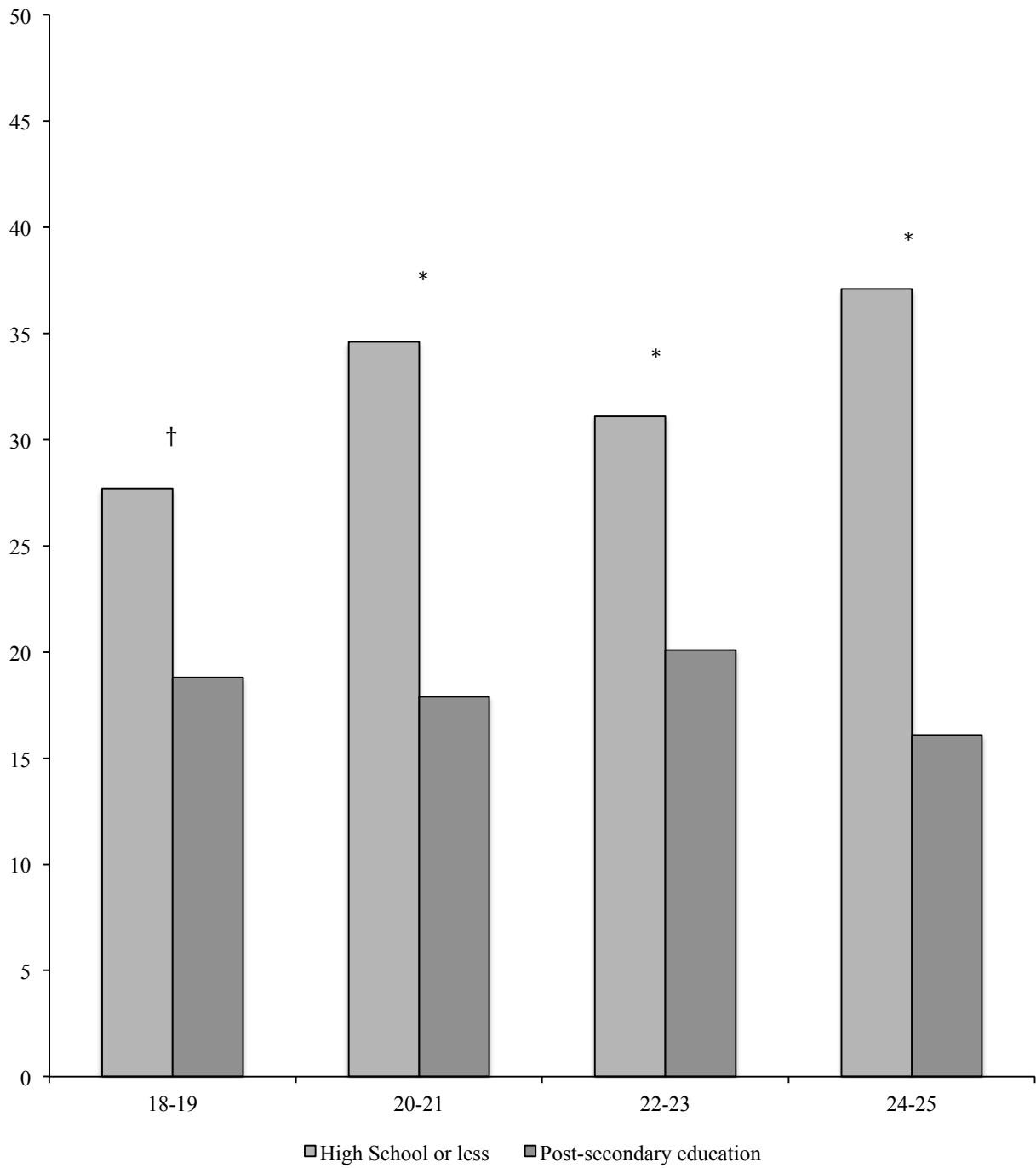
Figure 2 presents participants' probability of reporting smoking by personal income. Among participants who made \$20,000 or more last year, the risk of reporting smoking varied between 32.3% (95%CI 17.8–46.8) at ages 18–19, 44.5% (95%CI 31.2–57.7) at ages 20–21, 31.0% (95%CI 22.7–39.3) at ages 22–23, and 28.0% (95%CI 21.6–34.4) at ages 24–25. Among participants who had no income in the last year, the risk of reporting smoking varied between 14.0% (95%CI 9.8–18.1) at ages 18–19, 13.4% (95%CI 8.8–17.9) at ages 20–21, 20.4% (95%CI 13.5–27.2) at ages 22–23, and 22.1% (95%CI 13.2–31.1) at ages 24–25. The average marginal effect of a \$5,000 increase on the risk of reporting smoking was statistically significant at ages 18–19 and 20–21. It varied between 3.6 p.p. (95%CI 0.3; 7.0) at ages 18–

19, 6.2 p.p. (95%CI 3.0; 9.4) at ages 20–21, 2.1 p.p. (95%CI -0.4; 4.7) at ages 22–23, and 1.2 p.p. (95%CI -1.3; 3.6) at ages 24–25.

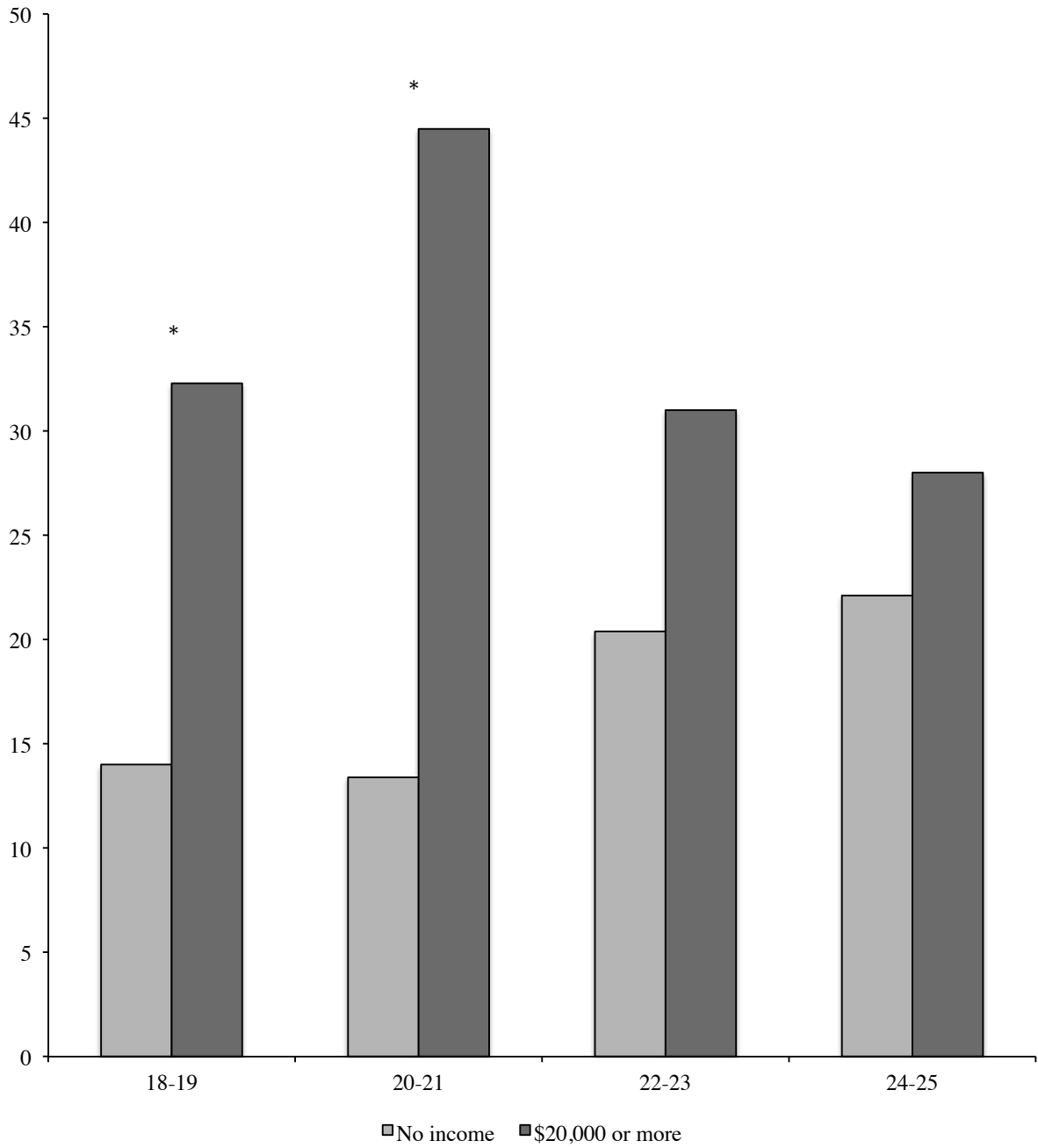
Figure 3 presents participants' probability of reporting smoking by student status. Among participants who were studying, the risk of reporting smoking varied between 18.4% (95%CI 14.5–22.4) at ages 18–19, 20.2% (95%CI 16.0–24.4) at ages 20–21, 27.2% (95%CI 22.2–32.3) at ages 22–23, and 23.8% (95%CI 17.9–29.6) at ages 24–25. Among participants who were not studying, the risk of reporting smoking varied between 28.5% (95%CI 19.4–37.6) at ages 18–19, 35.8% (95%CI 27.0–44.5) at ages 20–21, 21.2% (95%CI 15.2–27.1) at ages 22–23, and 22.8% (95%CI 17.5–28.0) at ages 24–25. The marginal effect of studying on the risk of reporting smoking was statistically significant at ages 18–19 and 20–21. It varied between -10.1 p.p. (95%CI -19.7; -0.5) at ages 18–19, -15.6 p.p. (95%CI -25.3; -5.9) at ages 20–21, 6.1 p.p. (95%CI -1.9; 14.0) at ages 22–23, and 1.0 p.p. (95%CI -6.4; 8.4) at ages 24–25.

Figure 4 presents participants' probability of reporting smoking by full-time employment status. Among participants who were working full-time, the risk of reporting smoking varied between 26.1% (95%CI 12.9–39.3) at ages 18–19, 34.2% (95%CI 23.2–45.1) at ages 20–21, 21.9% (95%CI 14.9–28.9) at ages 22–23, and 19.9% (95%CI 14.3–25.5) at ages 24–25. Among participants who were not working full-time, the risk of reporting smoking varied between 20.1% (95%CI 15.9–24.3) at ages 18–19, 22.6% (95%CI 18.3–26.9) at ages 20–21, 25.9% (95%CI 21.3–30.5) at ages 22–23, and 25.1% (95%CI 19.9–30.3) at ages 24–25. The marginal effect of working full-time on the risk of reporting smoking was marginally significant at ages 20–21 ( $p = .06$ ). It varied between 6.0 p.p. (95%CI -7.8; 19.9) at ages 18–19, 11.5 p.p. (95%CI -0.6; 23.6) at ages 20–21, -4.0 p.p. (95%CI -12.4; 4.4) at ages 22–23, and -5.2 p.p. (95%CI -12.2; 1.8) at ages 24–25.

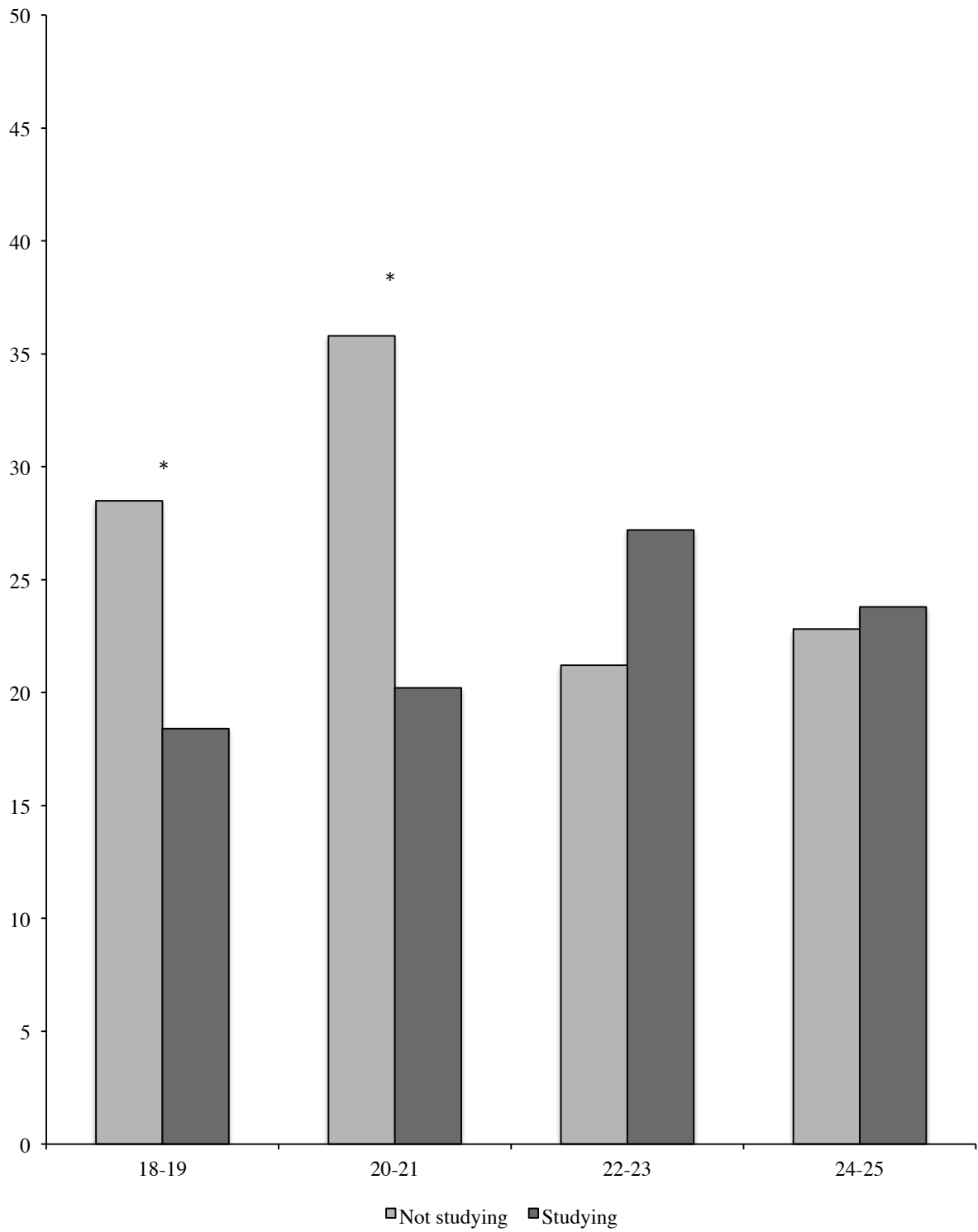
**FIGURE 1 Predicted probabilities of smoking, by education and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. (*n* = 2,083)**



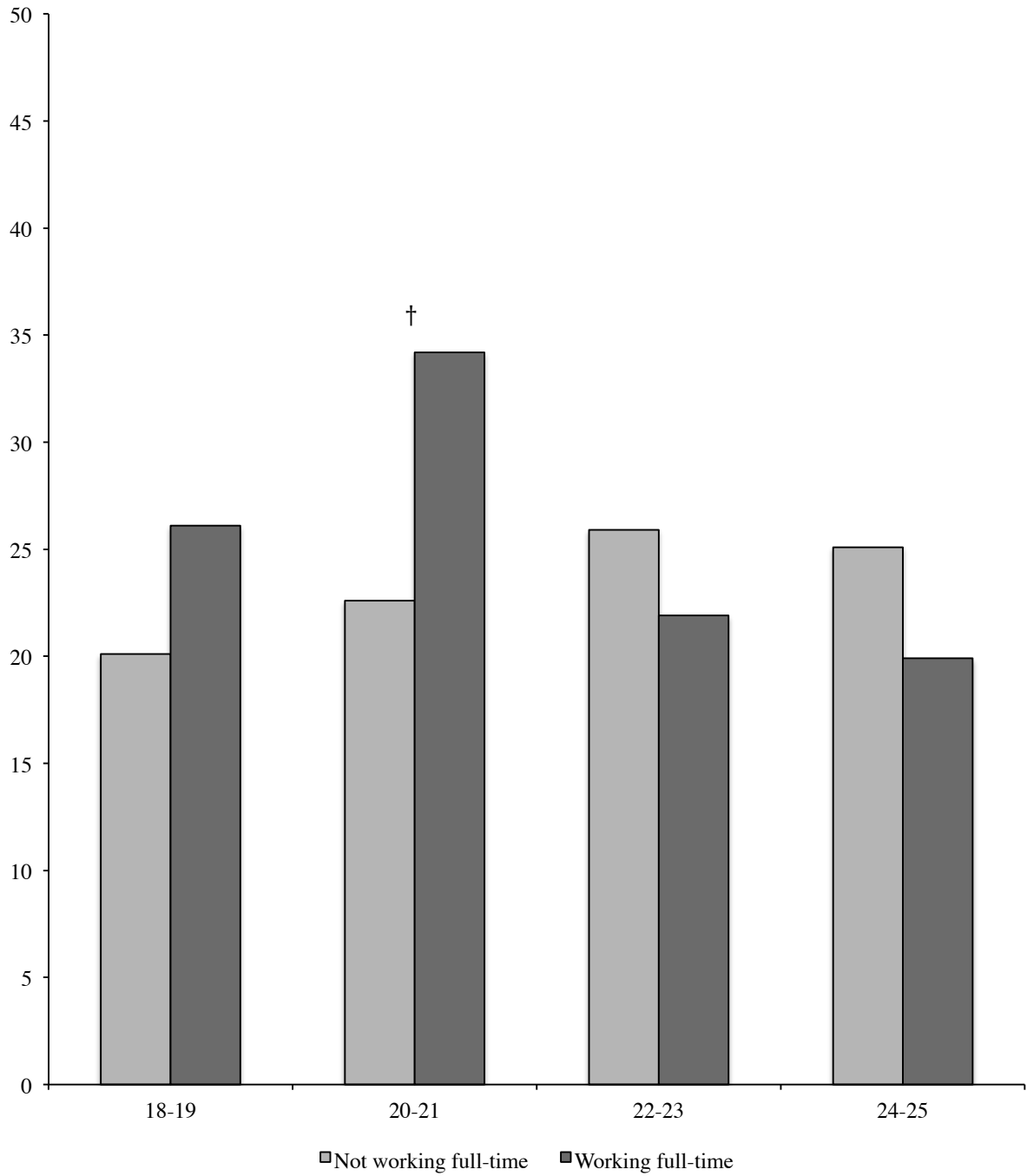
**FIGURE 2** Predicted probabilities of smoking, by personal income and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. (*n* = 2,083)



**FIGURE 3 Predicted probabilities of smoking, by student status and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( $n = 2,083$ )**



**FIGURE 4 Predicted probabilities of smoking, by full-time employment status and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. (*n* = 2,083)**



## DISCUSSION

This study sought to highlight the rapid age-based variation of associations between young adults' socioeconomic circumstances and smoking across the second and third decades of life. We found two sets of findings supporting this argument. First, we found that education-based inequalities in smoking increased somewhat linearly across age categories. This supports that those who do not pursue post-secondary education are more likely to continue initiating, intensifying, and maintaining smoking during the transition towards adulthood.<sup>5,6</sup> Supporting this, Gagné & Veenstra (2017) found among young adult Canadians a gradient-like association between education and the risk of progressing to daily smoking between the ages of 18 and 25.<sup>4</sup> Regarding cessation, studies have suggested that young adults in lower education categories are less likely to quit; results, however, have been inconsistent across studies.<sup>33-35</sup>

In contrast to the linear progression of education-based differences in smoking, we found a consistent non-linear trend for the associations of three indicators, personal income, student status, and full-time employment, with smoking across age categories: differences were strong among participants ages 18–19, reached their “maximum” among participants ages 20–21, and decreased to become no longer significant among participants ages 22–23 and 24–25. Our results squarely support the critique that average estimates in this age group can only provide limited results as two of these variables (i.e., studying and working full-time) were found to not be associated with smoking in our base full model. We note, however, that two characteristics, i.e., financial difficulties and living with parents, were associated with smoking in our base full model and their association did not significantly vary by age.

First, we found that having a higher personal income was associated with a significantly higher risk of smoking between the ages of 18 and 21. Evidence supports an inverse association between income and smoking in the adult population.<sup>36</sup> A growing number of studies, however, find that this is not the case during the transition towards adulthood.<sup>13,37</sup>



Young adults might, therefore, continue to share the economic practices of adolescents, where disposable income has been positively associated with smoking.<sup>38,39</sup>

Second, we found that being a student was associated with a significantly lower risk of smoking between the ages of 18 and 21. This supports the argument that, across the different education institutions in which young adults might study during this period, delaying the transition out of education provides benefits with regard to smoking. We note that other studies have proposed that studying in post-secondary education might be conducive to late initiation during this period.<sup>40</sup> Illustrating this, Terry-McElrath & O'Malley (2015) found that young Americans who pursued college education faced a higher risk of experimenting a first cigarette but a lower risk of intensifying to regular smoking between the ages of 19 and 26.<sup>41</sup> These conflicting trends might contribute to explain the absent influence of studying on smoking after the age of 21 in this sample.

Third, we found that being in full-time employment was also marginally associated with a higher risk of smoking around the ages of 20 and 21. This result could underline the health implications of the different industries in which young adults are employed across age. For instance, in Canada, the proportion of young adults who work in sales and services decreases from 68% at ages 15–19, 41% at ages 20–24, to 22% at ages 25–29.<sup>42</sup> Correspondingly, young adults employed in manual labor and services industries suffer the highest risk of smoking.<sup>43</sup> Young adults who enter full-time employment earlier might also be more likely to work in industries that share positive smoking norms. Studies suggest that employed young adults who are exposed to smoking from co-workers are more susceptible to initiate and intensify, that employed young adult smokers are less likely to intend to quit, and that working in a smoke-free building is associated with a lower risk of relapse during this period.<sup>44,45</sup>

### **Limitations**

We note that our cross-sectional design cannot address the longitudinal processes implied here. It also cannot disentangle reverse causality or unobserved confounding, meaning that we cannot claim causal relations from our results. We also note that, whereas results may be representative of urban areas with similar education systems and outcomes to Montreal, these

may not be generalizable to other regions with substantially different contexts. Finally, the sample was found to be slightly more educated than the Montreal average,<sup>29</sup> suggesting that we might have underestimated the importance of associations between socioeconomic characteristics and smoking.

### **Conclusion**

Young adults are facing elevated risks of encountering multiple health issues after the end of adolescence.<sup>1,2</sup> Our results add support to the critique of one common practice across public health research on this age group. Understanding how health behaviours such as smoking unequally progress during this period requires integrating their dynamic age-graded nature. Tobacco research should systematically address this in future surveillance, evidence synthesis, and policymaking efforts.

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**SUPPLEMENTARY TABLE 1** Variation in associations between young adults' socioeconomic characteristics and smoking status by age: interaction terms. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. (*n* = 2,083)

Variable	Full Model		Interaction (age continuous)		Interaction (age categorical, ref. cat 18-19)			Interaction (age categorical, ref. cat 24-25)		
	PR	95% CI	<i>p</i>	<i>p</i>	20-21	22-23	24-25	18-19	20-21	22-23
Sex (ref. = woman)	1.13	(0.96; 1.33)	---	---	---	---	---	---	---	---
Age *	1.01	(0.97; 1.06)	---	---	---	---	---	---	---	---
Father's capacity to provide \$500	0.87	(0.71; 1.05)	.68	.98	.79	.75	.75	.75	.76	.97
Mother's capacity to provide \$500	1.06	(0.86; 1.31)	.55	.91	.09	.95	.95	.95	.96	.10
Family's capacity to provide contact *	1.07	(0.98; 1.17)	.48	.74	.66	.61	.61	.61	.86	.94
Completed postsecondary education	1.77	(1.48; 2.12)	.14	.32	.85	.10	.10	.10	.43	.07
Financial difficulties in the last year	1.24	(1.01; 1.52)	.97	.91	.86	.63	.63	.63	.68	.44
Partner's capacity to provide \$500	0.83	(0.66; 1.03)	.26	.78	.79	.39	.39	.39	.18	.47
Friends' capacity to provide \$500	1.07	(0.90; 1.26)	.45	.38	.83	.36	.36	.36	.99	.47
Personal annual income *	1.14	(1.07; 1.22)	.02	.39	.31	.15	.15	.15	.01	.60
Social network size *	0.99	(0.97; 1.01)	.64	.67	.41	.65	.65	.65	.96	.71
Living with parents	0.78	(0.62; 0.97)	.75	.57	.74	.56	.56	.56	.95	.67
Studying	0.88	(0.72; 1.07)	<.001	.57	<.01	.05	.05	.05	<.01	.36
Working full-time	0.95	(0.75; 1.19)	.01	.64	.18	.11	.11	.11	<.01	.78
Being in a relationship	1.03	(0.84; 1.27)	.08	.68	.68	.13	.13	.13	.05	.24
Living with children	0.59	(0.34; 1.02)	---	---	---	---	---	---	---	---

*Models are Poisson regression with a robust variance estimator on 20 imputed datasets. Interaction terms were modelled after the full model separately for each independent variable. Variables with an asterisk represent continuous variables. Bolded coefficients are statistically significant at .05. Underlined coefficients are statistically significant at .10.*



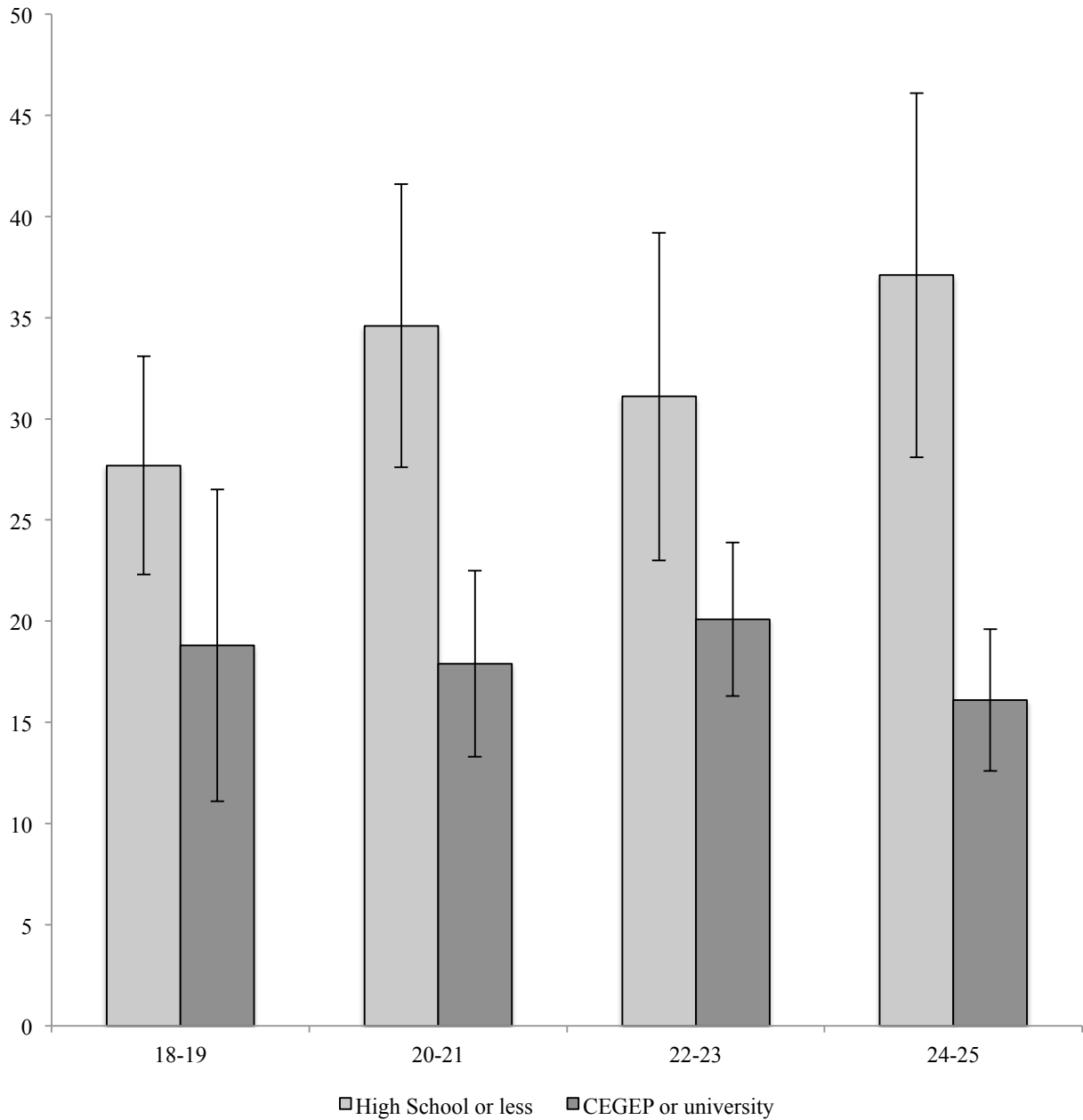
**SUPPLEMENTARY TABLE 2** Variation in associations between young adults' socioeconomic characteristics and smoking status by age: marginal probabilities. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. (*n* = 2,083)

Variable	Age 18-19		Age 20-21		Age 22-23		Age 24-25	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
<b>Father's capacity to provide \$500</b>								
Yes	19.1	(14.6; 23.6)	22.6	(17.8; 27.3)	23.8	(19.0; 28.5)	21.9	(16.9; 26.8)
No	23.1	(16.5; 29.7)	27.1	(19.9; 34.2)	26.9	(19.9; 33.9)	24.5	(18.2; 30.8)
<i>Marginal effect</i>	-3.9	(-11.5; 3.6)	-4.5	(-13.2; 4.2)	-3.1	(-11.8; 5.6)	-2.6	(-10.1; 4.9)
<b>Mother's capacity to provide \$500</b>								
Yes	20.1	(15.5; 24.7)	24.0	(19.1; 28.8)	27.8	(22.7; 32.7)	22.4	(17.7; 27.2)
No	21.1	(14.8; 27.4)	24.5	(17.4; 31.7)	19.0	(12.8; 25.2)	23.2	(16.5; 30.0)
<i>Marginal effect</i>	-1.0	(-8.4; 6.4)	-0.6	(-9.4; 8.2)	<b>8.8</b>	<b>(0.6; 17.0)</b>	-0.8	(-8.5; 6.9)
<b>Family's capacity to provide a job contact *</b>								
1 – Not at all probably	21.3	(15.9; 26.6)	26.0	(19.7; 32.2)	27.2	(20.5; 33.9)	25.2	(18.5; 31.9)
4 – Very probably	19.5	(11.6; 27.4)	21.3	(13.3; 29.0)	21.3	(14.1; 28.6)	19.2	(12.4; 26.0)
<i>Average marginal effect</i>	0.6	(-3.0; 4.1)	1.7	(-2.4; 5.8)	2.0	(-2.1; 6.2)	2.0	(-1.8; 5.9)
<b>Completed postsecondary education</b>								
Yes	18.8	(11.1; 26.5)	17.9	(13.3; 22.5)	20.1	(16.3; 23.9)	16.1	(12.6; 19.6)
No	27.7	(22.3; 33.0)	34.6	(27.6; 41.6)	31.1	(23.0; 39.3)	37.1	(28.1; 46.1)
<i>Marginal effect</i>	<u>8.9</u>	<u>(-0.1; 17.8)</u>	<b>16.7</b>	<b>(8.5; 25.0)</b>	<b>11.1</b>	<b>(2.1; 20.1)</b>	<b>21.0</b>	<b>(11.8; 30.2)</b>
<b>Financial difficulties in the last year</b>								
Yes	23.3	(13.9; 32.6)	28.1	(18.5; 37.8)	27.0	(18.3; 35.9)	28.7	(19.8; 37.6)
No	19.8	(15.6; 24.0)	23.1	(18.9; 27.4)	24.4	(20.0; 28.8)	21.2	(16.8; 25.6)
<i>Marginal effect</i>	3.5	(-6.7; 13.6)	5.0	(-5.6; 15.6)	2.7	(-7.2; 12.7)	7.5	(-2.0; 16.9)
<b>Partner's capacity to provide \$500</b>								
Yes	19.1	(10.5; 27.7)	23.7	(16.0; 31.3)	21.6	(15.1; 28.1)	17.7	(12.4; 22.9)
No	21.4	(16.9; 26.0)	24.5	(19.7; 29.3)	26.3	(21.3; 31.2)	25.6	(20.4; 30.9)

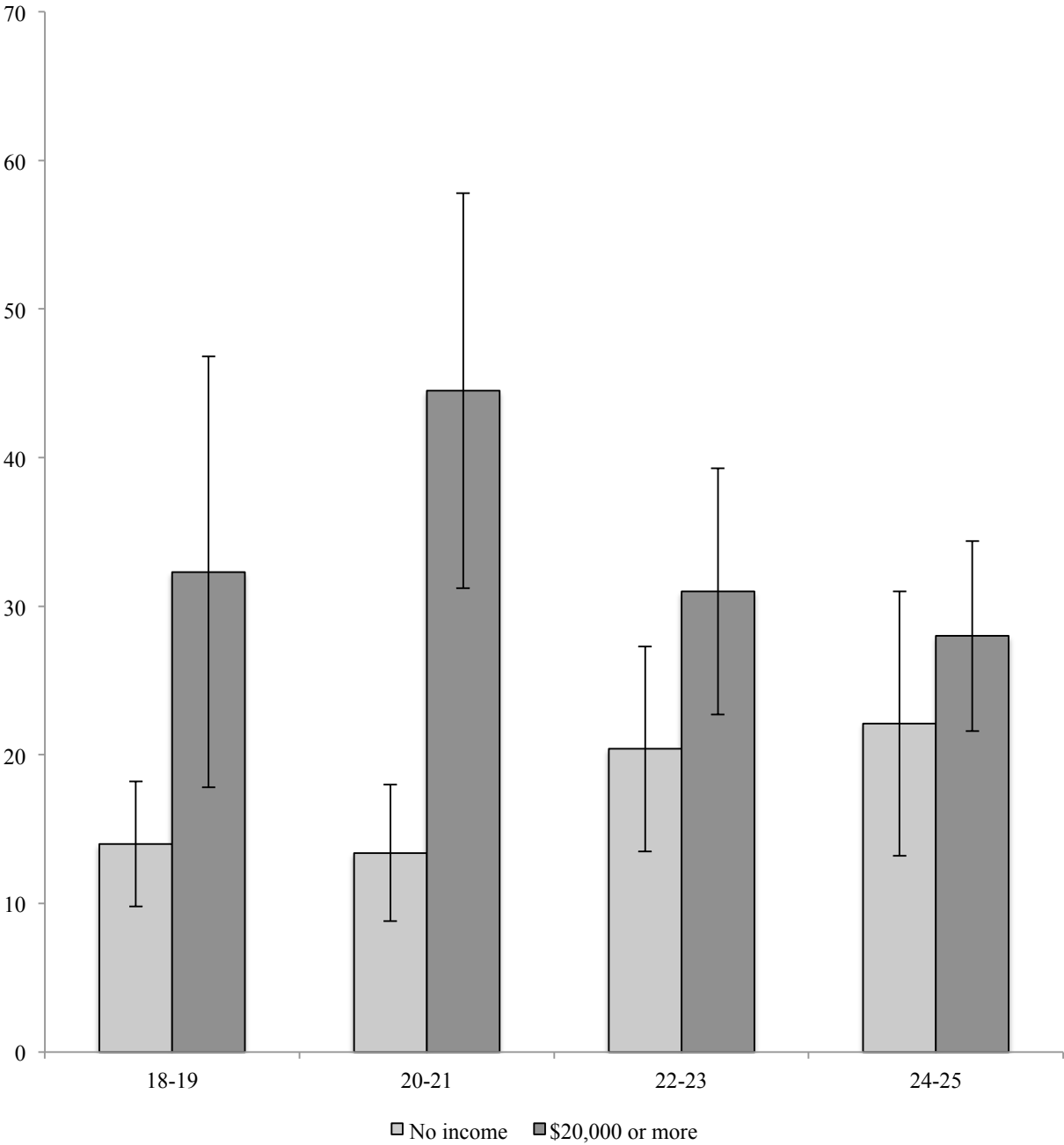
<i>Marginal effect</i>	-2.4	(-12.1; 7.4)	-0.8	(-10.1; 8.5)	-4.7	(13.2; 3.9)	<b>-8.0</b>	<b>(-14.9; -0.9)</b>
<b>Friends' capacity to provide \$500</b>								
Yes	22.9	(16.5; 29.2)	23.6	(17.6; 29.7)	26.6	(20.7; 32.5)	22.5	(17.1; 28.0)
No	19.1	(14.6; 23.5)	24.3	(19.2; 29.3)	23.3	(18.1; 28.4)	23.1	(17.7; 28.6)
<i>Marginal effect</i>	3.8	(-3.5; 11.1)	-0.6	(-8.6; 7.3)	3.3	(-4.6; 11.2)	-0.6	(-7.6; 6.4)
<b>Personal annual income *</b>								
1 – No income	14.0	(9.8; 18.1)	13.4	(8.8; 17.9)	20.4	(13.5; 27.2)	22.1	(13.2; 31.1)
6 – \$20,000 or more	32.3	(17.8; 46.8)	44.5	(31.2; 57.7)	31.0	(22.7; 39.3)	28.0	(21.6; 34.4)
<i>Average marginal effect</i>	<b>3.6</b>	<b>(0.3; 7.0)</b>	<b>6.2</b>	<b>(3.0; 9.4)</b>	2.1	(-0.4; 4.7)	1.2	(-1.3; 3.6)
<b>Social network size *</b>								
Having no friends	19.1	(10.4; 27.8)	25.3	(15.2; 35.4)	29.4	(16.8; 42.1)	24.1	(13.3; 35.0)
Having 15 or more friends	21.2	(15.4; 27.0)	23.5	(17.7; 29.4)	22.8	(17.0; 28.6)	22.0	(16.2; 27.7)
<i>Average marginal effect</i>	0.1	(-0.7; 1.0)	-0.1	(-0.9; 0.8)	-0.4	(-1.4; 0.6)	-0.1	(-1.0; 0.8)
<b>Living with your parents</b>								
Yes	19.1	(15.4; 22.8)	22.8	(18.9; 26.7)	23.0	(18.7; 27.2)	21.9	(16.7; 27.0)
No	30.3	(9.3; 51.3)	28.0	(14.8; 41.3)	31.7	(22.6; 40.9)	27.4	(20.4; 34.4)
<i>Marginal effect</i>	-11.2	(-32.4; 10.1)	-5.2	(-19.1; 8.7)	<u>-8.8</u>	<u>(-18.9; 1.4)</u>	-5.5	(-13.8; 27.8)
<b>Studying</b>								
Yes	18.4	(14.5; 22.4)	20.2	(16.0; 24.4)	27.2	(22.2; 32.3)	23.8	(17.9; 29.6)
No	28.5	(19.4; 37.6)	35.8	(27.0; 44.5)	21.2	(15.2; 27.1)	22.8	(17.5; 28.0)
<i>Marginal effect</i>	<b>-10.1</b>	<b>(-19.7; -0.5)</b>	<b>-15.6</b>	<b>(-25.3; -5.9)</b>	6.1	(-1.9; 14.0)	1.0	(-6.4; 8.4)
<b>Working full-time</b>								
Yes	26.1	(12.9; 39.3)	34.2	(23.2; 45.1)	21.9	(14.9; 28.9)	19.9	(14.3; 25.5)
No	20.1	(15.9; 24.3)	22.6	(18.3; 26.9)	25.9	(21.3; 30.5)	25.1	(19.9; 30.3)
<i>Marginal effect</i>	6.0	(-7.8; 19.9)	<u>11.5</u>	<u>(-0.6; 23.6)</u>	-4.0	(-12.4; 4.4)	-5.2	(-12.2; 1.8)
<b>Being in a relationship</b>								
Yes	23.0	(15.3; 30.7)	29.3	(19.9; 38.6)	25.5	(18.4; 32.6)	19.8	(14.0; 25.5)
No	19.8	(15.5; 24.1)	22.6	(18.3; 26.9)	24.4	(19.7; 29.1)	24.7	(19.6; 29.9)
<i>Marginal effect</i>	3.2	(-5.1; 11.5)	6.6	(-3.8; 17.1)	1.1	(-7.6; 9.8)	-5.0	(-12.4; 2.4)

Percentages are marginal probabilities produced from the models in Supplementary Table 1 (age in four categories: 18-19, 20-21, 22-23, 24-25). Marginal effects might be slightly different from the reported probabilities because of rounding. For continuous variables, the average marginal effect refers to the average increase in the probability of reporting smoking for a one-unit increase in the independent variable. Bolded coefficients are statistically significant at .05. Underlined coefficients are statistically significant at .10.

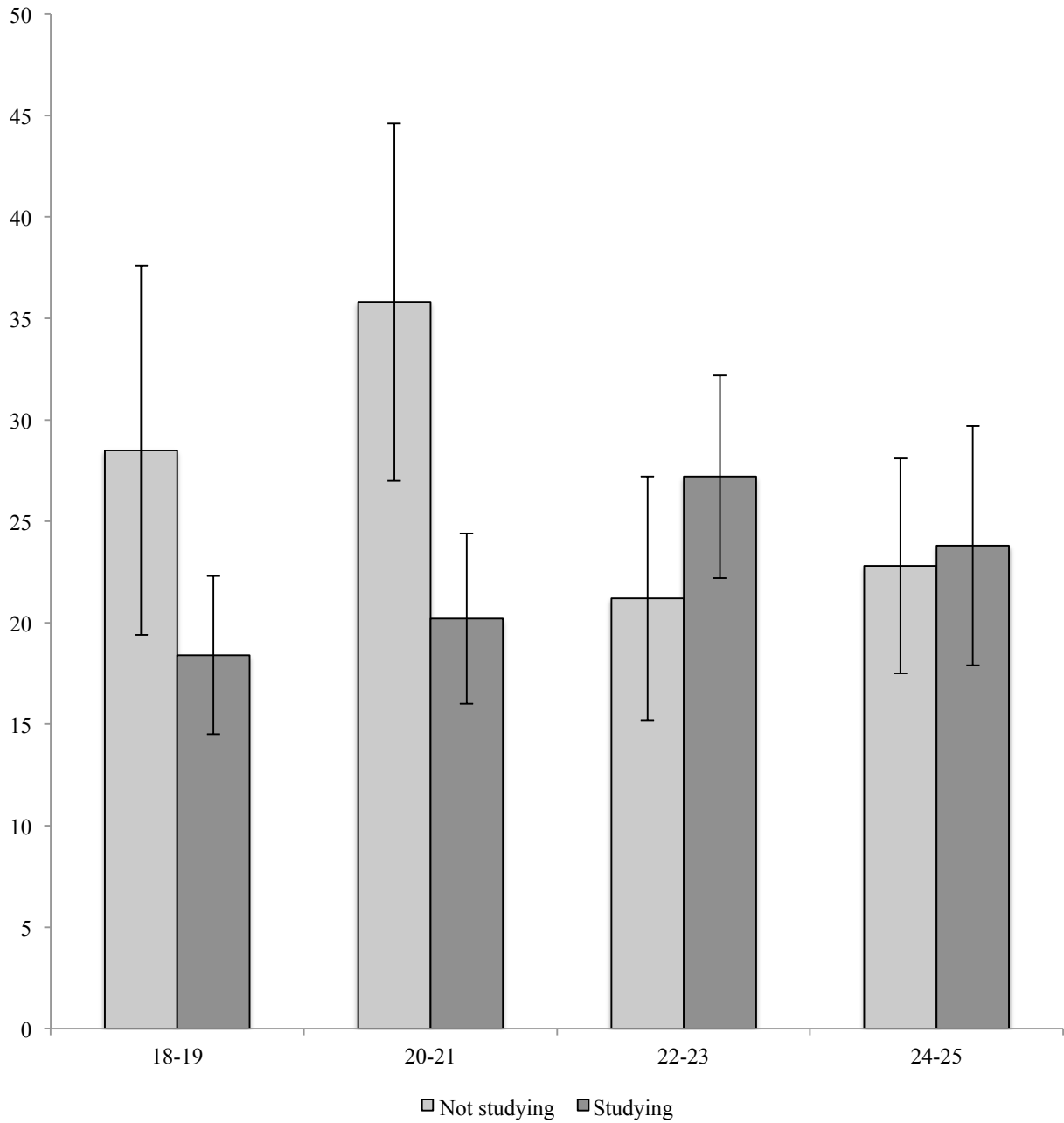
**SUPPLEMENTARY FIGURE 1 Predicted probabilities of smoking (with 95% confidence intervals), by education and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. ( $n = 2,083$ )**



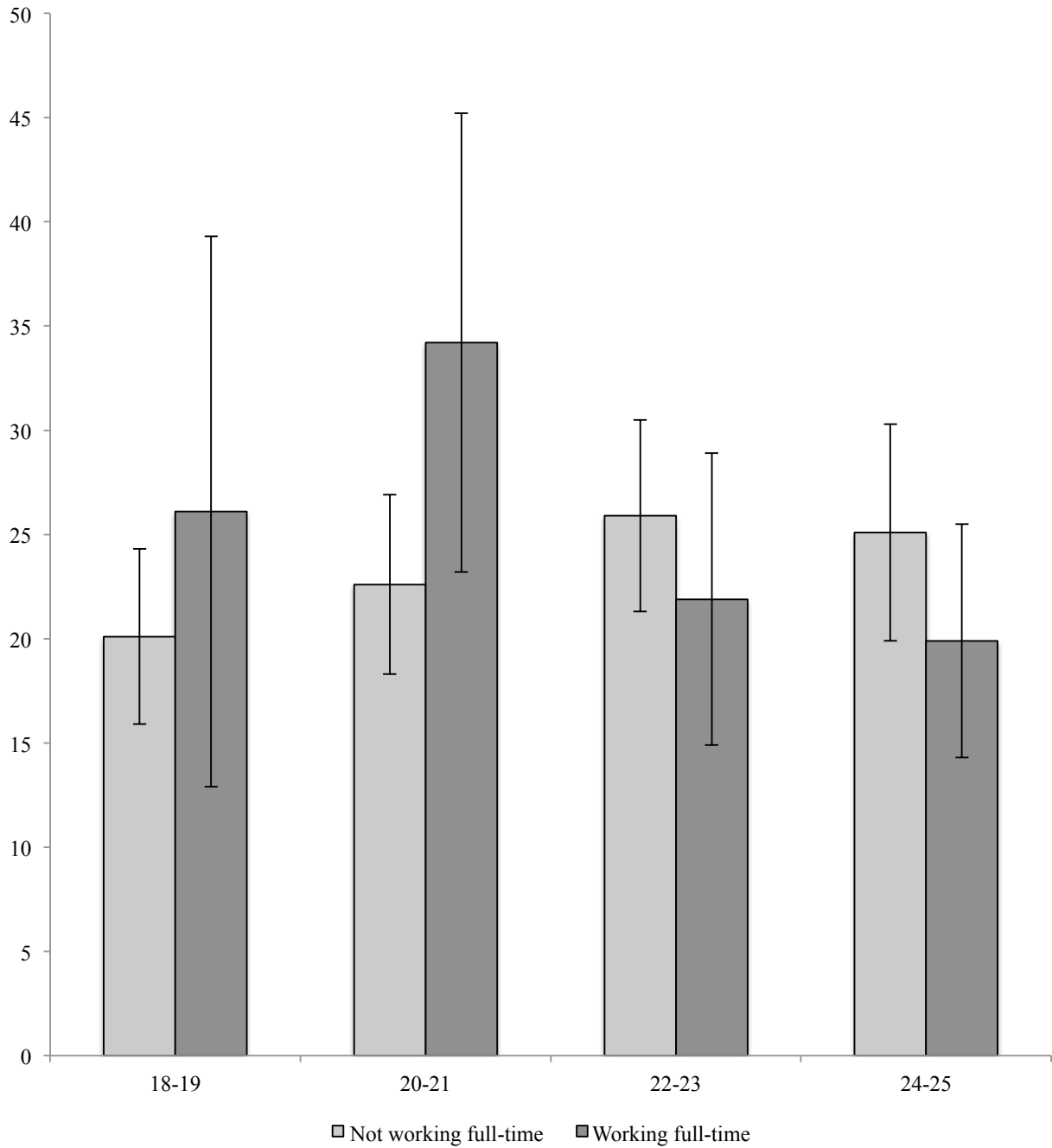
**SUPPLEMENTARY FIGURE 2 Predicted probabilities of smoking (with 95% confidence intervals), by personal income and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. (*n* = 2,083)**



**SUPPLEMENTARY FIGURE 3 Predicted probabilities of smoking (with 95% confidence intervals), by student status and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. (*n* = 2,083)**



**SUPPLEMENTARY FIGURE 4 Predicted probabilities of smoking (with 95% confidence intervals), by full-time employment status and age. Interdisciplinary Study of Inequalities in Smoking (ISIS), Montreal, Canada, 2011-2012. (*n* = 2,083)**



**ARTICLE 4. Challenging the study of health inequalities during  
young adulthood: smoking in the Canadian National Population  
Health Survey as a case example**

## **In preparation for submission in Social Science & Medicine**

### **TITLE**

Challenging the study of health inequalities during young adulthood: smoking in the Canadian National Population Health Survey as a case example

### **AUTHORS**

Thierry Gagné<sup>1,2</sup>, Katherine L. Frohlich<sup>1,2</sup>, Amélie Quesnel-Vallée<sup>3,4</sup>

<sup>1</sup> Institut de Recherche en Santé Publique de l'Université de Montréal (IRSPUM), Canada

<sup>2</sup> Département de médecine sociale et préventive, École de santé publique de l'Université de Montréal (ESPUM), Canada

<sup>3</sup> Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Canada

<sup>4</sup> Department of Sociology, McGill University, Canada

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## ABSTRACT

**Background.** Understanding health inequalities during young adulthood requires considering the dynamic and age-graded nature of socioeconomic circumstances during this life period. To illustrate this, we examine changes in social inequalities in smoking between the ages of 18 and 25. **Methods.** 1,243 young adults were followed every two years in the Canadian National Population Health Survey. Using GEE models, we regress smoking on education, living arrangements, and relationship, employment, and student statuses. We examine main effects and interactions by age and education with two- and three-way interaction terms and marginal effects (ME). **Results.** Post-secondary education (PR = 0.85, 95%CI 0.74–0.97) was associated with a lower risk of smoking while atypical living arrangements (PR = 1.16, 95%CI 1.02–1.32), not studying (PR = 1.13, 95%CI 1.02–1.24), and being single (PR = 1.29, 95%CI 1.09–1.53) were associated with a higher risk of smoking. These associations, however, heavily varied between ages 18–19 and 24–25: the ME of having completed post-secondary education increased from -1.8 pp to -12.9 pp and the ME of living with children (compared to “living with parents”) decreased from 30.9 pp to -2.4 pp. The influence of relationship status varied by both age and education: the ME of being single among those with post-secondary education varied from -7.6 pp to 14.0 pp. **Conclusions.** Average effects provide a limited understanding of health inequalities during young adulthood. Researchers should further address the influence of young adults’ socioeconomic circumstances in keeping with the intersecting and age-graded nature of these characteristics during this period.

## KEYWORDS

Canada; Young adults; Socioeconomic Factors; Smoking; Transition towards adulthood; Health inequalities

## TITLE

Challenging the study of health inequalities during young adulthood: smoking in the Canadian National Population Health Survey as a case example

## INTRODUCTION

Social epidemiology has emphasized life-course theory to understand how health inequalities are produced.<sup>1,2</sup> This scholarship has largely focused on the periods of infancy, childhood, and adolescence yet increasing evidence highlights the importance of young adulthood in the development of social and health inequalities.<sup>3-5</sup> As in the general population, behavioral, morbidity, and mortality outcomes are unequally distributed among young adults who are socially disadvantaged as characterized by their family background and socioeconomic trajectory.<sup>6-9</sup>

Despite the inherently dynamic nature of young adults' socioeconomic development, the bulk of the evidence on health inequalities in this group has been built on the foundations used to study socioeconomic status in the general population.<sup>10,11</sup> Oversveen and colleagues (2017) recently argued that the "SES-health" scholarship is limited by an enduring positivistic approach borrowed from risk-factor epidemiology that often considers socioeconomic characteristics as completely static (i.e., independent from the age or sequence when these are experienced) and isolable (i.e., independent from the other circumstances that are concurrently experienced).<sup>12</sup> We argue that this has led many to examine associations without investigating sub-group differences and using broad age categories limiting insights into the processes occurring within these periods.

Many are challenging these assumptions and evidencing that health inequalities are better understood through the interaction of life domains and from the sequence of their exposures across the life-course.<sup>13</sup> We argue that these notions are even more relevant for young adults. Our capacity to understand their socioeconomic circumstances is obfuscated by the complex

developmental process they embark on after adolescence. Young adults rapidly transition in and out of a large number of statuses, including finishing their studies, finding full-time employment, leaving the parental household, setting up their own household, establishing romantic relationships, and having children.<sup>14</sup> These transitions entail identifying with new adult social roles, creating new social networks, and coping with new opportunities, responsibilities, and environments.<sup>8,15</sup> Recent trends have also changed how this generation experiences this transition. Despite longer studies, young adults face today more debt, fewer social benefits, lower real incomes, and more obstacles towards the purchase of a first property than the previous generation.<sup>16</sup> In response, an increasing number of young adults now delay having children, stay with their parents, or return to live with them into the fourth decade of life.<sup>17</sup> There are, therefore, theoretical and methodological gaps in appropriately investigating young adults' circumstances and its influences on health-related practices. Two points should be addressed moving forward.

First, there is a need to redefine which characteristics circumscribe young adults' socioeconomic circumstances beyond achievements in education, occupation, and earnings. Graham and colleagues (2006) demonstrated the limitations of common socioeconomic indicators to study the unequal distribution of smoking among young women. Finding that early motherhood, lone motherhood, and living without a partner were independently associated with smoking, they proposed that “[b]oth the conventionally measured socioeconomic lifecourse and the domestic lifecourse contributed separately to the odds of smoking and former smoking, suggesting that lifecourse analyses should incorporate women's domestic circumstances as an important pathway of influence on their smoking status in early adulthood.” (p. 228).<sup>7</sup>

Second, there is a need to further investigate the rapid variation in the associations between young adults' socioeconomic circumstances and health-related practices at different ages. Young adults' resources and transition stages are likely to provide different advantages in keeping with their timing and sequence.<sup>8,18-20</sup> While studies have focused on the health-related consequences of precocious transitions, the timing and sequence of transitions are likely to influence health-related practices well into the fourth decade of life.<sup>8,18-20</sup> We build on this

argument to argue that the association of socioeconomic position with smoking is also likely to vary depending on the transition stages that are concurrently unequally experienced. Disentangling young adults' social disadvantage, therefore, requires capturing 1) the resources that are relevant to their knowledge, skills, contacts, and standing, 2) their stages in education, employment, family, and housing arrangements, and 3) their interplay across age during the transition towards adulthood.

### **Objectives**

This paper seeks to demonstrate how health inequalities during young adulthood can be better understood by investigating the dynamic interplay of young adults' socioeconomic characteristics across age. To illustrate this, we examine smoking as a case example. Smoking prevalence is higher among young adult Canadians than in any other age group.<sup>21</sup> Increasing cessation rates found in the general population and decreasing initiation rates found among youth have also been absent in the 18–25 age group.<sup>21,22</sup> Thus, we explore the unequal distribution of smoking during young adulthood by examining the direct associations of socioeconomic position and transition stages with smoking and investigating how these intersect and develop between the ages of 18 and 25.

## **METHODS**

### **Data**

We use data from the Canadian National Population Health Survey (NPHS), a longitudinal prospective cohort nationally representative of household residents of the ten provinces ages 12+.<sup>23</sup> The first survey wave occurred in 1994–1995, followed by biennial surveys until 2010–2011, resulting in nine survey waves over 16 years of follow-up. The NPHS initial longitudinal panel counted 17,276 individuals. For this study, we selected participants who were surveyed at ages 18 or 19 between 1994–1995 and 2004–2005 and followed in the three subsequent time points to create a synthetic cohort of young adults with four observation points at ages 18–19, 20–21, 22–23, and 24–25. We then excluded participants who had any

missing data on smoking. The analytic sample, therefore, represented the 4,972 repeated observation points of 1,243 participants.

### **Measures**

Smoking status was assessed by asking respondents who had smoked at least one entire cigarette in their lifetime whether they smoked ‘every day’, ‘occasionally’ or ‘never’. Those who smoked daily or occasionally were considered to be ‘current smokers’ while ‘non smokers’ consisted of never smokers and former smokers.

Main independent variables included one socioeconomic position and four transition variables, i.e., educational attainment (Completed high school or less / Received or completed post-secondary education), living arrangements (With parents / Without parents & with children / Without parents & without children / Other), employment status (Employed / Not), student status (Student / Not), and relationship status (In a couple / Not). We collapsed the measure of educational attainment into two categories because too few participants had completed university at ages 18–19 or had not finished high school at ages 24–25. Living arrangements were recoded from ten categories derived by Statistics Canada into four categories focusing on participants’ relations with parents and children. The “Other” category represents infrequent, atypical living arrangements with multiple household members. Student status was measured asking “Are you currently attending a school, college or university?”. For relationship status, we collapsed those in a civil union and married into a single category. We also included as a control variable a dichotomous measure of the ratio of household members to the number of rooms in the household (more than one member per room, Y/N) to account for social circumstances in participants’ households.

### **Statistical analyses**

We examined the associations between socioeconomic characteristics and smoking using prevalence ratios (PR) from weighted Poisson regression models with a robust variance estimator.<sup>24</sup> We used a Generalized Estimating Equations approach with an exchangeable correlation structure to account for the auto-correlation between participants’ observations over time.<sup>25</sup>

**TABLE 1 Sample characteristics. National Population Health Survey, Canada, 1994-1995 to 2010-2011. (*n* = 1,243)**

<b>Variables</b>	<b>18-19</b>	<b>20-21</b>	<b>22-23</b>	<b>24-25</b>	<b>Missing</b>
	(%)	(%)	(%)	(%)	(%)
<b>Smoking status</b>					
Smoker	33.0	34.2	33.3	31.5	0.0
Non-smoker	67.0	65.8	66.7	68.5	
<b>Gender</b>					
M	48.4	48.4	48.4	48.4	0.0
F	51.6	51.6	51.6	51.6	
<b>Educational attainment</b>					
HS completed or less	50.0	26.0	19.6	17.0	0.2
PS received or completed	50.0	74.0	80.4	83.0	
<b>Living arrangements</b>					
With parents	78.4	63.8	49.6	34.3	0.1
W/out parents, w/ children	1.1	3.8	6.0	12.0	
W/out parents, w/out children	9.1	19.4	31.1	42.0	
Other	11.4	13.1	12.5	11.7	
<b>Studying status</b>					
No	31.0	50.2	61.6	78.6	0.1
Yes	69.0	49.8	38.4	21.4	
<b>Employment status</b>					
No	38.6	29.3	23.9	18.8	1.6
Yes	61.4	70.7	76.1	81.2	
<b>In a relationship</b>					
No	97.8	92.2	80.5	70.2	0.7
Yes	2.2	7.8	19.5	29.8	

First, we built a full model with the main independent variables, controlling for sex, overcrowding, and age (18–19, 20–21, 22–23, 24–25). Second, we separately 1) introduced two-way interaction terms between education and transition variables; 2) introduced two-way interaction terms between age and the main independent variables; 3) introduced three-way interaction terms between age, education, and transition variables.

We then compared marginal probabilities to interpret results from models with significant interaction terms.<sup>26</sup> We examined marginal effects, i.e., the change in the predicted probability of smoking associated with a corresponding change in the independent variable, to assess their statistical significance.<sup>26</sup> We performed models using a listwise deletion approach because variables in this study had each less than two percent of missing cases. Results from interaction models and Figures with 95% confidence intervals are detailed in the Supplementary Material online. Analyses were produced using Stata 14.<sup>27</sup>

## RESULTS

### **Sample characteristics**

Table 1 presents participants' characteristics. Fifty-one percent of participants were women. Smoking prevalence varied between 33.0% at ages 18–19 and 31.5% at ages 24–25. Smoking prevalence across age and period is detailed in the Supplementary Material. At ages 24–25, 83.0% of the sample had received some post-secondary education (33 p.p. increase from ages 18–19), 34.3% were living with their parents (45 p.p. decrease from 18–19 yrs old), 21.4% were studying (48 p.p. decrease from ages 18–19), 81.2% were employed (20 p.p. increase from 18–19 yrs old), and 29.8% were in a relationship (27 p.p. increase from ages 18–19).

### **Associations between young adults' socioeconomic circumstances and smoking**

First, we examined the associations between young adults' circumstances and smoking and the presence of interactions between educational attainment and transition stages, controlling for age. We preliminarily examined differences by sex and confounding by period or cohort effects and household income but found no significant differences. Analyses are, therefore, produced for the full sample without additional controls.

Table 2 presents the associations between participants' socioeconomic circumstances and smoking status. In the full model, four characteristics were associated with smoking: 1) having received post-secondary education was associated with a 15% lower risk of smoking (95%CI 0.74–0.97); 2) having atypical living arrangements was associated with a 16% higher risk of

**TABLE 2 Associations between young adults' socioeconomic characteristics and smoking. National Population Health Survey, Canada, 1994-1995 to 2010-2011. (n = 1,243)**

	Model 1: Controlling for age, crowding, and time		Model 2: Full model	
	PR	95%CI	PR	95%CI
<b>Educational attainment</b>				
PS received or completed (ref. = HS or less)	<b>0.82</b>	<b>(0.73-0.94)</b>	<b>0.85</b>	<b>(0.74-0.97)</b>
<b>Living arrangements</b>				
Without parents, with children	1.00	(0.81-1.23)	1.13	(0.89-1.43)
Without parents, without children	1.10	(0.99-1.22)	1.10	(0.99-1.22)
Other (ref. = living with parents)	<b>1.17</b>	<b>(1.04-1.33)</b>	<b>1.16</b>	<b>(1.03-1.32)</b>
<b>Studying status</b>				
Not studying (ref. = Studying)	<b>1.18</b>	<b>(1.08-1.29)</b>	<b>1.13</b>	<b>(1.03-1.24)</b>
<b>Employment status</b>				
Unemployed (ref. = Employed)	0.93	(0.85-1.01)	0.95	(0.88-1.04)
<b>Relationship status</b>				
Single (ref. = In a couple)	<b>1.21</b>	<b>(1.04-1.42)</b>	<b>1.29</b>	<b>(1.09-1.53)</b>
<b>Gender</b>				
Woman (ref. = M)	N/A	N/A	1.04	(0.87-1.25)
<b>Overcrowding</b>				
1+ person per room (ref. = No)	N/A	N/A	0.97	(0.88-1.07)
<b>Time of observation</b>				
T2 at ages 20-21	N/A	N/A	1.04	(0.95-1.15)
T3 at ages 22-23			1.03	(0.92-1.15)
T4 at ages 24-25 (ref. = T1 at ages 18-19)			0.98	(0.85-1.11)



smoking (95%CI 1.03–1.32) when compared to those who were living with their parents; 3) not studying was associated with a 13% higher risk of smoking (95%CI 1.03–1.24), and; 4) being single was associated with a 29% higher risk of smoking (95%CI 1.09–1.53). Employment status (PR = 0.95, 95%CI 0.88–1.04) was not significantly associated with smoking.

We found one significant interaction with relationship status ( $p = .001$ ). The marginal effect of being single on the risk of smoking among those having pursued post-secondary education was 11.2 p.p. (from 21.4% to 32.6%,  $p < .001$ ) while the marginal effect of being single on the risk of smoking among those who only completed secondary school or less was - 1.0 p.p. (from 37.8% to 36.9%,  $p = .79$ ).

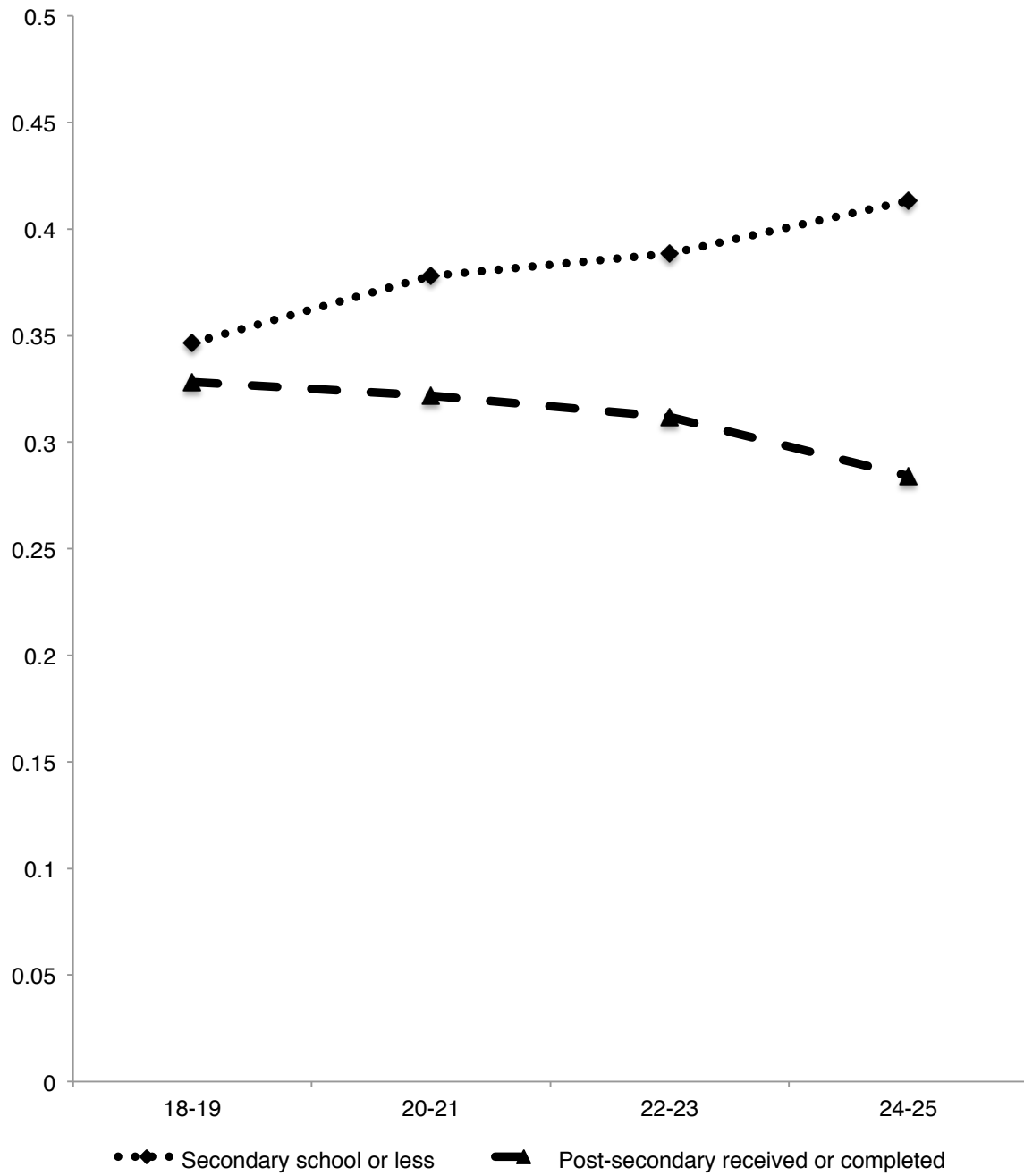
### **Changes across age in associations between young adults' socioeconomic circumstances and smoking**

Second, we investigated differences in associations between participants' socioeconomic circumstances and smoking across age and then whether these differences across age were further modified by education. Using ages 18–19 as the reference category, we found significant interactions by age with 1) having pursued post-secondary education at ages 24–25, 2) living without parents and without children at ages 20–21, 3) living in atypical living arrangements at ages 20–21 and 22–23, and 4) being single at ages 22–23 and ages 24–25.

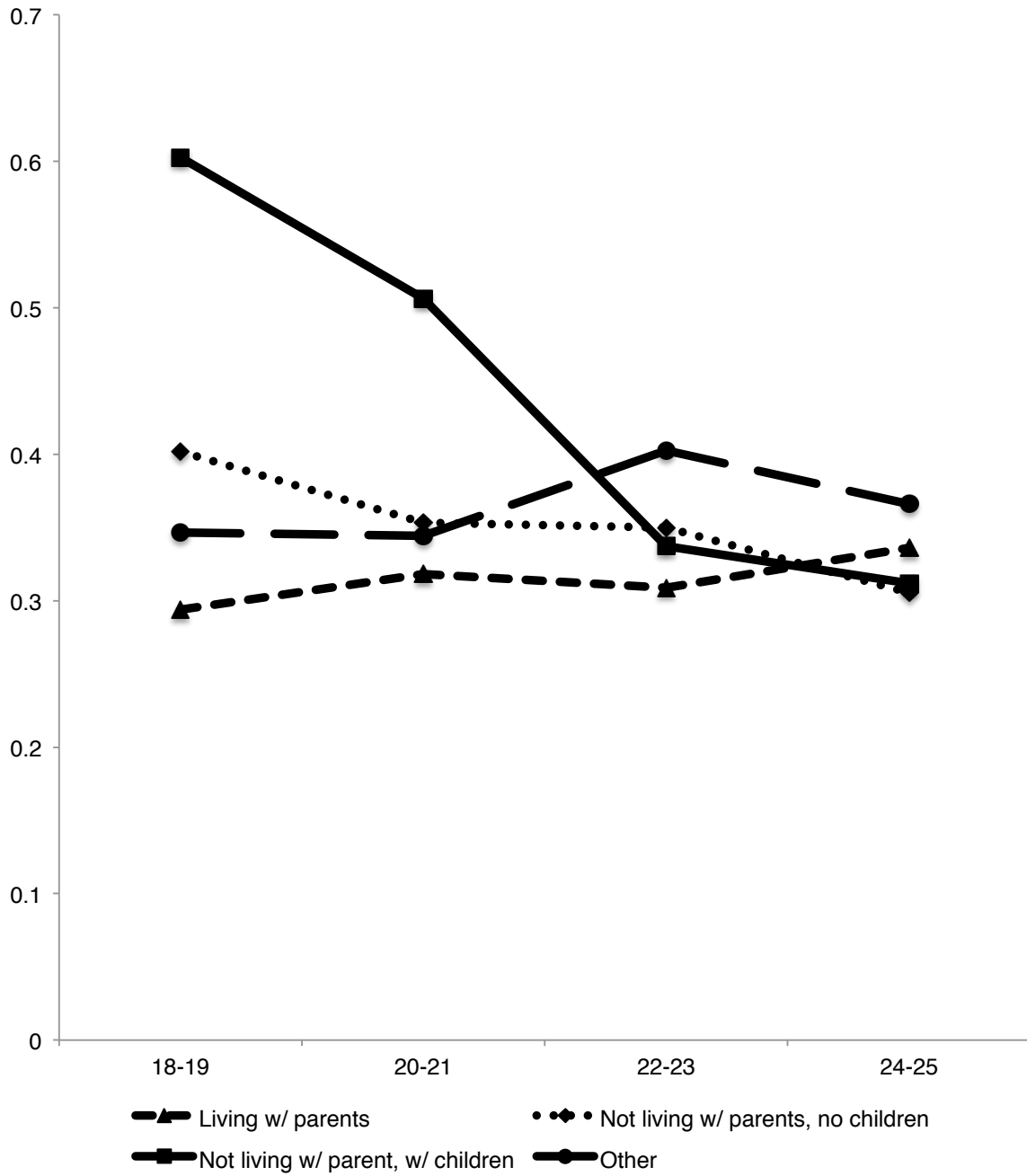
Figure 1 presents the marginal probabilities of smoking by educational attainment. The marginal effect of having pursued post-secondary education on the risk of smoking increased in size from - 1.8 p.p. at ages 18–19 (from 34.7% to 32.8%,  $p = .53$ ) to - 12.9 p.p. at ages 24–25 (from 41.3% to 28.4%,  $p = .001$ ).

Figure 2 presents the marginal probabilities of smoking by living arrangements. Using “living with parents” as the reference category, 1) the marginal effect of living without parents and with children on the risk of smoking decreased from 30.9 p.p. at ages 18–19 (from 29.4% to 60.3%,  $p = .03$ ) to - 2.4 p.p. at ages 24–25 (from 33.6% to 31.2%,  $p = .65$ ); 2) the marginal

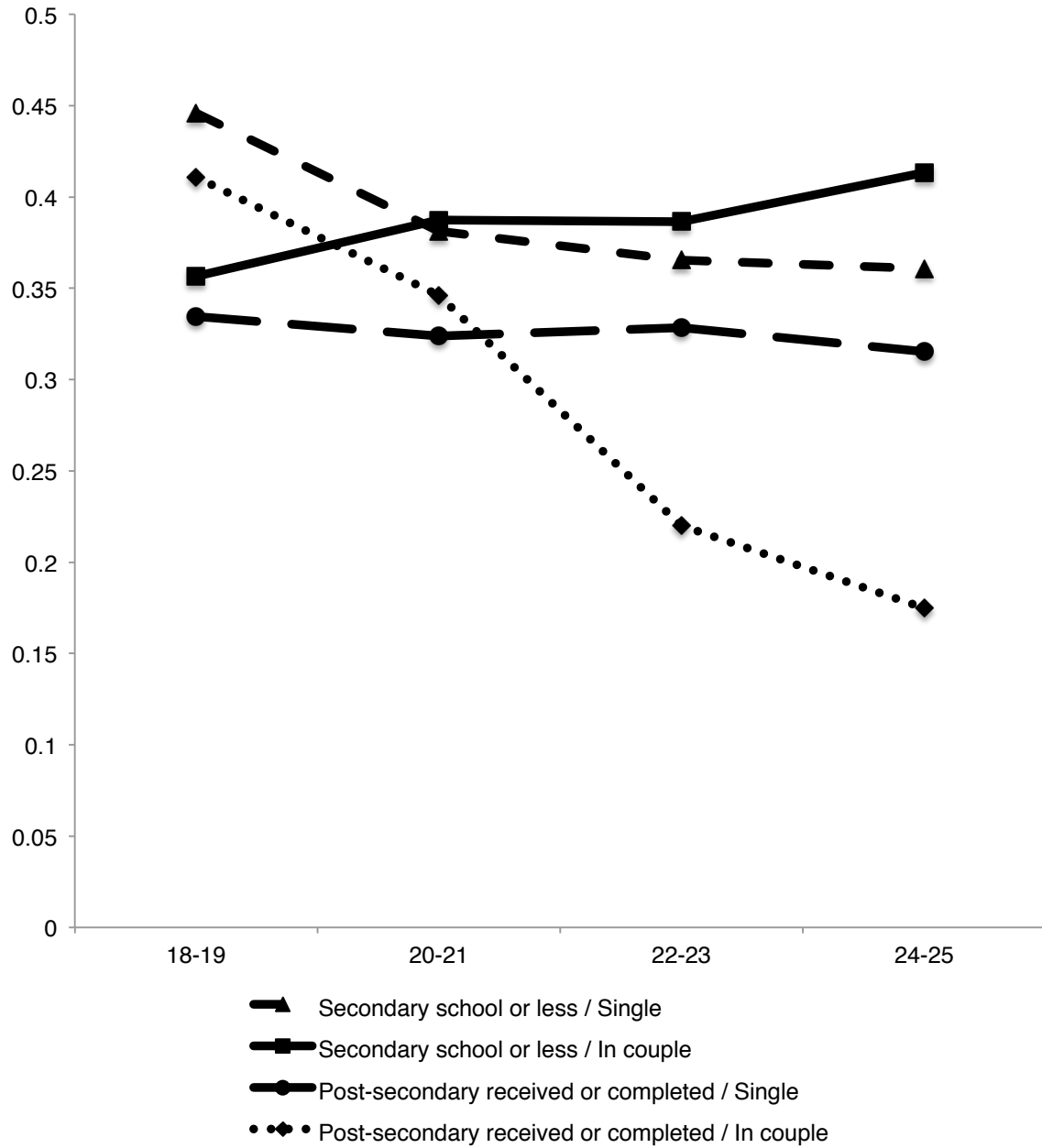
**FIGURE 1 Predicted probabilities of smoking between ages 18 and 25, by educational attainment. National Population Health Survey, Canada, 1994-1995 to 2010-2011. (n = 1,243)**



**FIGURE 2 Predicted probabilities of smoking between ages 18 and 25, by living arrangements. National Population Health Survey, Canada, 1994-1995 to 2010-2011. (*n* = 1,243)**



**FIGURE 3 Predicted probabilities of smoking between ages 18 and 25, by educational attainment and relationship status. National Population Health Survey, Canada, 1994-1995 to 2010-2011. (*n* = 1,243)**



effect of living without parents and without children on the risk of smoking decreased in size from 10.8 p.p. at ages 18-19 (from 29.4% to 40.2%,  $p = .004$ ) to - 3.1 p.p. (from 33.6% to 30.5%,  $p = .30$ ); 3) the marginal effect of having an atypical living arrangement on the risk of smoking varied from 5.3 p.p. at ages 18–19 (from 29.4% to 34.7%,  $p = .11$ ), 2.6 p.p. at ages 20–21 (from 31.8% to 34.4%,  $p = .39$ ), 9.4 p.p. at ages 22–23 (from 30.9% to 40.3%,  $p = .01$ ), to 3.0 p.p. at ages 24–25 (from 33.6% to 36.6%,  $p = .49$ ).

When investigating the two-way interaction between relationship status and age, we found that the marginal effect of being single on the risk of smoking changed in direction, varying from - 6.2 p.p. at ages 18–19 (from 33.0% to 39.2%,  $p = .31$ ) to 11.1 p.p. at ages 24–25 (from 23.0% to 34.1%,  $p < .001$ ). However, we found a three-way interaction between relationship status, education, and age that was (compared to ages 18–19) marginally significant at ages 22–23 ( $p = .06$ ) and statistically significant at ages 24-25 ( $p = .03$ ).

Figure 3 presents the marginal probabilities of smoking across age by relationship status and educational attainment. We found that the negative influence of being single on the risk of smoking was more pronounced among those who pursued post-secondary education and who were 22–23 and 24–25 years of age: among those who received post-secondary education, the marginal effect of being single changed in direction from - 7.6 p.p. at ages 18-19 (from 41.1% to 33.5%,  $p = .58$ ) to 14.0 p.p. (from 17.5% to 31.5%,  $p < .001$ ).

## **DISCUSSION**

Health inequalities during young adulthood cannot be uncovered without placing young adults back within their life-course context. Their socioeconomic circumstances can be captured through the combination of the resources that they accumulate and access, the transition stages that they navigate in and out of, and their timing, sequence, and interaction. To illustrate this, we investigated the dynamics of social inequalities in smoking between the ages of 18 and 25 in Canada through educational attainment and four central transition stages. Supporting our critique, we found that the associations of educational attainment and family arrangements

with smoking varied with age and that the association of relationship status with smoking varied with both education and age.

We found that having pursued post-secondary education was associated with a lower risk of smoking, which echoes other studies suggesting that young adults with lower education are more likely to intensify their consumption during this period.<sup>22,28,29</sup> However, few examined how this association unfolds across young adulthood. We found that the protective influence of having pursued post-secondary education on the risk of smoking was small at ages 18-19 and increased steadily over time. Higher education provides resources (e.g., critical thinking, social contacts, higher income) that are acquired and consolidated over different time frames.<sup>30,31</sup> Educational attainment might also become increasingly salient in defining individuals' status as the proportion of young adults who complete their education trajectory increase. Thus, the “full” effect of education on health behaviours might only reveal itself long after graduation.<sup>8,15,30,31</sup>

We also found that the association of two out of four transition stages – family arrangements and relationship status – with smoking varied with age. Young adults who lived with their parents had the lowest risk of smoking, which echoes studies that have found a protective influence of parents' presence in the household in this age group.<sup>15,32,33</sup> However, the large magnitude of the associations observed at ages 18–19 decreased rapidly over time and disappeared by ages 22–23. These results suggest that leaving the parental household with children at an early age represents a precocious transition that is likely to impact on the capacity to avoid or cease smoking. In contrast, leaving parents and having children at ages 22–25 appears to be more in line with a “normative” transition towards adulthood.

Regarding relationship arrangements, we found that young adults who were not in a couple or married were more likely to report smoking. This finding is also evidenced in other studies that have found a protective influence of marriage and co-habitation with a partner during this period.<sup>7,8,15,32</sup> In our study, however, this association only appeared at ages 22–23 and among young adults who pursued post-secondary education. Differences in the risk of smoking could suggest that young adults who establish a romantic relationship might also be further

indicative of a “normative” transition experience when it is produced at ages 22–25. However, differences by educational attainment suggest that this transition does not systematically lead to social advantage, contributing to the argument that transitions’ sequence lead to a “cascading” development of different health-related practices across social groups.<sup>8,15,18,19</sup>

Before concluding, we note that, in contrast to the popularity of education and occupation measures, relationship and family arrangements appeared to be stronger determinants of young adult smoking when taking into account their variation with age. Staff and colleagues (2010) also found among young Americans that relationship, family, and housing arrangements were more consistently associated with alcohol, smoking, marijuana, and cocaine use than student and employment roles during young adulthood.<sup>15</sup> These findings further support the argument by Graham and colleagues (2006) that uncovering the unequal distribution of health-related practices during young adulthood requires integrating a larger set of socioeconomic characteristics including relationship, family, and housing circumstances.<sup>7</sup>

### **Limitations**

We highlight three limitations. First, our analytic approach does not fully account for unmeasured confounding variables such as parental background variables that might be associated with young adults’ socioeconomic characteristics and smoking, limiting our ability to infer causal relations from associations. Second, personal income and work hours were not available for our full sample, preventing their use despite their relevance for participants’ capacity to afford smoking. Finally, our measure of employment status included as one response choice “not in labor force” and as one reason “educational leave”. Participants could have inappropriately reported their employment status if they were employed but identified as students.

### **Conclusion**

Uncovering health inequalities during young adulthood requires theoretical and methodological advances that account for the complexity of individuals’ socioeconomic circumstances and the dynamic nature of the transition towards adulthood. Our results emphasize that substantial differences in associations between individuals’ socioeconomic

circumstances and health behaviours occur within a narrow age range. This warrants more age-sensitive syntheses of evidence on young adult health to support better-targeted public health and healthy public policies.



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**SUPPLEMENTARY TABLE 1 Associations between young adults' socioeconomic characteristics and smoking : interactions with education. National Population Health Survey, Canada, 1994-1995 to 2010-2011. (n = 1,243)**

Interactions with educational attainment			
	<b>PR</b>	<b>95%CI</b>	<b>p</b>
	N/A	N/A	N/A
<b>Living arrangements</b>			
W/out parents, w/ children x PS more*	0.74	(0.50-1.09)	.13
W/out parents, w/out children x PS more	0.84	(0.69-1.02)	.07
Other x PS more (ref. = Living with parents)	0.82	(0.64-1.04)	.10
<b>Studying status</b>			
Not studying x PS more (ref. = Studying)	0.86	(0.71-1.06)	.17
<b>Employment status</b>			
Unemployed x PS more (ref. = Employed)	1.06	(0.89-1.27)	.49
<b>Relationship status</b>			
Single x PS more (ref. = In couple)	<b>1.56</b>	<b>(1.21-2.01)</b>	<b>.001</b>

The terms "HS less" and "PS more" refer to the categories "Secondary school completed or less" and "Post-secondary education received or completed", respectively.

**SUPPLEMENTARY TABLE 2 Associations between young adults' socioeconomic characteristics and smoking : interactions with age (time). National Population Health Survey, Canada, 1994-1995 to 2010-2011. (n = 1,243)**

Interactions with time			
	PR	95%CI	<i>p</i>
<b>Educational attainment</b>			
PS more x T2	0.90	(0.75-1.08)	.25
PS more x T3	0.85	(0.69-1.04)	.12
PS more x T4	<b>0.73</b>	<b>(0.58-0.91)</b>	<b>.006</b>
<b>Living arrangements</b>			
W/out parents, w/ children x T2	0.76	(0.47-1.27)	.32
W/out parents, w/ children x T3	0.81	(0.65-1.02)	.07
W/out parents, w/ children x T4	0.92	(0.73-1.15)	.46
W/out parents, w/out children x T2	<b>0.53</b>	<b>(0.32-0.89)</b>	<b>.02</b>
W/out parents, w/out children x T3	0.83	(0.66-1.04)	.11
W/out parents, w/out children x T4	1.10	(0.86-1.42)	.44
Other x T2	<b>0.45</b>	<b>(0.26-0.77)</b>	<b>.004</b>
Other x T3	<b>0.66</b>	<b>(0.51-0.86)</b>	<b>.002</b>
Other x T4	0.92	(0.68-1.25)	.61
(ref. = Living with parents)			
<b>Studying status</b>			
Not studying x T2	0.97	(0.81-1.17)	.78
Not studying x T3	1.02	(0.85-1.23)	.82
Not studying x T4	0.97	(0.77-1.22)	.79
(ref. = Studying)			
<b>Employment status</b>			
Unemployed x T2	0.91	(0.76-1.11)	.36
Unemployed x T3	0.84	(0.66-1.06)	.14
Unemployed x T4	0.92	(0.72-1.16)	.47
(ref. = Employed)			
<b>Relationship status</b>			
Single x T2	1.18	(0.810-1.70)	.39
Single x T3	<b>1.55</b>	<b>(1.08-2.22)</b>	<b>.02</b>
Single x T4	<b>1.77</b>	<b>(1.20-2.59)</b>	<b>.004</b>
(ref. = In couple)			

The terms "HS less" and "PS more" refer to the categories "Secondary school completed or less" and "Post-secondary education received or completed", respectively.

**SUPPLEMENTARY TABLE 3 Associations between young adults' socioeconomic characteristics and smoking : interactions with education and age. National Population Health Survey, Canada, 1994-1995 to 2010-2011. (n = 1,243)**

Interaction with educational attainment and age			
	PR	95%CI	p
<b>Living arrangements</b>			
W/out parents, w/ children x T1 X PS more	1.16	(0.51-2.64)	.72
W/out parents, w/ children x T2 X PS more	0.90	(0.59-1.40)	.65
W/out parents, w/ children x T3 X PS more	0.76	(0.48-1.19)	.23
W/out parents, w/ children x T4 X PS more	1.44	(0.86-2.41)	.16
W/out parents, w/out children x T1 X PS more	1.08	(0.78-1.48)	.64
W/out parents, w/out children x T2 X PS more	1.05	(0.71-1.54)	.81
W/out parents, w/out children x T3 X PS more	0.87	(0.47-1.61)	.65
W/out parents, w/out children x T4 X PS more	1.07	(0.72-1.61)	.73
Other x T1 X PS more	0.89	(0.58-1.37)	.60
Other x T2 X PS more	0.90	(0.48-1.67)	.73
Other x T3 X PS more	0.87	(0.58-1.30)	.50
Other x T4 X PS more	0.83	(0.52-1.31)	.42
(ref. = Living with parents)			
<b>Studying status</b>			
Not studying x T1 X PS more	0.77	(0.52-1.14)	.19
Not studying x T2 X PS more	1.23	(0.88-1.72)	.22
Not studying x T3 X PS more	1.20	(0.85-1.69)	.29
Not studying x T4 X PS more	0.99	(0.71-1.39)	.96
(ref. = Studying)			
<b>Employment status</b>			
Unemployed x T1 X PS more	1.11	(0.82-1.51)	.49
Unemployed x T2 X PS more	1.05	(0.81-1.35)	.72
Unemployed x T3 X PS more	1.17	(0.75-1.82)	.48
Unemployed x T4 X PS more	0.88	(0.60-1.29)	.51
(ref. = Employed)			
<b>Relationship status</b>			
Single x T1 X PS more	1.02	(0.49-2.10)	.96
Single x T2 X PS more	0.92	(0.65-1.31)	.65
Single x T3 X PS more	1.41	(0.98-2.03)	.06
Single x T4 X PS more	<b>1.57</b>	<b>(1.05-2.36)</b>	<b>.03</b>
(ref. = In couple)			

The terms "HS less" and "PS more" refer to the categories "Secondary school completed or less" and "Post-secondary education received or completed", respectively.

**SUPPLEMENTARY TABLE 4 Smoking status across time and period. National Population Health Survey, Canada, 1994-1995 to 2010-2011. (*n* = 1,243)**

	<b>18-19</b>	<b>20-21</b>	<b>22-23</b>	<b>24-25</b>
	(%)	(%)	(%)	(%)
1994-1995	34.1%			
1996-1997	38.7%	35.2%		
1998-1999	35.0%	41.5%	38.5%	
2000-2001	31.6%	42.1%	41.6%	36.6%
2002-2003	35.0%	29.1%	34.8%	36.0%
2004-2005	18.3%	31.8%	26.3%	33.6%
2006-2007		16.6%	33.3%	26.6%
2008-2009			17.5%	29.1%
2010-2011				20.7%

**SUPPLEMENTARY TABLE 5 Predicted probabilities of smoking : interactions with educational attainment. National Population Health Survey, Canada, 1994-1995 to 2010-2011. (n = 1,243)**

	Secondary school or less (%)	Post-secondary received or completed (%)
<b>Living arrangements</b>		
Living w/ parents	32.74 <sup>a, b</sup>	30.29
Not living w/ parents, no children	40.94 <sup>a</sup>	31.70
Not living w/ parent, w/ children	44.24	30.29
Other	43.44 <sup>b</sup>	32.81
<b>Relationship status</b>		
Single	36.86	<b>32.64</b>
In couple	37.83	<b>21.41</b>
<i>Marginal effect</i>	0.96	<b>-11.24</b>
<i>P-value</i>	.79	<b>&lt;.001</b>
<b>Student status</b>		
Studying	<b>32.08</b>	29.54
Not studying	<b>40.04</b>	32.02
<i>Marginal effect</i>	<b>7.97</b>	2.48
<i>P-value</i>	<b>.02</b>	.12
<b>Employment status</b>		
Employed	37.63	31.31
Unemployed	34.48	30.54
<i>Marginal effect</i>	-3.15	-0.77
<i>P-value</i>	.23	.64

Letters in superscript distinguish statistically significant differences at the .05 level between probabilities among "Living arrangements" categories.



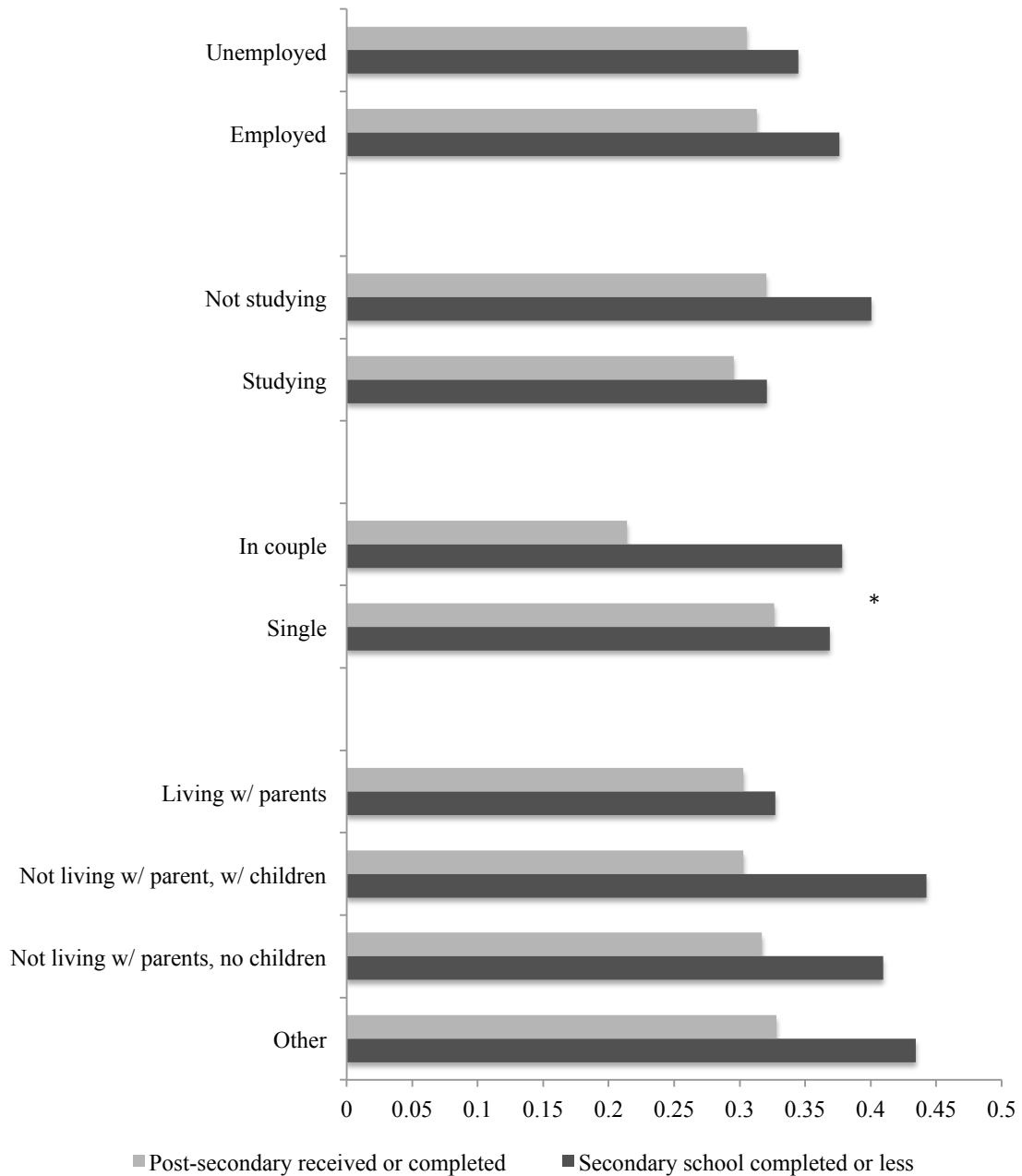
**SUPPLEMENTARY TABLE 6 Predicted probabilities of smoking : interactions with age (time). National Population Health Survey, Canada, 1994-1995 to 2010-2011. (n = 1,243)**

	18-19 (%)	20-21 (%)	22-23 (%)	24-25 (%)
<b>Education</b>				
Secondary school or less	34.66	37.79	38.85	41.31
Post-sec. received or completed	32.82	32.18	31.19	28.41
<i>Marginal effect</i>	-1.8	-5.6	-7.7	-12.9
<i>P-value</i>	0.527	0.052	<b>0.027</b>	<b>0.001</b>
<b>Living arrangements</b>				
Living w/ parents	<b>29.38<sup>a,b</sup></b>	<b>31.81<sup>a</sup></b>	<b>30.90<sup>a</sup></b>	33.60
Not living w/ parents, no children	<b>40.17<sup>a</sup></b>	<b>35.34<sup>b</sup></b>	34.98	30.53
Not living w/ parent, w/ children	<b>60.26<sup>b</sup></b>	<b>50.63<sup>a,b,c</sup></b>	33.74	31.19
Other	34.65	<b>34.42<sup>c</sup></b>	<b>40.25<sup>a</sup></b>	36.61
<b>Relationship status</b>				
Single	33.00	34.23	34.71	34.13
In couple	39.24	34.59	26.58	23.00
<i>Marginal effect</i>	6.2	3.6	<b>-8.1</b>	<b>-11.1</b>
<i>P-value</i>	0.309	0.918	<b>0.005</b>	<b>&lt; 0.001</b>
<b>Student status</b>				
Studying	30.05	31.86	30.44	29.95
Not studying	34.12	35.21	35.30	32.97
<i>Marginal effect</i>	4.1	3.3	<b>4.9</b>	3.0
<i>P-value</i>	0.115	0.164	<b>0.035</b>	0.299

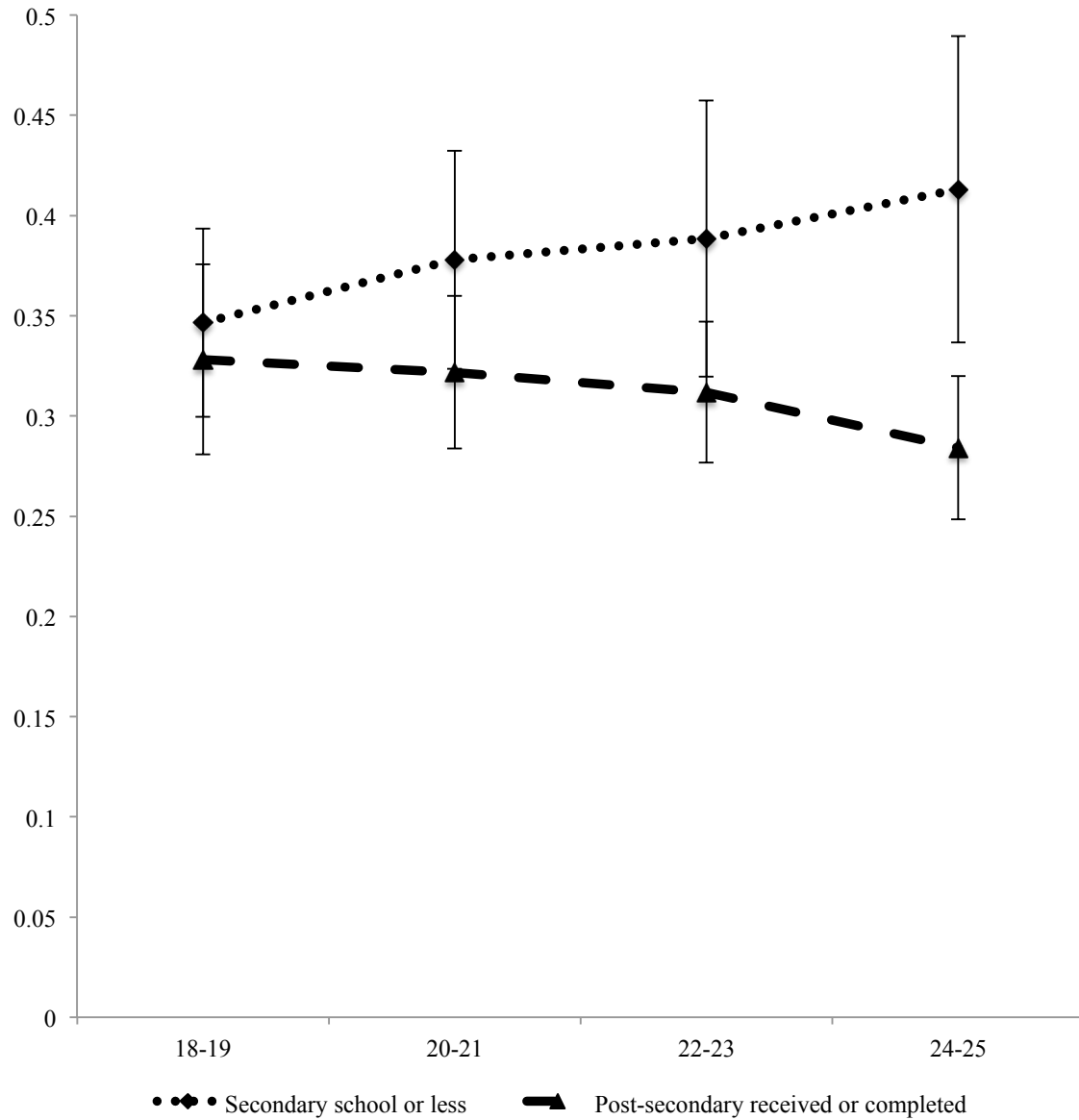
Employment status	Employed	Unemployed	Marginal effect		P-value
	31.71	32.65	0.9	0.706	
	34.29	32.31	-2.0	0.358	0.082
	34.40	29.67	-4.7	0.082	0.494
	31.98	30.15	-1.8	0.494	
Education * Relationship	HS or less: Single	35.66	38.75	<b>38.65<sup>a</sup></b>	<b>41.34<sup>a,d</sup></b>
	HS or less: In couple	44.61	38.14	<b>36.55<sup>b</sup></b>	<b>36.07<sup>b</sup></b>
	PS or more: Single	33.45	32.39	<b>32.84<sup>c</sup></b>	<b>31.52<sup>c,d</sup></b>
	PS or more: In couple	41.09	34.60	<b>21.99<sup>a,b,c</sup></b>	<b>17.49<sup>a,b,c</sup></b>

Letters in superscript distinguish statistically significant differences at the .05 level between probabilities in the "Living arrangements" and "Education \* Relationship" categories.

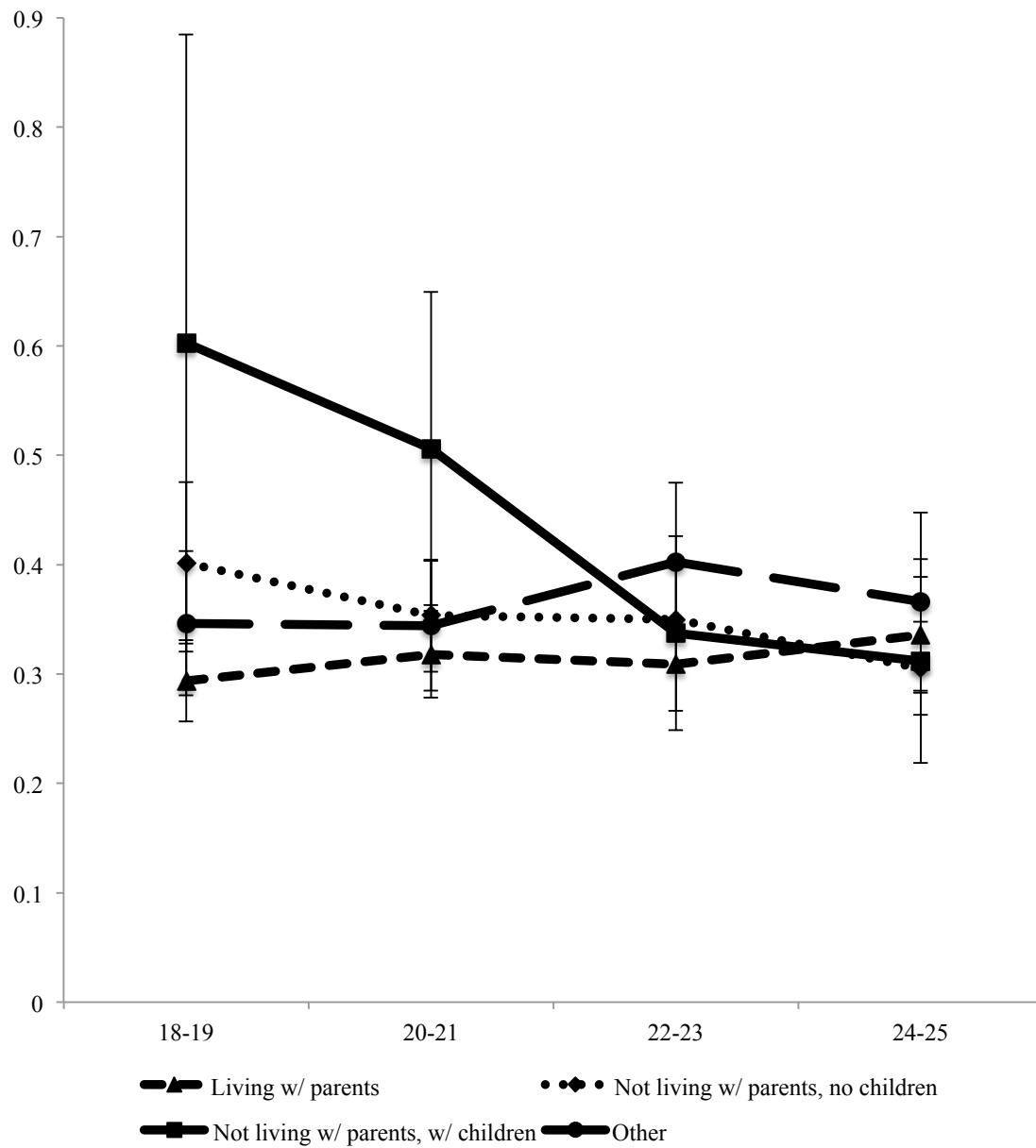
**SUPPLEMENTARY FIGURE 1 Predicted probabilities of smoking, by education status and transition stages. National Population Health Survey, Canada, 1994-1995 to 2010-2011. (*n* = 1,243)**



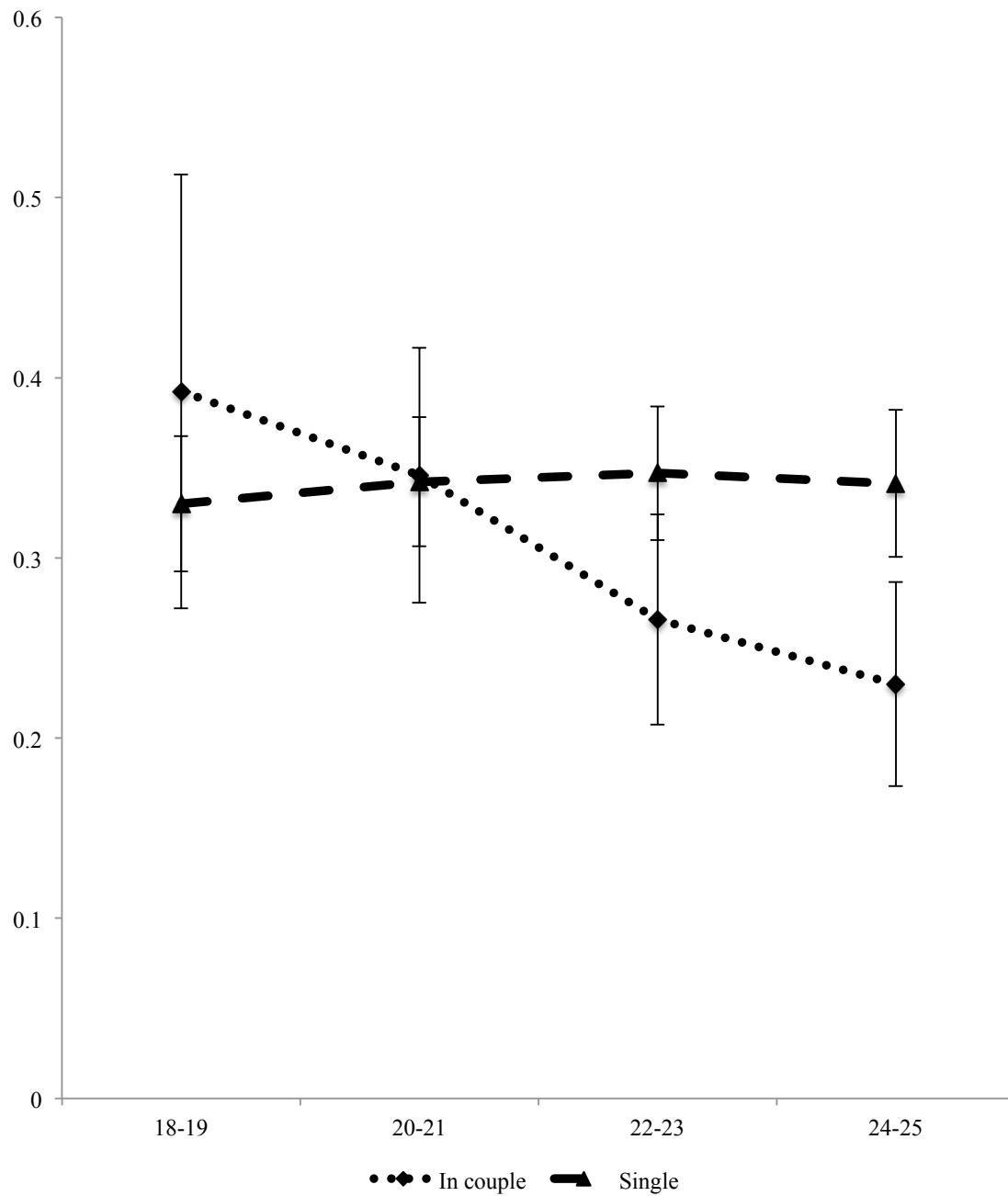
**SUPPLEMENTARY FIGURE 2 Predicted probabilities of smoking between ages 18 and 25, by educational attainment (with 95% confidence intervals). National Population Health Survey, Canada, 1994-1995 to 2010-2011. (*n* = 1,243)**



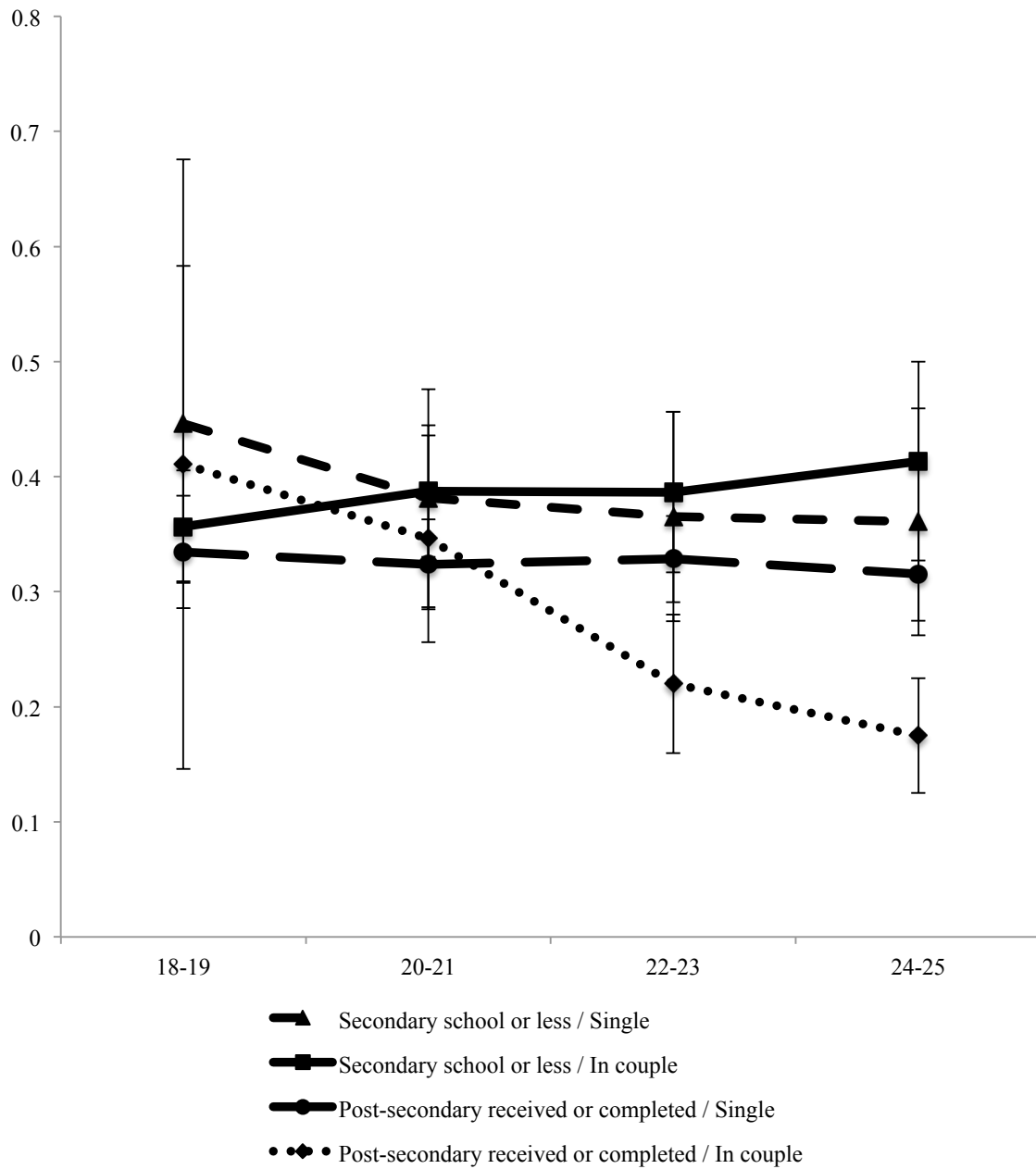
**SUPPLEMENTARY FIGURE 3 Predicted probabilities of smoking between ages 18 and 25, by living arrangements (with 95% confidence intervals). National Population Health Survey, Canada, 1994-1995 to 2010-2011. (*n* = 1,243)**



**SUPPLEMENTARY FIGURE 4 Predicted probabilities of smoking between ages 18 and 25, by relationship status (with 95% confidence intervals). National Population Health Survey, Canada, 1994-1995 to 2010-2011. (*n* = 1,243)**



**SUPPLEMENTARY FIGURE 5 Predicted probabilities of smoking between ages 18 and 25, by educational attainment and relationship status (with 95% confidence intervals). National Population Health Survey, Canada, 1994-1995 to 2010-2011. ( $n = 1,243$ )**



## **CHAPTER 6. DISCUSSION**



The overarching goal of this thesis was to shed new light on the role of young adulthood in the lifelong instalment of health inequalities, using smoking as a case example. In doing so, this thesis addresses four critical problems: (1) the higher prevalence of smoking and worrying trends in initiation and cessation among young adults, (2) the relatively unchallenged progression of social inequalities in smoking, (3) the limitations of traditional epidemiological approaches in understanding socio-economic circumstances and life-course processes, and (4) the rise of increasingly elongated, complex, and unequal trajectories to adulthood, obfuscating many of their consequences for generations to come.

The contributions of this thesis began with a review of the evidence on social inequalities in smoking among young adults. Celebrating the breadth of characteristics used to measure the socio-economic circumstances of young adults, and challenging the focus on traditional indicators such as educational attainment, I proposed a conceptual framework for how we might better understand socio-economic circumstances and their influence on the uptake of health practices during the transition to adulthood. In light of this, the specific objectives of the thesis aimed to demonstrate the applicability and relevance of this framework. Empirically, this entailed first examining, beyond educational attainment, what resources were associated with smoking and whether these associations varied by educational attainment. This then entailed examining the contribution of transition stages across social groups and the timing of each of these characteristics in keeping with the different ages through which young adults progress.

I begin this chapter by synthesizing, in section 6.1, the findings in articles 2 to 4. I then return in section 6.2 to the literature on social inequalities in smoking to address the novelty of my findings. I also use this section to compare my findings from the ISIS and NPHS data sets and explore the reasons for their discrepancies. In section 6.3, I address selected themes crosscutting the thesis findings, focusing on (1) understanding socio-economic circumstances and their relation to social inequalities in smoking, (2) contextualizing social inequalities in smoking in the transition to adulthood, and, finally, (3) questioning the relevance of the findings for intervention in smoking among young adults. I end this chapter by addressing the

thesis limitations in section 6.4 and next steps for research in section 6.5. I present the thesis conclusions in chapter 7.

### **6.1 Summary of articles 2 to 4**

I began article 2 by formalizing a set of theoretical arguments to understand young adults' socio-economic circumstances and their association with smoking. I built on the work of Pierre Bourdieu (1977, 1986) to shift the definition of behaviour from a product of rational thought to a social practice that emerges out of individuals' collective experiences with the resources that they unequally accumulate. I drew on the typology of capital – economic, social, and cultural – to distinguish among forms of resources (Bourdieu 1986). Building on the principle of “conditionality” (Abel 2007, 2008), I also proposed that the associations between resources and health practices were likely to be better understood through their interplay. However, I posited that individuals, after their early socialization, were likely to continue integrating different resources and social practices as they progressed to adulthood. Shifting my focus to life-course theory (Hogan and Astone 1986; Shanahan 2000; Elder, Johnson and Crosneo 2003; Côté and Bynner 2008), I proposed to extend the definition of socio-economic circumstances to include the transition stages in which social processes continue and to explore their different implications for smoking outcomes across social groups.

To illustrate this, I investigated the unequal distribution of smoking among young adults in the Montreal-based ISIS data set. Building on the indicator of educational attainment, I examined (1) the associations of additional resources and transition stages with smoking and (2) whether these associations were also modified by educational attainment. The hypothesis underlying this exercise was that those with less education would experience an excess risk of smoking resulting from the absence of other resources and from entering adult milestones between the ages of 18 and 25 (the opposite being true for those with higher education).

The findings supported the applicability and relevance of these arguments. Addressing the first objective, I found that educational attainment did not account for the contributions of (1) having experienced financial difficulties and a higher personal income, each of which was

associated with a higher risk of smoking; and (2) living with parents and living with children, each of which was associated with a lower risk of smoking.

Addressing the second objective, investigating differences across education-based categories offered a better understanding of the unequal distribution of smoking in this age group. Among participants who had not completed post-secondary education, I found that no longer being a student and having a higher income was each associated with an excess risk of smoking. On the other hand, among participants who had completed some university, I found that income was no longer associated with smoking and that being in a relationship, having a partner from whom one could borrow money, and no longer being a student was each associated with an excess lower risk of smoking. While I did not highlight it in article 2, I also found that full-time employment was marginally associated with an excess lower risk of smoking among participants who had completed some university ( $p_{\text{interaction}} = 0.05$ ; 10.3% versus 16.4%,  $p = 0.05$ ).

I moved in article 3 to present and illustrate the second life-course dimension underlying social inequalities in smoking during young adulthood: age. By examining age differences, we can further contextualize the roles that resources and transition stages play at different moments during the transition to adulthood in the unequal uptake of smoking. To support this, I built on the body of work that has examined the interface between young adult transitions and behaviour uptake in the social sciences (Yamaguchi and Handel 1995; Schulenberg and Maggs 2002; Schulenberg et al. 2005; Settersten, Rumbaut and Furstenberg 2005; Staff et al. 2010; Côté and Bynner 2008; Pampel et al. 2014). In this scholarship, the transitions in and out of education, employment, family, and housing are theorized to involve both the negotiation of stressful events with harmful coping behaviours and the integration of social norms with positive health implications.

These two outcomes, however, are strongly determined by when transition stages are experienced. In turn, socially disadvantaged groups are systematically more likely to experience these transitions “out of time,” either precociously or belatedly (Côté and Bynner 2008; Pampel, Mollborn and Lawrence 2014). Therefore, I explored whether differences in

associations between socioeconomic characteristics and smoking were also modified by age, comparing ISIS participants aged 18–19, 20–21, 22–23, and 24–25. I hypothesized that (1) the absence of resources was likely to be associated with an excess higher risk of smoking as age increased because those with fewer resources were more likely to have intensified smoking and less likely to have quit smoking, and (2) the entry into transition stages was likely to be associated with an excess higher risk of smoking at an early age (i.e., age 18) but an excess lower risk of smoking at a later age (i.e., age 25).

The findings supported the relevance and applicability of this second life-course principle. The majority of the socio-economic characteristics associated with smoking between the ages of 18 and 25 had significantly different associations across age categories. First, I found that education-based inequalities in smoking increased linearly across age categories. Second, I found that the association between smoking and each of personal income, student status, and full-time employment status was strong among participants at ages 18–19, strongest among participants at ages 20–21, and weak or absent among participants at ages 22–23 and 24–25. On the other hand, I found that having experienced financial difficulties and living with parents remained associated with a consistently lower risk of smoking between the ages of 18 and 25.

While analyses in the ISIS data set benefited from the amount of socio-economic information available for a large sample of young adults, they were limited by (1) its cross-sectional design, which could not support the longitudinal processes implied by age-based analyses; and (2) its metropolitan setting, which limited its generalizability to the Canadian population. In article 4, I sought to complement the findings developed in the ISIS study with a second data set that would offer a prospective design, a nationally representative sample, and a sufficiently large sample size to investigate age differences across education-based groups.

As a result, I examined the data of participants in the NPHS. Noting that information on economic characteristics was available for only a subset of the young adult participants, I focused on educational attainment and transition stages to test the full implications of my theoretical proposal. Article 4, therefore, examined the contribution of educational attainment

and transition stages (student status, employment status, relationship status, and family arrangements with parents and children) to smoking, the variation in their associations at the ages of 18–19, 20–21, 22–23, and 24–25, and, for the first time, the differences in variation in associations at different ages across education-based categories.

My findings further supported my theoretical framework and corroborated the findings in the ISIS data set. In the main models, having higher education, studying, living with parents, and being in a relationship was each associated with a lower risk of smoking. Investigating age differences across education-based groups, however, led to a nuanced understanding of the contribution of each of these characteristics to the progression of social inequalities in smoking during young adulthood. First, I found that education-based inequalities in smoking increased linearly in those aged 18–19 and 24–25, supporting the findings in the ISIS data set. Second, I found that living arrangements with parents and children had significant, different associations with smoking between the ages of 18 and 25, contrasting with the findings in the ISIS data set. Living without parents, especially with children, was associated with a much higher risk of smoking at ages 18–19. This association, however, rapidly decreased in importance with age and was no longer noticeable at the ages of 24–25. In the ISIS data set, living with parents and living with children was each associated with a lower risk of smoking, and it did not significantly vary with age.

Finally, I found that being in a relationship was associated with a lower risk of smoking only among those who had pursued post-secondary education; this again supports the results found in the ISIS data set. However, examining how this association unfolded across both education- and age-based categories in the NPHS helped disentangle this mechanism. In the NPHS, the association between relationship status and smoking increased with age and began to be significantly associated with an excess lower risk of smoking in those aged 22–23. However, the benefit for young adults of being in a relationship appeared with age only if they had also been pursuing post-secondary education.

To conclude this section, table 6.1 offers a summary of the findings in the ISIS and NPHS data sets. It reports, for each data set, whether a socio-economic characteristic was related to

**TABLE 6.1 Findings from the Interdisciplinary Study of Inequalities in Smoking (ISIS) and National Population Health Survey (NPHS)**

Scenario	Dataset	Resource			Transition stage					
		Educational attainment	Personal income	Economic <sup>a</sup> Partner \$500 Financial difficulties YES MAYBE	Social <sup>b</sup> NO	Student status	Employment status	Being in a relationship	Living with parents	Living with children
Associated with smoking between the ages of 18 and 25?	ISIS	YES	YES	YES	NO	NO	NO	NO	YES	YES
	NPHS	YES	---	---	---	YES	NO	YES	YES	YES
Further associated with smoking among those who do not pursue/complete post-secondary education?	ISIS	---	YES	NO	NO	YES	NO	NO	NO	---
	NPHS	---	---	---	---	NO	NO	NO	NO	NO
Further associated with smoking among those who pursue/complete post-secondary education?	ISIS	---	NO	Partner \$500 YES	NO	YES	MAYBE	YES	NO	---
	NPHS	---	---	---	---	NO	NO	YES	NO	NO
Further associated with smoking when experienced towards the end of adolescence (ages 18-21)?	ISIS	NO	YES	NO	NO	YES	MAYBE	NO	NO	---
	NPHS	NO	---	---	---	NO	NO	NO	YES	YES
Further associated with smoking when experienced towards the mid-twenties (ages 22-25)?	ISIS	MAYBE	NO	NO	NO	NO	NO	MAYBE	NO	---
	NPHS	YES	---	---	---	NO	NO	YES <sup>c</sup>	NO	NO

Note: YES represents a significant result at the .05 level; MAYBE represent a significant result at the .10 level.

<sup>a</sup> Includes 'having a father/mother/friend/partner from whom one can borrow \$500 from in case of emergency' and 'having experienced financial difficulties in the past year'

<sup>b</sup> Includes 'size of social support network' and 'having a family member who can provide a job-related contact'

<sup>c</sup> Only among those who pursued or completed post-secondary education

smoking status in five scenarios: among the young adult population, among those who had not pursued or completed post-secondary education, among those who had pursued or completed post-secondary education, among those who were closer to the end of adolescence (ages 18–21), and among those who were closer to their mid-twenties (ages 22–25).

## **6.2 Returning to the literature review**

The literature review in chapter 2 ended with the argument that there was still relatively little evidence on the socio-economic characteristics associated with smoking specifically during the transition to adulthood. The systematic review in article 1 found that the evidence had been disproportionately developed, using only a subset of socio-economic indicators, leaving inconsistent conclusions about many of the other characteristics that might be linked to smoking outcomes. Addressing this knowledge gap, the thesis findings are discussed below in three main subsections: (1) educational attainment, (2) economic and social resources, and (3) transition stages in education, employment, family, and housing.

### **6.2.1 Educational attainment**

The thesis findings add new support for the critical role that educational attainment plays in both social and health inequalities. The description of the ISIS sample in article 2 implied that each of the socio-economic characteristics examined in the analyses was associated with educational attainment. I reproduced these associations, controlling for age, in Appendix XI and came to similar conclusions. Compared with those who complete only high school or less, young adults who complete post-secondary education are 55% less likely to have experienced financial difficulties in the previous year; 22%–36% more likely to have either a father, mother, partner, and friend from whom they can borrow money; 30% more likely to have a family member who can “most probably” help them with a job contact; and 20% more likely to have a large social support network of 15+ peers. They are also 62% less likely to be living with children and 31% more likely to continue studying; this finding supports the idea that those who pursue post-secondary education are more likely to continue studies and delay family formation during this period.

These results support the argument that educational attainment is already a powerful predictor of socio-economic circumstances during a life period in which a majority of young adults are still obtaining educational credentials. I note, however, that educational attainment was no longer associated with personal income, full-time employment, relationship status, or living arrangements with parents once participants' age was controlled for.

Regardless of its capacity to capture young adults' socio-economic circumstances, educational attainment also emerged as the most robust socio-economic predictor of smoking in my findings. There was a notable difference in the size of the associations between post-secondary education and smoking between ages 18–19 and 24–25 in the two data sets: from 2 p.p. to 13 p.p. in the NPHS and from 9 p.p. to 21 p.p. in the ISIS, respectively. Three factors might explain this discrepancy. A first explanation might be the difference in measures between the ISIS and NPHS. The ISIS variable measured the highest diploma completed, while the NPHS variable measured the highest diploma received since it offered the response choices “*some* trade school,” “*some* community college,” and “*some* university.” This discrepancy might underestimate the association between education and smoking if young adults who receive, but do not complete, post-secondary education have a higher risk of smoking than those who complete post-secondary education.

A second explanation might be the period of time between these two studies. The analysis of the NPHS data set regroups young adults who transitioned to adulthood between 1994–1995 and 2010–2011, while the ISIS data set represents young adults from 2011 to 2012. Since social inequalities in smoking increased in Canada during this period (Corsi et al. 2014), it is reasonable to find larger education-based inequalities in smoking in the ISIS data set. One last explanation concerns the metropolitan status of Montreal. Differences in educational attainment explain a large proportion of financial opportunities across urban and rural areas in Canada (Beckstead et al. 2010). Social inequalities in smoking might, therefore, be more sizable in large urban centres, where post-secondary education is both more prevalent and important for employment possibilities. Supporting this, Idris and colleagues (2007) examined urban-rural differences in smoking across six European countries and found that educational inequalities in smoking were consistently larger in urban settings.



Controlling for economic and social resources and transition stages did little to explain the “education-smoking” association in both the ISIS and the NPHS data sets. Despite the extent of the literature that has addressed this association, researchers still know relatively little about what it is about educational attainment that protects from smoking (Cutler and Lleras-Muney 2010; Pampel, Krueger and Denney 2010; Takagi et al. 2016; Lawrence 2017; Holmes 2018). Cutler and Lleras-Muney (2010) examined the share of the education gradients in health behaviours that was attributable to income, knowledge, cognitive ability, risk discounting, personality, and social relations across multiple cohort studies and found that these accounted only for a relatively small portion of these gradients. In the context of smoking during young adulthood, Lawrence (2017) examined the benefits of education for smoking between the ages of 24 and 32 and observed that a third of this association could be explained by better financial and occupational opportunities. On the other hand, this author found no benefits from having more social (i.e., having close friends, attending social events, and volunteering) and psychological (i.e., cognitive ability, sense of mastery, perceived stress, and mental health) resources. It may be that the economic benefits associated with educational attainment emerge only after the age of 25, explaining why this mediation effect was not found in the ISIS and NPHS data sets. It is also possible that the social and psychological benefits associated with educational attainment regarding smoking cessation emerge only at a later point in the life-course.

My findings, therefore, contribute to the argument that there is a distinct cultural mechanism underlying the association between educational attainment and smoking, especially during young adulthood (Pampel, Krueger, and Denney 2010, Lawrence 2017). That is, beyond the material and psychosocial benefits that young adults may gain from pursuing education, they are likely to consolidate their social position by acquiring educational credentials. In turn, this position reinforces the embodiment of health practices that match their affiliation, including smoking cessation.

It is, finally, interesting to note that educational attainment was an important contributor to the change in the associations of the other resources and transition stages with smoking between

unadjusted and fully adjusted models. In Appendix XII, I report nested models in which educational attainment was the sole variable controlled for to support its contribution to the change in the associations of other characteristics with smoking. In these models, educational attainment appears to reduce the size of the associations of having a father and a mother from whom young adults can borrow and having experienced financial difficulties with smoking by 50%–75%. While explicit mediation analyses are needed to appropriately disentangle these relationships, these results add new support to the argument that the influence of family characteristics (defined here through the parents' capacity to support young adults financially) on smoking is often explained by the own educational achievement of young adults (Paavola et al. 2004; Kestila et al. 2006; Kuntz and Lampert 2013; Motta et al. 2015).

### **6.2.2 Economic and social resources**

Notwithstanding the importance of educational attainment, the thesis findings partially support the fact that the operationalization of young adults' socio-economic circumstances benefits from the integration of economic and social resources. With regard to economic resources, I found that (1) financial difficulties were associated with a higher risk of smoking, (2) personal income was associated with a higher risk of smoking among young adults who had not completed university, and (3) having a partner from whom they could borrow money was associated with a lower risk of smoking among young adults who had completed university. In contrast, the economic resources available in the rest of young adults' social network (i.e., parents and friends) were not significantly associated with a lower risk of smoking in fully adjusted models. Similarly, having more sources of social support in one's network and having a family member who could provide a job contact did not appear to be associated with a lower risk of smoking. These findings are addressed in turn.

#### **6.2.2.1 Financial difficulties**

Consistent with the findings in the systematic review, having experienced financial difficulties was independently associated with a 25% increase in the risk of smoking in the ISIS sample. This association did not appear to differ across education- or age-based categories. A sizable literature has observed that financial stress is associated with a higher risk of smoking, continuation among smokers, and relapse among ex-smokers (McKee et al. 2003; Siahpush,

Borland, and Scollo 2003; Siahpush and Carlin 2006; Siahpush et al. 2009; Widome et al. 2015). The association between financial difficulties and smoking appears to be consistent across income- and education-based groups, but might be stronger in households that spend a higher percentage of their expenditures on cigarettes (Siahpush, Borland, and Scollo 2003; Siahpush et al. 2012). Supporting the social inequalities driving this mechanism, Siahpush and colleagues (2018) found that controlling for the probability of being a household with smokers, households that spent a higher percentage of expenditures on cigarettes were more likely to be headed by someone with less education and employed in blue-collar work.

The positive association between financial stress and smoking is unique in that financial stress is usually negatively associated with spending on nearly all expenditure items, including clothing, food, alcohol, and gambling (Siahpush, Borland, and Scollo 2003; Siahpush and Carlin 2006). Siahpush and colleagues (2012) found that low-income smokers tended to underestimate the economic burden of cigarette purchases compared to other forms of expenditure. Guillaumier and colleagues (2015) observed that low-income smokers also learned to adapt their consumption practices, including going without meals, substituting food choices, and paying bills late, to afford cigarettes. This might explain, in part, why low-income smokers are more likely to report severe financial difficulties than low-income non-smokers (Guillaumier et al. 2017). Given the strong association of financial hardship with mental health, low-income smokers might also be more likely to smoke as a mechanism to alleviate stress, thereby increasing their likelihood to become dependent on nicotine (Widome et al. 2015; Butterworth et al. 2012). Supporting this, smokers in financial distress were more likely to report wanting to quit, but less likely to succeed when trying to quit (Siahpush et al. 2009; Cleyachetty et al. 2012; Kalkhoran et al. 2018).

I found no studies that examined how the association between financial difficulties and smoking progressed during the transition to adulthood. While there were no significant differences with age in the thesis findings, this association is likely to progress over the life course. The prevalence of financial hardship peaks during young adulthood and begins to decrease afterwards (Mirowsky and Ross 1999). Young adults are also twice as likely to report financial hardship as their main reason for quitting smoking compared with other age groups

(Grøtvedt and Stavem 2005). The association between financial hardship and income in this age group is also explained, in large part, by cigarette and alcohol consumption and trajectories in parenthood, indicating that those who do not smoke and do not have children are less likely to experience financial hardship when they have a lower income during this period (Mirowsky and Ross 1999).

Finally, the experience of having financial difficulties is likely to have a long reach over the life course (Kahn and Pearlin 2006). Lindstrom and colleagues (2013) found that financial difficulties experienced during childhood and adulthood cumulatively contributed to the risk of smoking in mid-life. Similarly, Bartley and colleagues (2012) found that financial hardship in early adolescence remained associated with lung function in mid-life after accounting for household assets in adolescence and occupational grade in adulthood.

#### **6.2.2.2 Personal income**

The strong relationship observed between personal income and smoking in the ISIS data set further informs how economic circumstances may be associated with young adults' risk of smoking. Consistent with two other studies in the US and New Zealand (Pampel et al. 2014; Blakely et al. 2014), it was found that young adults with an annual income of \$20,000 or more were approximately 70% more likely to report smoking than those who did not have a personal income. However, when investigating education- and age-based differences, personal income was associated with a higher risk of smoking only among young adults who had not completed university and were between the ages of 18 and 21. This finding corroborates studies that observed that socially disadvantaged individuals were more sensitive to price differences, although no study found has confirmed this among socially disadvantaged young adults (Bader, Boisclair, and Ferrence 2011).

Economic models of behavioural change suggest that highly educated groups are less likely to be influenced by cigarette prices given their future orientation; less educated groups, however, are more likely to base their smoking decisions on current prices (Pampel, Krueger and Denney 2010). Therefore, while income is normally understood to be a protective factor in health behaviour uptake (including in mitigating financial hardship), its contribution to the

capacity to avoid or cease smoking might be offset by its capacity to directly facilitate cigarette consumption among those with less education in this age group.

It is important to note that occupation might represent a strong alternative explanation for the “income-smoking” association among those who have not completed university. The jobs that young adults seek across education categories might provide them with both different incomes and risks of smoking (Asfar et al. 2016). In Canada, the jobs employing the most young adults who have not completed high school are found in manual labour (e.g., construction trade helpers and labourers, transport truck drivers) and service industry (light-duty cleaners, cashiers, food and drink servers) (Gilmore 2010; Uppal 2017). These jobs are likely to provide a higher income for young adults, especially men, with little education who want to rapidly move on to full-time employment (Uppal 2017). Young employees in these industries are, however, systematically more likely to report smoking (Hammond 2005; Caban-Martinez et al. 2011).

Multiple characteristics disproportionately burden these employees’ chances of avoiding or stopping smoking. Poor working conditions and occupational hazards such as heavy physical workload, dirty working conditions, and noise pollution, more prevalent in manual labour jobs, have been consistently associated with a lower capacity to stop smoking (Albertsen et al. 2004; Kim 2015). These industries are also more likely to expose their employees to second-hand smoke, to provide less access to smoking cessation programs, and to have fewer workplace rules limiting smoking (Ham et al. 2011; Holmes and Ling 2014). As discussed in article 3, studies have also found that young adults exposed to smoking from co-workers are more susceptible to initiating and intensifying smoking and that young adults who work in a smoke-free building are less likely to relapse (Macy et al. 2007; Fagan et al. 2007).

Ultimately, the alternative hypothesis that it is not income but occupational type that influences smoking cannot be confirmed here. While the thesis controlled for full-time employment status, analyses could not be further adjusted for occupational type in the ISIS data set. This, however, may have been explored in the NPHS data set in the sub-sample of

young adult participants in which information on personal income and occupational type was collected (I address this further in section 6.5.)

### **6.2.2.3 Social resources**

Compared with financial difficulties and personal income, the majority of other economic and non-economic measures used to represent young adults' social resources in the ISIS data set were not associated with smoking. These included having a father, mother, or friend from whom one could borrow money, having sources of social support in one's social network, and having a family member who could provide a job contact. Only having a partner from whom one could borrow money was associated with a lower risk of smoking among participants who had completed a university degree.

Multiple dimensions of social relations have been found to be associated with smoking (Umberson, Crosnoe, and Reznick 2010). Of these, peer smoking represents by far the most robust predictor of smoking outcomes (Kobus 2003; Christakis and Fowler 2008; Blok et al. 2017). Illustrating this, Blok and colleagues (2017) in Australia found that having only smokers among family members and friends was independently associated with 300% increased odds of maintaining smoking and 500% increased odds of relapsing over a one-year period in comparison to those who did not have smokers in their network. Similarly, in another publication using the ISIS data set, it was found that having most of or all one's friends who were smokers was associated with 220% higher odds of becoming a smoker, and 190% higher odds of remaining a smoker, over a two-year period in comparison with those who had none or few smoking friends (Appendix XIII) (Steinmetz-Wood et al. 2018).

Notwithstanding the role of peer smoking, having a strong social network is a considerable resource for individuals' capacity to avoid or cease smoking (Umberson, Crosnoe, and Reznick 2010). Two reviews found that adolescents who were socially isolated were systematically more likely to smoke in comparison with others who had friends (Seo and Huang 2012; Choi and Smith 2013). Social isolation remains consistently associated with smoking over the life course (Shankar et al. 2011). It is also interesting to note that there appears to be a stronger effect on smoking from being socially isolated than from feeling socially isolated. Dyal and

Valente (2015) reviewed 25 studies on the influence of loneliness on smoking and observed inconsistent findings across studies. These reviews, however, did not further examine whether associations across studies varied in keeping with socio-economic characteristics.

If having a social network is important, the implications of social support depend both on the source (e.g., family, friend, partner) and on the type of support (e.g., emotional, instrumental) provided (Westmaas et al. 2010). In the ISIS data set, I found that having a partner from whom one could borrow money was independently associated with a 57% lower risk of smoking among participants who had completed some university. Few studies have explored the association of a partner's resources with smoking, and none have done so in the young adult population (de Neve and Kawachi 2017). Two studies in Norway and the Netherlands found that having a partner with a higher level of education was associated with a lower risk of smoking (Egeland et al. 2002; Monden et al. 2003). Supporting my findings, Egeland and colleagues (2002) found that the influence of a partner's education on smoking was stronger among men who were more educated. Studies are only beginning to disentangle the contribution of different forms of resources that a partner may contribute to health inequalities (de Neve and Kawachi 2017; Torssander et al. 2018).

The study of other sources or types of social support, however, has a long history of mixed results for health outcomes (Smith et al. 1994; McPherson et al. 2013). This is also the case for smoking among young adults. Allgöwer, Wardle, and Steptoe (2001) found among young adults across 15 European countries that having more people to rely on in different situations was associated with physical activity, alcohol consumption, sleeping habits, and seat belt use, but not with smoking. On the other hand, Pokhrel and colleagues (2016) found among young American adults that having a larger network of friends, knowing your friends for a longer time, and spending more time with your friends was each associated with a higher perception of social support and a lower risk of smoking. Soulakova and colleagues (2018) also found in the US that young adults were more likely than older age groups to seek social support to quit smoking and that young adults who relied on social support were more likely to try quitting again in the near future if they had failed to quit earlier. However, some young adults might

still be reluctant to integrate their peers into their attempts to quit and share with them when they fail (Thomas et al. 2015).

Most research leveraging social support for smoking cessation has yet to show positive results (Westmaas et al. 2010). May and West (2000) reviewed interventions promoting “buddy systems” to facilitate cessation and found a significant benefit in only 2 out of 10 studies. Most recent Cochrane reviews found that there was no evidence promoting social support as an effective mechanism for smoking cessation (Cahill and Lancaster 2014; Chamberlain et al. 2017). Consequently, the US Department of Health and Human Services has removed social support from its smoking cessation clinical guidelines (Westmaas et al. 2010). Despite this, it is important to remain mindful of the potential unintended consequences of tobacco-control interventions on smokers’ social resources. Experts have argued that tobacco bans in public spaces may disproportionately burden disadvantaged smokers in their capacity to meet with peers, effectively increasing their social isolation (Frohlich et al. 2010; Lock et al. 2010). Therefore, tobacco-control strategies should be complemented with interventions that help reduce social isolation, for which there is already a strong evidence base among adolescents, working-age adults, and older adults (Masi et al. 2011; Public Health England 2015).

Ultimately, there might be different reasons for the lack of association between social resources and smoking in the thesis findings. First, recalling the discussion on the mechanisms linking education and smoking over the life course, it may be that the benefits of emotional and instrumental support emerge only after the age of 25. Second, the role of peers is expected to change over the life-course. Friends and family members are hypothesized to start playing a decreasing role in shaping social- and health-related decisions and to be eventually replaced by the partner during the transition to adulthood (Umberson, Crosnoe, and Reznick 2010). Finally, alternative measures focused on social isolation, satisfaction with one’s network, and the presence of smokers among people one can rely on might have each yielded a more comprehensive portrait of social resources related to smoking outcomes.

### **6.2.3 Transition stages**



Moving beyond educational attainment and economic and social resources, incorporating a life-course perspective offered new findings supporting the contribution of transition stages in education, employment, family, and housing to social inequalities in smoking during young adulthood. By examining their variation at different ages and across education-based groups, the thesis findings also helped nuance the inconsistencies found in these characteristics in the systematic review. I address the thesis findings on each of the transition stages below.

### **6.2.3.1 Education and employment**

The findings in this thesis support the idea that student status and employment status each has nuanced associations with smoking during the transition to adulthood. In the NPHS, being a student was associated with a 15% lower risk of smoking between the ages of 18 and 25. In the ISIS, this association hid substantial differences across education- and age-based categories. Being a student was associated with a 42% lower risk of smoking among those who had not completed post-secondary education, a 35% lower risk of smoking among those at the ages of 18–19, and a 44% lower risk of smoking among those at the ages of 20–21. Those who remained students after having a first university degree, however, were 70% more likely to report smoking. Partially supporting its stronger role among those with less education, the association between studying and smoking in the NPHS was greater among those who had not pursued post-secondary education (25% lower risk; 7.9 p.p. difference) than among those who had (8% lower risk; 2.5 p.p. difference), but the interaction test was not statistically significant ( $p = 0.17$ ).

There was only weak support for the role of employment with regard to smoking. In the ISIS data set, I found marginally significant, yet sizable, estimates suggesting that full-time employment was associated with a 51% higher risk of smoking (11.5 p.p.) at the ages of 20–21 and a 37% lower risk of smoking (6.1 p.p.) among those who had completed a university degree. The smaller role of employment in smoking might be explained, in part, by the arguments that (1) occupation type, rather than employment status, informs the risk of smoking; and (2) personal income plays a strong mediating mechanism. Partially supporting this, I report in Appendix XII nested models controlling only for personal income to appreciate its contribution to the change in the association between full-time employment and

smoking in the ISIS data set. While full-time employment was associated with a statistically significant, 24% higher risk of smoking in a model controlling only for age and sex in the full sample, this association completely disappeared once participants' personal income was controlled for.

Despite the size of the literature that has addressed the deleterious effects of unemployment (Wilson and Walker 1993; Bartley 1994; Ezzy 1994; Jin, Shah, and Svoboda 1995), few studies have examined the role of employment on smoking in young adulthood (Vancea and Utzet 2016). Two studies found in a Swedish cohort that unemployment was consistently associated with a higher risk of smoking during young adulthood and that the length of unemployment was also associated with an excess risk of smoking among men (Hammarström et al. 2011; Janlert, Winefield, and Hammarström 2015). Two other studies found that the deleterious effects of unemployment were unequally distributed among socially disadvantaged groups. Melchior and colleagues (2015) found in a French cohort that young adults who were unemployed were more likely to smoke and to be dependent on nicotine only if they had not completed post-secondary education. Similarly, Lee and colleagues (2015) found in a US cohort that unemployment was associated with a higher risk of smoking daily only if participants had parents with fewer years of education and a lower income. It is, therefore, possible that there are subgroup differences in the association between employment and smoking that were not captured in my findings.

The thesis findings on student and employment status support two main arguments. First, they add new support to the literature highlighting that young adults who precociously quit their studies represent one of the highest-risk groups for smoking during young adulthood (Drapela 2006; Townsend, Flisher, and King 2007; USDHHS 2012). Illustrating this, Maynard and colleagues (2015) found in the US that, controlling for income and employment, high school dropouts between the ages of 18 and 25 had 167% higher odds of being daily smokers and 50% higher odds of being dependent on nicotine than the rest of the young adult population. However, as with the education-smoking association, there is still little consensus about what it is about early dropout that drives the progression of smoking after the end of adolescence (Drapela 2006; Townsend, Flisher, and King 2007).

Since studies have often focused on student populations, there is still a dearth of information regarding the circumstances contributing to the higher risk of smoking among young adults who have exited the education system (Hammond 2005; Green et al. 2007). New studies have started addressing this gap by examining the health outcomes of young adults who are NEET. These studies, however, have focused on mental health and health care needs and are only starting to address their implications for smoking outcomes (Baggio et al. 2015; Henderson et al. 2017; Stewart et al. 2017).

Second, findings on studies and employment add new support for the argument that the rapid school-to-work transition after the completion of university represents the most successful trajectory that young adults can pursue into their mid-twenties with regard to the social inequalities of smoking. The quality of the school-to-work transition is known to be unequally experienced across education groups. For instance, those who have only a high school diploma are half as likely to find stable, full-time employment in the first five years following the end of their studies in comparison with those who complete university (Bowlby 2000; Quintini, Martin, and Martin 2007).

The transition out of studies after post-secondary education has also been identified as a catalytic milestone associated with changes in partnering and parenthood and the uptake of positive health practices, including smoking cessation (Clark et al. 2007; Green et al. 2017; Bricard et al. 2017). This suggests that a significant number of young adult smokers who are pursuing university may “naturally” quit smoking when they complete their studies and delve into new adult roles. Despite this, tobacco experts have warned that some of the contexts that young adult students interact with during college and university (e.g., leisure settings with positive smoking norms) might be conducive to smoking in the long term (Schulenberg and Maggs 2002; Moran et al. 2004; Hammond 2005; Freedman et al. 2011).

### **6.2.3.2 Family and housing**

As with transitions in education and employment, the transitions in family and housing were strongly associated with young adults’ risk of smoking. In the NPHS, I found that young

adults who were living with multiple family and non-family household members (i.e., in “atypical” arrangements) had a 16% higher risk of smoking in comparison with those living with parents between the ages of 18 and 25. However, when investigating age-based differences, I found that, compared with those who lived with parents, (1) young adults who lived without parents and without children had a 37% higher risk of smoking at ages 18–19, and (2) young adults who lived without parents but with children had a 105% higher risk of smoking at ages 18–19 and a 59% higher risk of smoking at ages 20–21. There were, however, no longer significant differences in smoking across living arrangement categories at the ages of 24–25.

In the ISIS data set, I found that (1) participants who lived with their parents had a stable, 25% lower risk of smoking compared with those who lived without parents; and (2) participants who lived with their children had a 45% lower risk of smoking compared with those who lived without parents. Partially supporting the findings in the NPHS, the results in the ISIS data set suggested that living with parents was associated with a larger decrease in the risk of smoking at the ages of 18–19 (37% lower risk; 11.2 p.p. difference) than at the ages of 24–25 (20% lower risk; 5.5 p.p. difference), but the interaction test was not significant ( $p_{\text{interaction}} = 0.56$ ).

Three potential reasons might explain the differences in association between living arrangements and smoking observed at different ages in the NPHS and ISIS data sets. First, the measure of “living with parents” in the ISIS data set regrouped those who were living without children, with children, and in other arrangements into a single category, thereby underestimating the role of each subgroup. Second, the statistical power attributable to the small number of participants who lived without parents and with children at the ages of 18–19 and 20–21 in the ISIS data set increased our risk of making a type II error. In fact, no ISIS participants lived with children between the ages of 18 and 20. This suggests that, even when controlling for age, the association between smoking and living with children in the ISIS data set captured the role of this transition only when it was experienced at a later age.

Finally, this discrepancy might be explained by the different control variables that were modelled between the ISIS and NPHS data sets. In particular, ISIS participants living with

children were 90% more likely to have an income of \$20,000 or more and 210% more likely to have had financial difficulties in the previous year compared with those without children. Controlling for these variables may have removed the negative confounding effect that biased the association of living with children toward the null when it was experienced at a later age (Mehio-Sabai et al. 2005).

#### **6.2.3.2.1 Living with parents**

Consistent with other studies that addressed this issue, living with parents appeared to be a protective factor associated with a lower risk of smoking, especially during the beginning of the transition to adulthood (McDermott, Dobson, and Russell 2004; Staff et al. 2010; Mendel et al. 2012; Kvaavik et al. 2014). A large body of literature has detailed the contribution of parents to the risk of smoking in adolescence (Wellman et al. 2016). For instance, Komro and colleagues (2003) found in the US that, controlling for smoking behaviour, parents' perception of the prevalence of smoking, their permissiveness, and their communication and punishment practices was each associated with their adolescents' risk of smoking. This body of work also supports the idea that smoking and lenient smoking-related practices are systematically more likely among socially disadvantaged parents (Orton et al. 2014). On the other hand, few studies have examined the long arm of parents' smoking-related characteristics on smoking during young adulthood (Stone et al. 2012). Yet these associations are likely to vary with age as the nature of the parental relationship changes. Highlighting this, Mahabee-Gittens and colleagues (2012) found in the US that while parents tend to exercise fewer monitoring and punishing practices on their adolescents as they age, these practices actually have a stronger influence on smoking toward the end of adolescence.

Changes in smoking circumstances across households are likely to explain only a portion of the association between living arrangements with parents and smoking. The different reasons leading young adults to move out during the transition to adulthood are also likely to reflect different changes in socio-economic circumstances across social groups. On the one hand, young adults who live in disadvantaged households with disrupted families are one of the most likely groups to leave early to avoid difficult relationships (Beaupré, Turcotte, and Milan 2008). Illustrating this, Molgat (2002) found in the province of Quebec that up to 10% of

young adults who had moved out before the age of 20 reported parents as their main reason for doing so (e.g., “parents did not have money,” “parents divorced,” “to break off with parents”), while almost none reported these same reasons when moving out at a later age.

On the other hand, young adults with better familial circumstances are likely to delay moving out to secure their economic opportunities (Clark 2007; Settersten and Ray 2010; Galarneau et al. 2013; Milan and Bohnert 2015; Vespa 2017). The important life events leading to moving out for more socially advantaged young adults, then, become more likely to involve moving to college, finishing studies, finding full-time employment, establishing a relationship, and becoming parents (Goldscheider, Hofferth, and Curtin 2014; South and Lei 2015). Supporting this again, Molgat (2002) found that moving “to lead your own life” was reported by only 30% of young adults at the ages of 18–19 but by over 80% of young adults after the age of 25. Therefore, moving out of the family household at a precocious age is more likely to be associated with a lower capacity to improve their socio-economic circumstances if young adults have fewer resources to rely on, given their parents’ lack of support. Moving out later, however, is more likely to be associated with feelings of readiness and agency, which may help young adults leverage this event to seek out healthy practices, including smoking cessation.

#### **6.2.3.2.2 Parenthood**

We can also highlight the different implications of domestic transitions on smoking outcomes during young adulthood, in keeping with the thesis findings on parenthood. Living with children was associated with a higher risk of smoking between the ages of 18 and 21 in the NPHS and a lower risk of smoking in the ISIS. These results highlight two main dimensions normally associated with parenthood and smoking. First, parenthood represents, for many, one of the most important events associated with smoking cessation (Castles et al. 1999; Bottorff et al. 2009). In the US, 36.6% of women who smoked and gave birth in 2014 quit smoking in the months leading up to or during pregnancy (Curtin and Matthews 2016). However, the *timing* of pregnancy is also one of the most important factors determining whether smoking cessation is likely to occur during this event (USDHHS 2001; Lu, Tong, and Oldenburg 2001; Schneider and Schütz 2008). In Canada, women who gave birth before the age of 25 are

approximately 90% more likely to smoke during pregnancy compared with older mothers (Cui et al. 2014). These early mothers are also more likely to relapse afterwards if they quit during their pregnancy (Orton et al. 2018).

These two dimensions – the probability of quitting smoking during pregnancy and the probability of having an early pregnancy – capture how different parenthood experiences across social groups contribute to social inequalities in smoking during young adulthood (Brown and Wilk 2014; Curtin and Matthews 2016). Systematic reviews on the determinants of early pregnancy highlight the critical role that young mothers' education and their parents' resources play in this outcome (Imamura et al. 2007; Penman-Aguilar et al. 2013). In the US, women who complete university are 280% more likely to quit before pregnancy, and 148% more likely to quit during pregnancy, in comparison with those who did not finish high school (Curtin and Matthews 2016). Combined with the lower prevalence of smoking among highly educated women, women who do not finish high school are 16 times more likely to smoke during their pregnancy compared to those who complete university.

These social inequalities are also increasing over time (Brown and Wilk 2014). Examining changes between 1995 and 2010 in the province of Ontario, Brown and Wilk (2014) found that the prevalence of smoking during pregnancy had increased by 8.2% among women who gave birth before the age of 25, while decreasing by 35.4% among women who gave birth at a later age. Similarly, they found that the prevalence of smoking during pregnancy had increased by 12.8% among women who had completed only high school or less, while decreasing by 34.3% among women who had completed post-secondary education.

### **6.2.3.3 Relationship status**

Finally, the thesis findings regarding relationship status reinforce the narrative describing the findings on family and housing arrangements with parents and children. In the NPHS, being single was associated with a 29% higher risk of smoking. However, this association varied with both education and age. At the ages of 18–19, there were no significant differences in smoking by relationship status. At the ages of 24–25, however, those who had pursued post-secondary education had a 45% lower risk of smoking if they were in a relationship, while

those who had not pursued post-secondary education had a non-significant, 15% higher risk of smoking if they were in a relationship. Supporting this difference across education-based groups, findings in the ISIS data set showed that being in a relationship was associated with a 50% lower risk of smoking among young adults who had completed university.

It is important to highlight the differences in relationship characteristics between the ISIS and NPHS data sets. At ages 18–19, 26% and 2% were in a relationship in the ISIS and NPHS data sets, respectively; at ages 24–25, 44% and 30% were in a relationship in the ISIS and NPHS data sets, respectively. In the 2016 Canadian census, the proportion of youth in a relationship in Montreal and Canada were 0.8% and 1.1% at ages 15–19, 13.5% and 14.5% at ages 20–24, and 42.4% and 43.9% at ages 25–29, respectively (Statistics Canada 2017). This discrepancy can likely be explained by the different response choices used in the ISIS (“Common-law *or in a couple*”) and NPHS (“Living in common law”) questionnaires; it may have led the ISIS participants to report being in a relationship that was not as established.

Therefore, the ISIS measure of marital status may have underestimated the “relationship-smoking” association if a relationship is less likely to be associated with a change in smoking when it was not as established (Klein, Rapp, and Schneider 2013). This difference in measures also likely explains why 178 ISIS participants (9.2% of the sample) reported having a partner from whom he or she could borrow money *and* not being in a relationship. This issue, however, challenges whether the traditional measure of marital status appropriately captures the diversity of young adults’ relationship arrangements when over 80% of young adult Canadians report being sexually active (Rotermann and McKay 2009; Rotermann 2015).

There is already a large body of literature addressing the benefits of establishing a romantic partnership for reducing smoking outcomes (Falba and Sindelar 2008; McDermott et al. 2009; Umberson, Crosnoe, and Reznick 2010; Bricard et al. 2017). My findings, however, are among the first few to suggest that this is not an experience shared by everyone during the transition to adulthood. Young adults who rapidly complete post-secondary education and move on to establish relationships might be the most likely to seek adult roles with positive health



implications and the partner's support for quitting smoking (Sorensen et al. 2004; Harwood et al. 2007; Christakis and Fowler 2008; Businelle et al. 2010).

The vast majority of this literature has disentangled these associations exploring gender, age, and the smoking status of the partner. Few, however, have examined how these associations vary across social groups. Cutler and Glaeser (2010) examined in the US the causal effect of having a partner who had stopped smoking and found that this association was absent for those who had not completed high school yet strong among those who had completed post-secondary education. Fletcher and Marksteiner (2017) also found in the US that a large-scale smoking cessation intervention had a weaker spillover effect on the smoking of the partner if the participant had not completed high school. Supporting this, Takagi and colleagues (2014) found in Japan that women were more likely to quit smoking after their partner had quit but only if both partners had completed university. Okechukwu, Nguyen, and Hickman (2010) argued that this difference also extended to occupation in the US, finding that blue-collar workers were highly likely to have a smoking partner and that this was associated with a higher risk of continuing smoking over time.

It is important to acknowledge the alternative explanation of social homogamy, which posits that partners select each other and are likely to be similar to each other. The thesis findings, therefore, may imply both selection and causation mechanisms (Fletcher and Marksteiner 2017). Di Castelnuovo and colleagues (2009) performed a review of 13 studies on spousal concordance and estimated that smokers had 230% higher odds of being partnered with a smoker in comparison with non-smokers. This association is increasing over time, in keeping with the decreasing proportion of smokers in the population (Kuo et al. 2007; Treur et al. 2015).

This selection process extends to the majority of social characteristics shared among partners. Illustrating this with educational attainment, Hamplova and Le Bourdais (2008) found in Canada that young adults who had completed university were the most likely to marry or cohabit with a partner with the same degree and that the probability of marrying "up" the social ladder with a partner who had completed university was particularly low. Under this

hypothesis, regardless of the capacity to leverage a partner to quit smoking, young adults who have less education also have a lower probability of entering a relationship with someone with the resources and practices likely to be found in a university-educated partner.

### **6.3 Crosscutting themes**

This section addresses selected crosscutting themes linking the thesis findings. To frame this discussion, I return to my critique of the theoretical foundations in health inequality research and my proposal to integrate (1) a Bourdieusian approach to operationalize socio-economic characteristics and study social inequalities in health practices and (2) a life-course approach to further contextualize these social inequalities within the life period of young adulthood. I conclude with thoughts on the implications of these arguments for intervention in social inequalities in smoking.

#### **6.3.1 Understanding the socioeconomic circumstances of young adults**

The causal interpretation of associations in the social realm, even in the context of randomized controlled trials and causal inference modelling, will always remain poor if we do not have proper theory to question the heterogeneity of associations and the generalizability of findings. In this thesis, I was therefore not focused on updating surveillance data, discovering new predictors, or inferring strong causal claims about the characteristics associated with smoking among young adults. Confronting the limitations of the findings in the systematic review in article 1 and the lack of theoretical foundations to address them in chapter 3, I argued that what was needed first was a nuanced theoretical framework with pragmatic implications that could better understand young adults' socio-economic circumstances and their contribution to the progression of social inequalities in smoking during this life period.

The first assumption I critiqued was the capacity to develop a comprehensive definition of socio-economic circumstances using only achievements in education, occupation, and income. I began chapter 3 by arguing that the most common models developed to understand health inequalities built disproportionately on traditional indicators as an entry point to the operationalization of socio-economic circumstances (Krieger, Williams, and Ross, 1997; Galobardes et al. 2006a, 2006b; WHO 2008). By focusing on these indicators instead of the

concepts that they were meant to represent, health inequality research runs the risk of putting the cart before the horse. Perhaps the concept of SES itself may be blocking the capacity to better understand health inequalities. An increasing number of social scientists have come to compare SES to the theory of miasma and to call for more precise measurement that would focus inquiry on the true causes of health inequalities. Despite this, few are challenging what indicators actually represent conceptually and whether other indicators may complement the range of characteristics likely to be involved in health inequalities.

Subjective, one-dimensional measures are unlikely to solve this puzzle. Researchers from the Truth Initiative, the largest non-profit tobacco-control organization in the US, recently argued for exploring young adults' subjective status by asking, "Considering your own income and the income from any other people who help you, how would you describe your overall personal financial situation?" (Williams 2017; Villanti et al. 2017). Proponents argue that this measure has the advantage of capturing the common stratification process underlying social inequalities across education, income, and occupation (Singh-Manoux, Marmot, and Adler 2005; Karvonen and Rahkonen 2011; Quon and McGrath 2015). This approach has also gained particular prominence in adolescence research to circumvent the problems related to the measurement of parental characteristics (Quon and McGrath 2015).

Health inequality research, however, still has a limited understanding of subjective status and its relation to "objective" indicators and health outcomes (Shaked et al. 2016; Andersson 2018). Mounting evidence also suggests that these measures are unlikely to substantially improve our understanding of health inequalities. Quon and McGrath (2014) performed a meta-analysis of 44 studies among adolescents and found that there was no association between these measures and health behaviour uptake. Similarly, Tang and colleagues (2016) produced a meta-analysis of nine studies in the general population and found that there was no significant association between subjective status and coronary artery disease, hypertension, or diabetes once they had adjusted for traditional socio-economic indicators.

This evidence invites new research into the measurement of economic and social resources that is aligned with the world of young adults. With regard to economic characteristics, this

approach includes moving away from household characteristics to separate young adults' resources from parents' wealth. It also includes further exploring the roles of home ownership and debt accumulation since (1) these events primarily occur during young adulthood, (2) young adults today are less likely to afford home ownership and more likely to accumulate non-housing debt than previous generations, and (3) social inequalities in home ownership and debt accumulation during young adulthood have increased over time (Hou 2010; Lafrance and Larochelle-Côté 2012; Wei 2017).

With regard to social resources, this thesis offers an opportunity to address the knowledge gap in the role of resources from sources such as family members, friends, and partners in health behaviour uptake. In a scoping review, De Neve and Kawachi (2017) found 286 studies examining the role of parents' resources but only 22 studies examining resources from other sources, with only one study addressing smoking (Egeland et al. 2002). To further explore this line of research, we may turn to sociological research, which has a long history of examining the contribution of peers' resources to social processes (Lin 1999; Van der Gaag and Webber 2008).

The second assumption I critiqued concerned the isolated and additive nature of the associations between social characteristics and health behaviours driven by traditional epistemologies in health inequality research (Poland et al. 2006; Øversveen et al. 2017). Building on the concept of conditionality (Abel 2007, 2008; Abel and Frohlich 2012), I argued that the study of interactions among resources offered a pragmatic approach to capturing the "structure of relations" proposed by Bourdieu (1979) and understanding the distribution of practices across social groups. This argument was supported when examining the different associations among resources, transition stages, and smoking across education-based categories. In fact, nearly half the socio-economic characteristics had different associations across education-based groups in the ISIS and NPHS data sets. This finding reinforces the argument that examining only the direct contribution of traditional indicators such as educational attainment does not suffice to capture the social distribution of health practices, including smoking. More importantly, it supports the idea that the inability to consider the

multiplicative nature of the influence of socio-economic circumstances on health practices perpetuates the underestimation of the true burden faced by the most vulnerable groups.

In this thesis, I focused on educational attainment because it is a critical theoretical dimension of cultural capital and a key marker of the distribution of smoking. However, the principle of conditionality is likely to extend to other forms of resources and transition stages with which young adults interact. Some researchers have used approaches insufficiently grounded in theory to assess such mechanisms. For instance, De Clercq and colleagues (2017) examined interactions among 17 economic, social, and cultural indicators that were potentially involved in adolescents' healthy eating practices, effectively testing 136 unique interactions. In this scenario, data-driven approaches such as Classification and Regression Tree analysis provide a heuristic for exploring subgroup differences across social groups (Friel, Newell, and Kelleher 2005; Cairney et al. 2013; Nayak et al. 2016, 2017).

New advances, however, will ultimately require robust hypotheses and deep reflection about the nature of relations among socio-economic characteristics. An increasing number of studies have begun to explore the interaction of socio-economic indicators such as income and education with morbidity and mortality outcomes (Schnittker 2004; Aitsi-Selmi et al. 2012; Chung et al. 2017; Östergren 2018). Few studies, however, have examined such interactions in the context of smoking outcomes. While the principle of conditionality allows for the uptake of distinct practices across certain intersections (e.g., having a high income but a low level of education), I posit that social groups that experience disadvantage across multiple dimensions are the most likely to face difficulties in not engaging in harmful health practices.

### **6.3.2 Contextualizing the socioeconomic circumstances of young adults in the life-course**

The Bourdieusian approach to health inequalities led to a nuanced understanding of the associations of educational attainment and other resources with smoking among young adults. This approach, however, was built on a static definition of social inequalities, which did not question the role of transition stages or the significance of when they occurred, despite the importance of both these mechanisms for social processes (Hogan & Astone 1986; Shanahan 2000; Elder, Johnson, and Crosnoe 2003). In turn, integrating a life-course perspective led me

to shed new light on two main issues, thus adding to the resource-based approach of this thesis to the study of social inequalities in smoking among young adults.

The first implication of this life-course approach is that a focus on resources is unlikely to capture the extent of the social processes leading socially disadvantaged groups to disproportionately follow harmful health practices. The thesis findings corroborate the argument that transition stages represent a critical dimension of socio-economic circumstances. This argument extends to each life period, including transitions such as divorce and retirement (Dave, Rashad, and Spajosevic 2008; Semyonov et al. 2012; Sbarra, Hasselmo, and Bourassa 2015). During young adulthood, this approach is particularly helpful, given the intensity of transition stages across multiple domains and the magnitude of their association with smoking outcomes. The thesis findings, therefore, reinforce the call to extend the study of health inequalities to include domestic life-course indicators such as partnering and parenthood as explicit dimensions of social disadvantage in early adulthood (Graham 2002, 2007; Graham et al. 2006).

Additionally, since these transitions are differently accessed and experienced across social groups, they effectively represent a distinct mechanism through which social and health inequalities are reinforced over the life course. The thesis findings highlighted this argument when observing the excess risk that young adults experience when exiting studies without pursuing post-secondary education and the excess benefit that young adults experience when finishing studies, entering full-time employment, and establishing relationships once they complete post-secondary education. Therefore, these findings also provide a new nuance in the extent to which the unequal experience of transition stages actually contributes to the uptake of harmful health practices (Wickmara and Baltimore 2010; Staff et al. 2010; Pampel, Mollborn, and Lawrence 2014).

The second implication in using a life-course approach to understanding social inequalities in smoking among young adults addresses the notions of timing in keeping with normative timetables. First, the thesis findings highlight the extent of changes in the circumstances characterizing young adults at different ages. Indeed, the relatively small, eight-year span

separating the ages of 18 and 25 suffices to distinguish completely different worlds. In the NPHS data set, Canadians who were 24–25 years old were 70% less likely to be studying, 30% more likely to be employed, 13 times more likely to be in an established relationship, and 11 times more likely to be living with children than when they were 18–19 years old. Using the ISIS data set, we can also expect these changes to include income (e.g., reporting an income over \$20,000 was 22 times more likely among participants aged 24–25 than among participants aged 18–19) and other economic resources (e.g., having a friend or a partner from whom one could borrow money was 70% and 160% more likely among participants aged 24–25 than among participants aged 18–19, respectively).

Beyond the changes that young adults rapidly experience at different ages, the consideration of timing emphasizes that, regardless of their prevalence, these characteristics also have inherently varying influences on the practice of smoking with age. This argument was supported in the thesis findings on personal income, student status, and living arrangements with parents and children, which were more strongly associated with smoking toward the age of 18, and educational attainment and relationship circumstances, which were more strongly associated with smoking toward the age of 25.

Supporting these life-course principles provides new impetus for the study of the dynamic, age-graded nature of the progression of social inequalities in smoking during this period. The majority of public health reports build on large age brackets to capture young adults – for example, (1) ages 18–34 in the Quebec Directeur national de santé publique’s report on young adult smoking (Gov. Québec 2017), (2) ages 18–25 in the last US Surgeon General’s report on youth smoking (USDHHS 2012), and (3) ages 18–26 in the US Institute of Medicine report on young adult well-being (IOM 2015). Even when young adult outcomes are stratified by age, it is rare to find divisions smaller than five years (e.g., ages 15–19, 20–24, 25–29).

However, by not questioning the definition of age groups used to study this life period, researchers are missing the opportunity to develop meaningful age categories that better address the heterogeneity of social processes underlying the transition to adulthood. Such an exception is found in public health only when age thresholds are based on the epidemiological

progression of health behaviours. For instance, the ages of 21 and 25 are critical markers for tobacco control because they represent important milestones in smoking-initiation trajectories (USDHHS 2012; IOM 2015). However, the heterogeneity of associations at different ages in the thesis findings supports the argument that average effects in young adult samples are likely to hide substantial variation and support insufficiently nuanced interpretations. At the very least, a significant portion of age-based differences emerged in the thesis findings between the ages of 18 to 21 and the ages of 22 to 25, suggesting that comparing these two groups offers a pragmatic approach to the exploration of age differences during this life period.

### **6.3.3 Implications for intervention**

I conclude this section by arguing that a refined understanding of social inequalities in smoking among young adults based on the Bourdieusian and life-course approaches presented here also has implications for intervention.

#### **6.3.3.1 Disentangling what works among socially disadvantaged groups**

Nearly 30 years ago, the 1989 US Surgeon General's report on smoking noted that educational attainment had become the strongest socio-demographic predictor of smoking outcomes (USDHHS 1989; Zhu et al. 1996). Despite this finding, tobacco control has been notoriously slow to address the socio-economic nature of the distribution of smoking (Graham 2012; Garrett et al. 2015). Kelly and Barker (2016) argue that this problem persists, in part, because of the beliefs that continue to be held by public health practitioners and policy-makers, including that (1) behaviour is simple to modify, (2) health education works, (3) knowledge and information drive behaviour, (4) individuals are expected to be rational and practise healthy lifestyles, (5) individuals who do not are considered irrational, and (6) knowing who smoke means that we also know what to do about it.

For instance, Millar (1996) proposed in Canada that tobacco control should promote smoke-free policies in the workplaces of less educated individuals and develop media campaigns that were coherent with less-educated smokers' concerns and were disseminated in the channels that they were most likely to use. However, workplace bans have had a larger influence on smoking outcomes among professional occupations than in manual labour industries (Thomas



et al. 2008; Hill et al. 2014). Similarly, media campaigns appear to be “often less effective, sometimes equally effective, but rarely more effective” in promoting smoking cessation among disadvantaged populations (Hill et al. 2014, e92).

Other examples, such as clean-indoor-air laws and limiting exposure to tobacco advertising, have been found to have similar influences on smoking outcomes across education-based groups (Dinno and Glantz 2009; Zhu et al. 2010). Except price-based policies, however, there is still only very limited evidence of population-level tobacco-control interventions that reduce social inequalities in smoking among youth and adults (Thomas et al. 2008; Hill et al. 2014; Brown, Platt, and Amos 2014). Evidence on targeted tobacco-control interventions among less educated groups is just as scarce (Vilhemsson and Ostergren 2018).

What makes this problem critical is that there is growing support for the critique that public health is actively contributing to the progression of social inequalities in smoking by failing to reach vulnerable populations (Frohlich and Potvin 2008). In particular, the denormalization of smoking championed by tobacco-control practitioners has led to increased discrimination against disadvantaged groups who are more likely to smoke and the entrenchment of smoking as a practice associated with social disadvantage (Krange and Pederson 2001; Frohlich et al. 2010, 2012; Graham 2012). Despite this trend, most evaluation studies of tobacco policies continue to under-report their impact among disadvantaged groups and their unintended effects (Greaves et al. 2006; Bader, Boisclair, and Ferrence 2011). Bambra (2018, 787), however, is hopeful that the recognition of these “intervention-generated inequalities” puts new pressure on public health to acknowledge that (1) interventions that improve population health might not always be effective in reducing health inequalities, (2) interventions need to combine both upstream and downstream approaches to reach different socio-economic groups, and (3) strategies should target both the behavioural and the social causes of health inequalities.

The principle of conditionality highlighted throughout this thesis invites new reflection on the mechanisms amenable to intervention for reducing education-based inequalities in smoking. Entry points traditionally include intervening in root causes (e.g., preventing students from

dropping out of high school), diminishing the hazards of low education (e.g., promoting better employment conditions for the less educated), or targeting the mechanisms that link educational attainment to different exposures to smoking (e.g., appropriately enforcing smoke-free policies in the workplace across industries, reducing economic barriers to smoking-cessation treatment) (Cohen and Syme 2013).

However, the heterogeneity of associations presupposes that one-size-fits-all approaches are unlikely to apply across education-based and other social groups. What is needed is to explore why certain mechanisms occur only among less educated groups and why others occur only among more educated groups. This reinforces the argument that we should not only intervene *more* in vulnerable populations, but also *differently* (Frohlich and Potvin 2008).

#### **6.3.3.1.1 Example: Personal income**

Examples can be gleaned from the thesis findings in keeping with personal income. Despite the strength of the income-smoking association found in the ISIS data set, there is a surprising knowledge gap regarding the role of personal income in smoking outcomes and the role of economic policies in reducing smoking during young adulthood. Increasing excise taxes on tobacco products is championed as the most equitable approach to reducing smoking outcomes, in part because of the higher price sensitivity that has been evidenced among youth and disadvantaged groups (Chaloupka and Weschler 1995; Chaloupka and Grossman 1996; Thomas et al. 2008). In keeping with the different income-smoking associations observed across education-based groups in the ISIS data set, this approach could perform better among those who are less socially advantaged and, therefore, lead to a reduction in social inequalities in smoking.

These approaches should, however, be encouraged with caution for two reasons. First, increases in excise taxes are unlikely to prevent initiation. Bader, Boisclair, and Ferrence (2011) reviewed studies examining the impact of price increases on smoking initiation rates and argued that only a minority of studies in adolescents (7 out of 16 studies) and young adults (1 out of 4 studies) supported this association. In Canada, Manivong, Harper, and Strumpf (2017) examined the effect of taxation on youth smoking in the previous 15 years and argued

that price increases were likely to have a diminishing impact on initiation rates in countries with a long history of taxation. The evidence on smoking cessation, however, appears to be more positive, with four out of five studies finding that price increases were associated with higher rates of smoking cessation among young adults (Bader, Boisclair, and Ferrence 2011).

Second, increasing excise taxes may have unintended consequences for those who have fewer resources. While quitting smoking is associated with subsequently reporting less financial stress, fiscal policies might be less effective among those who are financially distressed and less likely to be able to quit, thereby effectively reinforcing social inequalities in smoking (Siahpush and Carlin 2006; Siahpush, Spittal, and Singh 2007a, 2007b). Studies that support increased taxes underscore the need to implement policies to assist those who continue to smoke, especially those who suffer from increased financial hardship (Wilson et al. 2004; Wilson and Thomson 2005). Therefore, an increase in price needs to be accompanied by other strategies to mitigate any adverse consequences of such taxes among disadvantaged populations (Bader, Boisclair, and Ferrence 2011; Purcell, O'Rourke, and Rivis 2015).

#### **6.3.3.2 Applying a life-course perspective**

A second implication of the thesis findings for intervention lies in the use of a life-course approach to conceptualize entry points for the promotion of young adult health outcomes. In public health, socio-ecological and multi-level models have been successful in demonstrating the contribution of multiple settings to health promotion (Richard, Gauvin, and Raine 2011). Of these settings, the family, the (secondary) school, and the neighbourhood have received the most attention. For instance, Sorensen and colleagues (2004) proposed a socio-ecological model to address smoking among blue-collar workers and highlighted, as settings, family and social ties, workplaces, neighbourhoods, and social institutions. Similarly, King and colleagues (2018) produced a systematic review of nicotine replacement therapy use among adolescents and used a socio-ecological framework to review the contribution of interpersonal relationships and school and community settings. Despite proposals in the context of health care (Harper, Steiner, and Brooker 2018), I found no attempts to capture the settings in which health inequalities progress during young adulthood in the public health literature. However, tobacco-control interventions are likely to gain from leveraging settings associated

with education, employment, family, and housing circumstances to tackle social inequalities in smoking in young adults. This argument may be illustrated with the current extension of smoke-free policies in the workplace to educational institutions.

Fichtenberg and Glantz (2002) produced a meta-analysis of 26 studies to find that smoke-free policies in the workplace reduced the prevalence of smoking by 3.8 p.p. and the daily consumption of remaining smokers by 3.1 cigarettes, estimated to be a 76% increase in the price of cigarettes. Similarly, Fallin, Roditis, and Glantz (2015) found in the US state of California that stronger smoke-free policies in four-year colleges were systematically associated with a lower prevalence of smoking and exposure to second-hand smoke. In this context, many educational institutions are instituting tobacco-free policies, and this emerging trend is being increasingly championed to support smoking prevention and cessation during young adulthood (Fallin, Roditis, and Glantz 2015).

In the US, almost 40% of colleges and universities now have some form of smoke-free policy, a 260% increase from 2012 (Wang et al. 2018). In Canada, the Canadian Cancer Society counted 15 colleges and universities that offered 100% smoke-free campuses in 2015 (CCS 2018). While none of these institutions were in Quebec, the 2015 Quebec *Act to Bolster Tobacco Control* encouraged colleges and universities to adopt a smoke-free policy by the end of 2017 (MSSQ 2017). In September of 2018, more than 65 Canadian colleges and universities offered 100% smoke-free campuses, including 31 in the province of Quebec (CCS 2018).

Evidence from smoke-free policies in the workplace, however, compels us to pay special attention to the risk of unintended consequences: implementing these policies in educational settings may contribute to the increase in social inequalities in smoking. The lack of enforcement of smoking restrictions in the workplace has made them largely ineffective among blue-collar workers and in manual labour industries (Thomas et al. 2008; Okechukwu et al. 2013; Garrett et al. 2015). Employers in low-wage industries are also less likely to believe that health promotion policies in the workplace are feasible and to perceive that they are able to implement these policies (Hannon et al. 2012). Studies have found that support for

smoke-free policies in public spaces varies with education and income and that there was more support for enforcing smoke-free policies in public spaces in neighbourhoods with educated and wealthy inhabitants who did not work in manual labour industries (Skeer et al. 2004; Nykiforuk et al. 2007; Doucet, Velicer, and Laforge 2007; King et al. 2014).

Similarly, the majority of institutions in educational settings are unlikely to implement well-developed smoke-free programs despite the availability of guidelines (Murphy-Hoefer et al. 2005; Rodgers 2012; McIntosh et al. 2016). In particular, community colleges and vocational schools are more likely to implement smoke-free programs that are neither based on best practices nor appropriately enforced (McIntosh et al. 2016). Therefore, smoke-free policies might become the most effective in the higher education institutions whose clientele needs them the least. Other educational institutions applying smoke-free policies to reduce smoking need to ensure that these policies are aligned with the needs of those who are most likely to initiate and maintain smoking.

#### **6.4 Limitations of this thesis**

Before concluding, this thesis discusses its limitations with regard to the operationalization of young adults' smoking behaviour and socio-economic characteristics, gender considerations, and the interpretation of causal relations in its findings.

##### **6.4.1 Operationalizing young adults' smoking behaviour**

Two points should be addressed with regard to the measures of smoking behaviour used in this thesis. First, self-reported measures of smoking status are more prone to underestimation than the gold standard of biometric cotinine measures (Gorber et al. 2009). This misreporting bias could be higher among young adults who are socially disadvantaged. Wagenknecht and colleagues (1992) found in the US CARDIA study that 4.2% of young adult smokers misreported their status as non-smokers, with higher misclassification rates found among Black participants with less education. Second, while the measure of current smoking status (Yes/No) is almost universally accepted across public health sciences, not considering the heterogeneity of smoking practices may have underestimated the importance of some socio-economic characteristics.

Cigarette smoking is a complex activity, one that includes biological, psychological, social, and cultural dimensions (Poland et al. 2006; Haines, Poland, and Johnson 2009; Song and Ling 2011; Lisha et al. 2015). In comparison with other age groups, young adults are more likely to smoke fewer cigarettes, to smoke on fewer days, to consider themselves social smokers, and to underestimate their consumption (Schane, Glantz, and Ling 2009; Reid et al. 2017; Guillory et al. 2017). In turn, heavy smoking is more likely among the most socially disadvantaged young adults (Klein et al. 2013; Kvaavik, von Soest, and Pedesen 2014). Hu, Davies, and Kandel (2006) found in the US that daily smoking and nicotine dependence were both more likely among young adults with less education who had precociously quit their studies, established a relationship, and had children. On the other hand, Kvaavik and colleagues (2014) argued that non-daily smokers in this age group were more likely to match the socio-economic circumstances of non-smokers than those of daily smokers.

#### **6.4.2 Operationalizing young adults' socio-economic characteristics**

The methods developed to operationalize the constructs of concern to the thesis represent analyses of secondary data. Therefore, the variables selected were not developed *a priori* for this thesis but derived from the information that was available. Were I to have developed the questionnaire items to match the concepts in the theoretical framework, I might have been better able to operationalize them. The variable selection process first sought to capture indicators that were likely to represent tangible resources, which could be directly leveraged for action. The selection process also sought to strike a balance between having a sufficiently comprehensive set of indicators and mitigating the problems associated with multivariable modelling (e.g., small cell sizes, missing data, multicollinearity, over-adjustment). This led me to exclude indicators that could have been relevant to better understanding the unequal distribution of smoking in this age group, including housing tenure, parents' education, books in the household, unemployment benefits, savings, access to a car and/or to a public transit pass, and area-level deprivation in the residential neighbourhood and other environments where young adults travel daily (Shareck et al. 2014; Frohlich et al. 2017).

#### **6.4.3 Gender considerations**

There are likely to be strong gender-based differences underlying the findings in this thesis. Canadian evidence suggests that men smoke more and that education-based and occupation-based inequalities in smoking are not significantly different between men and women today, but that they have increased more rapidly among women over time (Corsi et al. 2013, 2014; Reid et al. 2017). Studies have proposed that young men and women have different interactions with their family and peers when attempting to quit smoking (Branstetter et al. 2012). More importantly, studies have highlighted substantial gender-based differences in the associations among parenthood, partnering, and smoking: (1) new fathers are much less likely to quit smoking than their partner before and during the pregnancy (Blackburn et al. 2005; Shih et al. 2008; Bottorff et al. 2009; Kerr et al. 2011; White, Oliffe, and Bottorff 2012), and (2) partnered women are more likely to quit smoking if their partner is a non-smoker, and to relapse if their partner is a smoker, compared with partnered men (Umberson 1992; Homish and Leonard 2005; Cutler and Glaeser 2010; Cobb et al. 2014).

The thesis explored gender considerations in sensitivity analyses by testing additional interactions for each association; none were found to be statistically significant. Stratifying by gender, however, significantly reduces the statistical power to detect true differences. Neither the ISIS nor the NPHS was designed to support the study of gender differences in social inequalities in smoking among young adults. It cannot, therefore, be reliably asserted that there are no gender-based differences underlying the thesis findings.

#### **6.4.4 Causal inference, analytic designs, and alternative explanations**

The designs and analyses used in the ISIS and NPHS data sets do not allow me to appropriately disentangle temporality and unobserved confounding; thus, I cannot derive causal claims from many of the associations that are presented in this thesis. The associations between socio-economic characteristics and smoking often include reinforcing mechanisms over time (Widome et al. 2015). Studies have also suggested that smoking can subsequently influence relationship and employment preferences during young adulthood, reinforcing the notion that most associations may support both selection and causation explanations (Dermer and Jacobsen 1986; Malouff and Schutte 1990; Malouff, Schutte, and Kenyon 1991).

With regard to confounding, there is a massive amount of literature on the determinants of smoking, and it reaches far beyond the socio-economic characteristics discussed in this thesis. These determinants include biological and psychosocial mechanisms such as susceptibility to nicotine dependence, intelligence, self-efficacy, risk discounting, and peer effects (IOM 2015). They may contribute to young adults' capacity to pursue both better socio-economic opportunities and healthier behaviours. However, a large amount of scholarship supports the notion that these variables are unlikely to explain the consistent associations observed between socio-economic characteristics and health behaviour uptake (Cutler and Muney-Llunas 2010; Pampel, Dennis, and Krueger 2010).

It should also be noted that the models were not adjusted for the presence of smokers in participants' household, family, and/or extended network because they can represent important mediators of the association between young adults' socio-economic circumstances and smoking (Soteriades and DiFranza 2003). For instance, Taylor-Robinson and colleagues (2017) found in the UK that adjusting for parental smoking explained nearly 60% of the association between parents' occupational status and the risk of early smoking initiation in childhood. Mediation and confounding can only be distinguished on a theoretical basis in the absence of appropriate inferential designs (MacKinnon, Krull, and Lockwood 2000). Adjusting for these variables, therefore, could lead to the erroneous conclusion that there was confounding (i.e., not mediation) if a weaker association between a socio-economic characteristic and smoking had been found.

Ultimately, the methodological decisions used in this thesis represent a compromise in the balance between hypothesis generating and hypothesis testing in the general process of scientific inquiry. At the other end of this spectrum, there are still studies estimating the causal relation between educational attainment and smoking (Gilman et al. 2008; Gage et al. 2017). Therefore, the findings presented in this thesis will benefit from being reproduced and corroborated using robust, prospective longitudinal designs with appropriate causal inference statistical analyses.

## **6.5 Next steps**



Unpacking young adults' socio-economic circumstances, following their progression at different ages, and investigating their association with smoking outcomes would ideally require a data set that (1) is recent enough to represent current trends in education, employment, family and housing arrangements, and smoking behaviour; (2) follows a longitudinal, prospective cohort design; (3) follows participants from the age of 18 well into the fourth decade of life; (4) has multiple time points to appreciate rapid, intra-individual changes; and (5) measures an extensive amount of information on young adults' socio-economic characteristics and smoking outcomes.

Currently, however, there is no single Canadian data set that can accommodate each of these issues. For instance, in the province of Quebec, the Quebec Longitudinal Study of Child Development, managed by the Institut de la Statistique Québec, has followed approximately 1,400 youth 13 times since their birth in 1998, but the last measurement was taken in 2016, when they were 18 years old. Fortunately, this study is funded until 2023, with the intention of following participants until age 25 (ISQ 2018).

There are other large-scale, nationally representative, longitudinal, prospective cohort studies related to young adults' socio-economic transitions in Canada. For instance, the Youth in Transition Survey followed over 10,000 adolescents and young adults every two years between 1998–1999 and 2008–2009 and obtained very detailed information on their education, employment, and financial transitions. However, it did not collect information on the participants' health outcomes. Therefore, unlike countries such as the US and the UK, which have an established track record with cohort studies, Canada has not seen a large-scale, nationally representative cohort study developed to support the study of health inequalities during the transition to adulthood.

Despite this, the questions addressed in this thesis invite a range of new research endeavours in the immediate future:

1. Future studies need to examine the precise mechanisms – that is, initiation, intensification, cessation, and relapse – through which social inequalities in smoking develop during young

adulthood. In this thesis, the focus was on a simple measure of smoking status (Current smoker/Non-smoker). There is still debate about which socio-economic characteristics influence initiation to a first cigarette, intensification to daily smoking, cessation, and relapse during the transition to adulthood (Breslau and Pederson 1996; Moran et al. 2004; Curry et al. 2007; Solberg et al. 2007; Mendel et al. 2012; Khati et al. 2015; Gagné and Veenstra 2017; Steinmetz-Wood et al. 2018). Social determinants, however, are likely to be different for each outcome (Maralani 2014). The NPHS can pursue this work by examining the smoking trajectories of smokers and non-smokers followed between the ages of 18–19 and 24–25.

**2.** Future studies might also want to examine the relationship among income, occupation, and smoking status across the life-course. While income is associated with a higher risk of smoking during adolescence and with a lower risk of smoking in adulthood, no studies have unpacked this inversion during the transition to adulthood (Tyas and Pederson 1996; Casetta et al. 2016). Furthermore, studies need to corroborate whether the influence of personal income on smoking during young adulthood is modified by educational attainment or other socio-economic characteristics. In the NPHS, personal income data was collected starting only in the fourth survey cycle. Therefore, including personal income in article 4 would have removed over 40% of the sample. We can, however, examine the progression of the association between personal income and smoking between the ages of 18–19 and 24–25 among the 650 to 700 remaining participants who were observed between the fourth and ninth survey cycles.

**3.** Future studies could explore how the associations between socio-economic characteristics and smoking progress after the age of 25. Transitions in education, employment, family, and housing circumstances continue well into the fourth decade of life; this fact implies that associations between socio-economic circumstances and smoking are likely to continue to vary after the 18–25 age period covered in this thesis (Clark 2007; Vespa 2017). The NPHS can do this work by reproducing the analytic approach used in this thesis in a second sample of young adult participants followed between the ages of 26–27 and 32–33. Alternatively, researchers can use an “accelerated” design that pools observations from multiple age cohorts, followed over a shorter period of time, to examine change over a longer period of time (Miyazaki and Raudenbush 2000).

## **CHAPTER 7. CONCLUSION**

This thesis began with the statement that, despite our country's global leadership role in health, a significant number of Canadians continue to face an unequal burden of injury, illness, and premature death in keeping with the socio-economic circumstances that they experience daily (CIHI 2016; Clark and Horton 2018; PHAC 2018). Building on the life-course approach, I defined the unequal uptake of health behaviours across social groups as a key mechanism by which these health inequalities occur (WHO 2008). A recent review found that smoking, alcohol, physical activity, and dietary patterns explained between 17% and 33% of social gradients in all-cause mortality, cardiovascular disorders, and metabolic disorders (Petrovic et al. 2018). Recent advances in causal inference methodology suggest that the contribution of health behaviours to these social gradients is likely to be even higher when we appropriately model the complex relations linking socio-economic characteristics and health behaviour over the life course (Groeniger and van Lenthe 2016).

Public health research is rightfully shifting from a “science of problems,” focused on risk factors, to a “science of solutions,” focused on policy-making and implementation research (Potvin and di Ruggiero 2016). This shift, however, does not invalidate the need for better theory and evidence for the mechanisms driving the progression of health inequalities. Graham (2007, xii) argued that while unravelling causes may seem out of place in a policy world where the priority is finding solutions, part of the reason for the lack of progress in reducing health inequalities lies in the fact that too little, rather than too much, attention has been paid to understanding the social determinants of health inequalities.

New advances in health inequality research also have the potential to support the prevention of other health practices that follow the same social underpinnings as smoking. For instance, as the prevalence of smoking continues to diminish, obesity will soon start to replace it as the most important preventable cause of morbidity and mortality (Jia and Lubetkin 2010). Consistent with the historical perspective of Link and Phelan's theory of fundamental causes (1995), practices such as physical activity and dietary patterns are likely to reproduce social inequalities in morbidity and mortality if public health does not learn from the trials and tribulations of tobacco control.

Using one systematic review and three empirical investigations, this thesis worked to demonstrate how some of the principles buttressing health inequality research are unlikely to hold in young adulthood. Socio-economic circumstances should no longer be subsumed by a small number of traditional indicators believed to be independent. These circumstances should also no longer be abstracted from their timing over the life course and condensed to vague time points of exposure such as childhood and adulthood.

I hope that this thesis highlights, in a new way, the complexity of the conditions that shape smoking. I hope it fosters new theoretical reflection within health inequality research on the intersections among the resources that young adults accumulate, the transition stages that they experience, and the different ages at which these processes occur. I also hope that this thesis motivates public health researchers to embrace nuanced approaches to the empirical study of health inequalities; these approaches would include refining their measurement of socio-economic characteristics, further reporting subgroup differences across social groups, and adopting a life-course approach, which contextualizes these health inequalities in keeping with young adults' transition stages and across meaningful age brackets. Finally, I hope that this thesis adds support for the appropriate evaluation of tobacco-control interventions designed to reduce smoking by systematically questioning how the mechanisms of change might differ among young adults' resources, transition stages, and different ages.

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**APPENDIX I. Gagné T, Veenstra G. Trends in smoking initiation in Canada : Does the non-inclusion of young adults in tobacco control strategies represents a missed opportunity? Can J Public Health. 2017; 108(1) : e14-e20**

## QUANTITATIVE RESEARCH

# Trends in smoking initiation in Canada: Does non-inclusion of young adults in tobacco control strategies represent a missed opportunity?

Thierry Gagné, MSc,<sup>1,2</sup> Gerry Veenstra, PhD<sup>3</sup>

## ABSTRACT

**OBJECTIVES:** Young adults face high prevalence rates for smoking. Recent evidence suggests that many people initiate smoking during young adulthood, but little is currently known about trends in initiation rates for this age group.

**METHODS:** We examined rates of initiation to first cigarette (FC) and daily smoking (DS) during youth (5–17 years) and young adulthood (18–25 years) using nationally representative data from the 2001, 2003, 2005, 2007, 2009, 2011 and 2013 cycles of the Canadian Community Health Survey. We included all participants aged 25–26 to obtain seven mutually exclusive retrospective cohorts ( $n = 16\,216$ ). We used logistic regression to examine four correlates of smoking – sex, education, poverty status, and immigration status – and whether these factors modify time trends in smoking.

**RESULTS:** We found that initiation rates decreased during youth ( $p < 0.001$  for FC,  $p = 0.02$  for DS) but not during young adulthood ( $p = 0.94$  for FC,  $p = 0.28$  for DS). We found that men and respondents with fewer educational credentials had relatively higher odds of initiating during young adulthood. Trends in young adulthood stayed constant across subgroups. Trends in youth were modified by education: participants who did not complete high school had no decrease in initiation to FC and DS while those with post-secondary education experienced a decrease in both outcomes.

**CONCLUSION:** Tobacco control has failed to address smoking initiation during young adulthood. Given the considerable amount of initiation that occurs during this period, practitioners and policy-makers should direct more of their planning toward young adults.

**KEY WORDS:** Smoking; young adult; socioeconomic factors; Canada

La traduction du résumé se trouve à la fin de l'article.

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Cigarette smoking remains one of the main preventable causes of morbidity and mortality in Canada and other Western countries and its prevalence continues to rise among developing countries.<sup>1</sup> With regard to preventing the initiation of smoking, tobacco control initiatives have included among their top priorities interventions targeted towards children and adolescents (5–17 years of age). These include school-based and community interventions, anti-smoking media campaigns, tobacco advertising restrictions, and youth access restrictions.<sup>2,3</sup> Certain public health institutions, including the Surgeon General's Office<sup>4</sup> and the Institute of Medicine,<sup>5</sup> have proposed to extend this age bracket up to 25 years of age and establish new priorities specific to the young adult (18–25) age group. In Canada, cigarette smoking prevalence is now highest among young adults.<sup>1</sup> The large decline in prevalence observed since the 1950s, particularly salient among children and adolescents, has also been slowest in this age group.<sup>1</sup> Evidence from the United States suggests that smoking cessation rates have remained constant in young adults over the last three decades, while they have steadily increased among people aged 45+ during that time.<sup>6</sup>

Twenty years ago, smoking initiation was believed to occur almost entirely during adolescence.<sup>4</sup> In the last decade, however, public health experts have begun to examine college students' and young adults' smoking initiation trends and their determinants.<sup>7–9</sup>

Recent studies suggest that young adult smoking initiation rates in Canada and the US could be as high as 30%.<sup>10–13</sup> Of particular concern, certain reports suggest that young adult initiation rates might even be increasing for some groups.<sup>5,13,14</sup> For instance, Terry-McElrath and O'Malley found using large consecutive American young adult cohorts that initiation rates during young adulthood of experimental and occasional smoking increased almost twofold over the last three decades.<sup>14</sup>

There is reason to believe that these rates and trends are unequally distributed among the young adult population.

## Author Affiliations

1. Institut de recherche en santé publique de l'Université de Montréal (IRSPUM), Montréal, QC
2. Département de médecine sociale et préventive, Université de Montréal, Montréal, QC
3. Department of Sociology, University of British Columbia, Vancouver, BC

**Correspondence:** Thierry Gagné, Département de médecine sociale et préventive, Université de Montréal, 7101 av du Parc, bureau 3139, Montréal, QC H3N 1X9, Tel: 514-343-6111, ext. 4565, E-mail: thierry.gagne@umontreal.ca.

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**Conflict of Interest:** None to declare.

Socio-demographic correlates of initiating during young adulthood include being male, not being married, not having a college degree, living in a poor neighbourhood and currently attending college.<sup>10,15,16</sup> Evidence related to racial/ethnic differences in young adult smoking initiation is mixed: in the US, Asian/Pacific Islander and African-American smokers are more likely to have initiated during young adulthood and non-Hispanic whites are more likely to initiate cigarette smoking during college.<sup>10</sup> Inquiries into young adult initiation should therefore examine how rates develop specifically among the disadvantaged segments of the Canadian population. Unfortunately, the majority of this evidence has been based upon single cross-sectional and cohort studies, limiting our understanding of the evolution of smoking initiation over time and across socio-economic subgroups.<sup>17</sup>

The objectives of this study are twofold. First, we examine and compare trends in youth (5–17 years) and young adult (18–25 years) smoking initiation rates using data from the Canadian Community Health Survey (CCHS). Second, we examine whether youth and young adult smoking initiation rates are associated with four important correlates of smoking (sex, education, poverty status, and immigration status) and whether trends in initiation during these two periods differ with regard to these factors.

## METHODS

### Data

The CCHS is a repeated cross-sectional survey that collects information related to health status, health care utilization and health determinants for the Canadian population.<sup>18</sup> Statistics Canada conducted the CCHS in 2001, 2003 and 2005 and annually from 2007. The target populations for these cross-sectional surveys were all persons 12 years of age and older residing in Canada, excluding individuals living on Indian Reserves and on Crown Lands, institutional residents, full-time members of the Canadian Armed Forces and residents of some remote regions. One eligible person was chosen randomly from each household to complete the survey. Response rates for the surveys range from a high of 84.7% in 2001 to a low of 67.3% in 2013. The larger project to which this study belongs was approved by the Behavioural Research Ethics Board at the University of British Columbia.

### Measures

We used two outcomes related to smoking initiation as dependent variables: initiation to first cigarette and initiation to daily smoking. *Initiation to first cigarette* was measured using the questions “Have you ever smoked one entire cigarette in your life?” and “At what age did you smoke your first cigarette?” The variable was coded as never smoked, youth initiator and young adult initiator. *Initiation to daily smoking* was measured using the questions, “At the present time, do you smoke cigarettes every day, occasionally or not at all?”, “Have you ever smoked daily?”, and “At what age did you begin to smoke (cigarettes) daily?” The variable was coded as never smoked, youth initiator and young adult initiator.

For socio-demographic correlates, we examined sex, education, poverty status, and immigration status. *Education* was measured from a battery of four questions and was combined to produce four categories: 1) High school not completed, 2) High school

completed, 3) Some post-secondary education, and 4) Post-secondary education completed. *Poverty status* is a dichotomous variable (living in poverty/not living in poverty) and was defined as being in the bottom quintile of household income adjusted for household size. *Immigration status* is a dichotomous variable (born in Canada/immigrated).

### Statistical analyses

Using a full adult sample can hide important cohort effects in regard to smoking initiation trends. We therefore restrict our analyses to participants who were 25 or 26 years of age at the time of the survey. We examine these participants' initiation to smoking in CCHS cycles 2001, 2003, 2005, 2007, 2009, 2011 and 2013 (initial  $n = 16\,216$ ).

We first present unweighted descriptive data of our sample and weighted proportions of initiation of first cigarette and daily smoking during youth and young adulthood between 2001 and 2013. We also report relative proportions that are calculated by dividing the proportion “initiation among young adulthood” by the sum of the two proportions (initiation during youth and during young adulthood). We then conduct three separate analyses. First, we test whether there were significant changes in the proportions over time by modeling survey year as an independent variable in binary logistic regression models. Survey year (2001–2013) was transformed using its natural logarithm to account for nonlinearity since it improved model fit. We tested trends in an unadjusted bivariate model and an adjusted multivariate model controlling for sex, education, poverty status, and immigration status. Second, we examine correlates of initiation of first cigarette and daily smoking during youth and young adulthood using multinomial logistic regression models controlling for independent variables and survey year. Finally, we examine differences in trends in initiation of first cigarette and daily smoking during youth and young adulthood by sex, education, poverty status, and immigration status using interaction terms in binary logistic regression models. Interaction terms were modeled separately. All variables had less than 2% of missing cases except for poverty status (7.1%). The analyses were performed using a listwise deletion approach given the small amount of missing cases in multivariate models (8.9%). To account for the complex sampling design, we applied the master weight and 500 bootstrap replicate weights provided by Statistics Canada to our models, a strategy recommended by Statistics Canada to produce more accurate point estimates and standard errors respectively.<sup>18</sup> All statistical analyses were conducted in Stata 13.<sup>19</sup>

## RESULTS

### Description of the sample

Table 1 presents the distribution of study variables according to initiation status. In the pooled (unweighted) CCHS sample of participants who were 25–26 years old at the time of survey, 50.1% were 26 years old and 55.2% were women. The yearly sample size varied from 3,351 in 2001 to 1,355 in 2013. In this (unweighted) sample, 36.6% have never initiated a full cigarette, 51.4% did so before age 18, and 12.0% did so during young adulthood. For daily smoking, 74.4% of participants had never initiated daily smoking, 17.6% did so before age 18, and 7.7% did so during young adulthood.

**SMOKING INITIATION AMONG YOUNG ADULTS**

**Table 1.** Description of the study sample (CCHS, 2001–2013) (*n* = 16 216)

Variables	Initiation of first cigarette (FC)			Initiation of daily smoking (DS)			Missing
	Never <i>n</i> (%)	Youth (5–17) <i>n</i> (%)	Young adult (18–25) <i>n</i> (%)	Never <i>n</i> (%)	Youth (5–17) <i>n</i> (%)	Young adult (18–25) <i>n</i> (%)	
Total	5894 (36.6)	8280 (51.4)	1926 (12.0)	12 067 (74.4)	2861 (17.6)	1247 (7.7)	FC = 41 (0.3) DS = 116 (0.7)
Age (years)							
25	2940 (49.9)	4125 (49.8)	971 (50.4)	6005 (49.8)	1454 (50.8)	615 (49.3)	0
26	2954 (50.1)	4155 (50.2)	955 (49.6)	6062 (50.2)	1407 (49.2)	632 (50.7)	
Sex							
Men	2421 (41.1)	3707 (44.8)	1071 (55.6)	5188 (43.0)	1312 (45.9)	740 (59.3)	0
Women	3473 (58.9)	4573 (55.2)	855 (44.4)	6879 (57.0)	1549 (54.1)	507 (41.7)	
Education							
Less than high school	290 (5.0)	1221 (14.9)	113 (5.9)	759 (6.4)	718 (25.5)	157 (12.7)	258 (1.6)
High school completed	895 (15.5)	1657 (20.3)	330 (17.4)	1923 (16.2)	681 (24.2)	300 (24.3)	
Post-secondary education received	449 (7.8)	838 (10.3)	214 (11.3)	1011 (8.5)	330 (11.7)	160 (13.0)	
Post-secondary education completed	4158 (71.8)	4454 (54.5)	1243 (65.4)	8189 (68.9)	1086 (38.6)	617 (50.0)	
Poverty							
Bottom quintile	997 (18.0)	1707 (22.4)	370 (20.5)	1975 (17.5)	843 (32.8)	277 (23.8)	1158 (7.1)
Top quintiles	4543 (82.0)	5916 (77.6)	1439 (79.5)	9323 (82.5)	1724 (67.2)	885 (76.2)	
Immigration status							
Immigrated	892 (15.4)	405 (5.0)	276 (14.5)	1362 (11.5)	82 (2.9)	134 (10.8)	267 (1.7)
Born in Canada	4894 (84.6)	7764 (95.0)	1627 (85.5)	10 507 (88.5)	2736 (97.1)	1102 (89.2)	
Survey year							
2001	1116 (18.9)	1769 (21.4)	440 (22.9)	2364 (19.6)	662 (23.1)	313 (25.1)	0
2003	1170 (19.6)	1818 (22.0)	368 (19.1)	2512 (20.8)	620 (21.7)	239 (19.2)	
2005	1237 (21.0)	1901 (23.0)	388 (20.2)	2600 (21.5)	674 (23.6)	265 (21.3)	
2007	574 (9.7)	873 (10.5)	167 (8.7)	1214 (10.1)	290 (10.1)	117 (9.4)	
2009	605 (10.3)	730 (8.8)	160 (8.3)	1174 (9.7)	223 (7.8)	109 (8.7)	
2011	585 (9.9)	658 (8.0)	195 (10.1)	1134 (9.4)	215 (7.5)	97 (7.8)	
2013	607 (10.3)	531 (6.4)	208 (10.8)	1069 (8.9)	177 (6.2)	107 (8.6)	

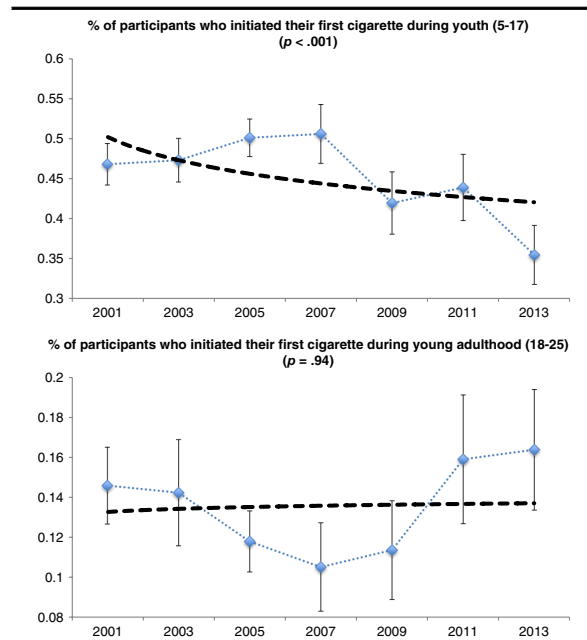
Note: Percentages do not take into account missing values and are rounded to the first decimal.

**Trends in initiation during youth and young adulthood**

Figures 1 and 2 present the weighted proportions of participants aged 25–26 in the CCHS who initiated their first cigarette (FC) and daily smoking (DS) during youth (5–17 years) and young adulthood (18–25 years). The proportions and their 95% confidence intervals are reported in Supplementary Table 1 (supplementary files mentioned in this article are accessible in the ARTICLE TOOLS section on the journal site). We added a logarithm trend in the plots to represent graphically the tests performed in logistic regression models. Detailed outputs from these models are available in Supplementary Table 2.

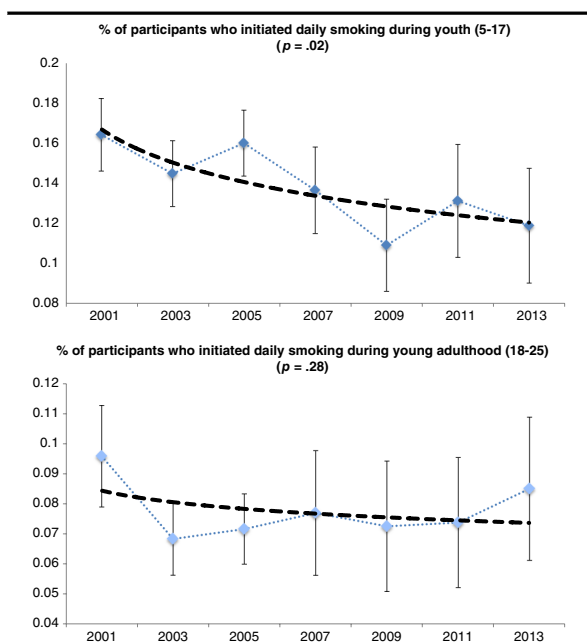
For initiation of FC, the proportion of participants in 2001 who had smoked their first cigarette was 46.8% (95% CI 44.2–49.3) during youth and 14.6% (95% CI 12.7–16.5) during young adulthood. In 2013, the proportion for those who initiated their FC during youth decreased to 35.6% (95% CI 31.8–39.2). The downward trend was statistically significant after controlling for socio-demographic characteristics ( $p < 0.001$ ). The proportion for those who initiated their FC during young adulthood in 2013 changed to 16.4% (95% CI 13.4–19.4). There was no statistically significant trend in changes over time ( $p = 0.94$ ).

For initiation of DS, the proportion of participants in 2001 who started smoking daily was 16.4% (95% CI 14.6–18.2) during youth and 9.6% (95% CI 7.9–11.3) during young adulthood. In 2013, the proportion decreased to 11.9% (95% CI 9.0–14.7) for those who initiated DS during youth. This downward trend was statistically significant after controlling for socio-demographic characteristics



**Figure 1.** Initiation of first cigarette among participants aged 25–26 years in the CCHS (2001–2013)





**Figure 2.** Initiation of daily smoking among participants aged 25–26 years in the CCHS (2001–2013)

( $p = 0.02$ ). The proportion of participants who initiated DS during young adulthood changed to 8.5% (95% CI 6.1–10.9) in 2013. There was no statistically significant trend in changes over time ( $p = 0.28$ ).

Relative proportions over time are presented in Figure 3. Looking at the 2001 estimates, we can divide the proportion of participants who initiated their first cigarette during young adulthood (14.58%) by the sum of this proportion and the proportion of initiation to FC during youth (46.76%) for a relative proportion of 23.8% ( $0.1458 / (0.1458 + 0.4676)$ ). This means that 23.8% of participants who have ever initiated did so during their young adulthood. For initiation to FC, the relative proportion of initiators during young adulthood increased from 23.8% (95% CI 20.9–26.7) in 2001, to a low of 17.26% (95% CI 13.9–20.6) in 2007 up to 31.5% in 2013

(95% CI 26.6–36.5). Relative proportions in 2005, 2007 and 2009 were significantly lower than the relative proportion in 2013. When modelling the time trend for these relative proportions, we found that a quadratic trend best fit the changes over time (linear and quadratic terms were both significant at the  $p < 0.001$  level). In this model controlling for socio-demographic characteristics, the predicted relative proportions for the 2003, 2005, 2007, 2009 and 2011 survey cycles were significantly lower than the 2013 predicted proportion. We present the quadratic time trend in Supplementary Figure 1. For initiation to daily smoking, the relative proportion of initiators during young adulthood increased from 36.9% (95% CI 31.7–42.0) in 2001, down to 30.9% (95% CI 26.7–35.2) in 2005 and up to 41.7% (95% CI 32.3–51.1) in 2013. There was no statistically significant trend in changes in relative proportions for initiation to DS during young adulthood over time.

**Correlates of initiation during youth and young adulthood**

Table 2 presents associations between four independent variables – sex, educational attainment at age 25–26, living in poverty at age 25–26, and immigration status – and the four outcomes, i.e., having initiated a first cigarette or daily smoking during youth or young adulthood in comparison to having never initiated.

For initiation of FC, we found that women (RRR = 0.80, 95% CI 0.71–0.91) and immigrants (RRR = 0.27, 95% CI 0.22–0.33) had lower relative odds of having initiated during youth. Those who did not finish high school (RRR = 3.95, 95% CI 3.08–5.05), only completed high school (RRR = 1.58, 95% CI 1.34–1.86), or received some post-secondary education (RRR = 1.52, 95% CI 1.22–1.91) at 25–26 years of age had higher relative odds of having initiated during their youth in comparison to those who completed post-secondary education. With regard to initiation of FC during young adulthood, women (RRR = 0.55, 95% CI 0.45–0.66) had lower relative odds of having initiated then. Participants with some post-secondary education at 25–26 years old (RRR = 1.59, 95% CI 1.13–2.26) had higher relative odds of having initiated during young adulthood.

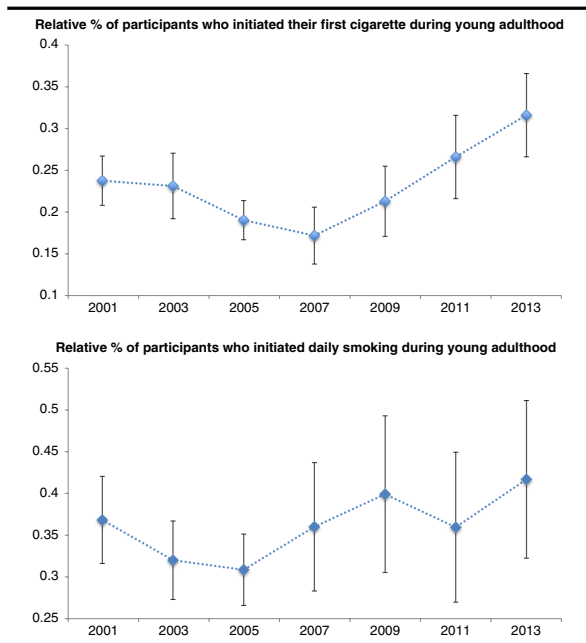
For initiation of DS, immigrants (RRR = 0.21, 95% CI 0.14–0.31) had lower relative odds of having initiated during youth. Participants who lived in poverty at 25–26 years old

**Table 2.** Correlates of smoking initiation during youth and young adulthood (CCHS, 2001–2013)

Variables	Initiation of first cigarette				Initiation of daily smoking			
	Youth		Young adult		Youth		Young adult	
	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
Sex								
Female (male = ref.)	<b>0.80</b>	<b>(0.71, 0.91)</b>	<b>0.55</b>	<b>(0.45, 0.66)</b>	0.88	(0.75, 1.05)	<b>0.46</b>	<b>(0.37, 0.57)</b>
Education at 25–26 years								
Less than high school	<b>3.95</b>	<b>(3.08, 5.05)</b>	1.34	(0.90, 2.01)	<b>7.46</b>	<b>(5.94, 9.37)</b>	<b>2.59</b>	<b>(1.78, 3.77)</b>
High school completed	<b>1.58</b>	<b>(1.34, 1.86)</b>	1.15	(0.91, 1.46)	<b>2.89</b>	<b>(2.37, 3.51)</b>	<b>1.64</b>	<b>(1.26, 2.15)</b>
Post-secondary received (post-secondary completed = ref.)	<b>1.52</b>	<b>(1.22, 1.91)</b>	<b>1.59</b>	<b>(1.13, 2.26)</b>	<b>2.62</b>	<b>(2.00, 3.43)</b>	<b>1.69</b>	<b>(1.24, 2.31)</b>
Poverty at 25–26 years								
Bottom quintile (above = ref.)	1.12	(0.96, 1.31)	1.06	(0.84, 1.33)	<b>1.65</b>	<b>(1.36, 1.99)</b>	1.22	(0.95, 1.60)
Immigrant status								
Immigrated (born in Canada = ref.)	<b>0.27</b>	<b>(0.22, 0.33)</b>	0.86	(0.68, 1.09)	<b>0.21</b>	<b>(0.14, 0.31)</b>	1.03	(0.80, 1.39)

Note: Weighted multinomial logistic regression using listwise deletion. Models included all independent variables and controlled for survey year. Confidence intervals were computed using 500 bootstrap replicate weights. Bold coefficients are significant at the  $\alpha < 0.05$  level.

## SMOKING INITIATION AMONG YOUNG ADULTS



**Figure 3.** Relative proportions of initiation during young adulthood versus youth in the CCHS (2001–2013)

(RRR = 1.65, 95% CI 1.36–1.99) had higher relative odds of having initiated during youth. Participants who did not finish high school (RRR = 7.46, 95% CI 5.94–9.37), only completed high school (RRR = 2.89, 95% CI 2.37–3.51) or completed some post-secondary education (RRR = 2.62, 95% CI 2.00–3.43) at 25–26 years old had higher relative odds of initiating during their youth in comparison to those who completed post-secondary education. With regard to initiation of DS during young adulthood, women (RRR = 0.46, 95% CI 0.37–0.57) had lower relative odds of having initiated then. We also found that those participants who did not finish high school (RRR = 2.59, 95% CI 1.78–3.77), only completed high school (RRR = 1.64, 95% CI 1.26–2.15) or had some post-secondary education (RRR = 1.69, 95% CI 1.24–2.31) at 25–26 years old had higher relative odds of initiating during young adulthood in comparison to those who completed post-secondary education.

### Differences in trends in initiation during youth and young adulthood

Next we examine whether sex, educational attainment at age 25–26, living in poverty at age 25–26, and immigration status also modify trends in smoking initiation during youth and young adulthood. Detailed results from the logistic regression models that tested interaction terms are shown in Supplementary Table 2. Two groups defined by education – those who did not finish high school and those who finished post-secondary education at 25–26 years old – had significant differences in the rates of change in initiation of first cigarette ( $p = 0.03$ ) and daily smoking ( $p = 0.02$ ) during youth over time. Other interaction terms were not statistically significant.

Supplementary Figure 2 presents the predicted probabilities of participants to have initiated their first cigarette and daily smoking

during youth for those who did not finish high school and those who finished post-secondary education at 25–26 years old, with other factors held at their mean values. For initiation of FC, predicted probabilities of having initiated during youth among those who did not finish high school changed from 67.5% (95% CI 60.7–74.2) in 2001 to 72.4% (95% CI 66.1–78.8) in 2013. In comparison, predicted probabilities of having initiated during youth among those who completed post-secondary education decreased significantly from 46.2% (95% CI 43.1–49.3) in 2001 to 37.0% (95% CI 34.3–39.7) in 2013. For initiation of DS, predicted probabilities of having initiated during youth among those who did not finish high school changed from 33.5% (95% CI 26.7–40.3) in 2001 to 35.7% (95% CI 29.1–42.3) in 2013. In comparison, predicted probabilities of having initiated during youth among those who completed post-secondary education decreased significantly from 10.6% (95% CI 8.6–12.6) in 2001 to 6.2% (95% CI 5.2–7.3) in 2013.

## DISCUSSION

Our goal was to examine and compare the rates and trends in initiation during youth and young adulthood and to examine whether selected demographic and socio-economic factors were associated with smoking initiation and influenced changes in smoking initiation over time. The transition from adolescence to adulthood is accompanied by changes in family, school and work environments,<sup>20</sup> and we currently know very little about the promoting or deterring exposures that young adults experience with regard to smoking uptake.<sup>13</sup> These transitions are further shaped by young adults' socio-economic resources which may help them avoid smoking initiation. The imperative to address the unequal distribution of smoking comes after decades of research showing the potentially unequal influence of tobacco control initiatives on smoking behaviour.<sup>21</sup> This issue remains critically important in light of the deficient evidence on interventions able to reliably reduce smoking-related inequalities<sup>22,23</sup> and the widening of inequalities in smoking initiation over time.<sup>24–26</sup>

Consistent with an increasing amount of research on young adult initiation,<sup>10–13</sup> we found that proportions of initiation made during young adulthood had not decreased in our retrospective cohorts between 2001 and 2013. This means that initiation during young adulthood also represented a progressively larger proportion of initiation behaviour, which is in stark contrast with the first reports to study this issue.<sup>2</sup> In the most recent retrospective cohort of adults (2013), more than 30% of those who initiated their first cigarette did so during their young adulthood and more than 40% of those who initiated daily smoking did so during this period (however, changes in the relative proportions of initiation to DS during young adulthood were non-significant). These results highlight the missed opportunities of integrating young adults in tobacco control initiatives.

As with initiation during youth, men and participants with fewer educational credentials were disproportionately likely to initiate DS during young adulthood, a finding consistent with the current literature.<sup>10</sup> For initiation of a first cigarette, we found statistically significant differences between the “some post-secondary education” and “post-secondary education completed” groups, supporting other studies which suggest that post-secondary institutions may provide a fertile ground for smoking initiation

in certain groups.<sup>8–10</sup> Living in poverty and having immigrated, while influencing risk of initiation during youth, were not significantly associated with participants' odds of initiating specifically during young adulthood. None of these factors modified the stagnant initiation rates during young adulthood.

In contrast to the disappointing results in young adulthood, initiation rates during youth decreased by approximately 24% (first cigarette) and 27% (daily smoking) between cohorts in 2001 and 2013. These results suggest that Canada's public health efforts – nation-wide legislations and programs that promoted restrictions on tobacco advertising, youth access and smoking in public spaces, tax hikes on tobacco products and graphic warnings on packaging – have been successful in reducing youth initiation.<sup>27,28</sup> Efforts directed towards young adults could reap similar benefits. However, certain groups did not enjoy the same level of success in youth initiation: in particular, the most socially disadvantaged (as measured by their lack of educational credentials in adulthood) witnessed no progress at all. These results suggest that tobacco control initiatives have failed to address inequalities and had unforeseen negative consequences on its reduction.<sup>21,29</sup>

### Strengths and limitations

The main strengths of this study lie in the strong methodology, large sample size and repeated nature of the Canadian Community Health Survey, Statistics Canada's flagship health survey. There are two main limitations in this study. The first pertains to the non-overlapping time periods between youth and young adult trends that are observed by this study design. Examining retrospectively the initiation that occurred in participants when they were 18 to 25 between 2001 and 2013 refers to what occurred in the seven-year period preceding each survey year. Correspondingly, examining retrospectively the initiation that occurred when participants had not reached 18 years old refers to the period that occurred before that seven-year period. Readers should not compare directly trends in youth and young adulthood occurring over the same year. The second limitation pertains to the causality implied in certain associations. We emphasize that the associations between education, poverty, and smoking initiation are correlational and that we cannot rule out reverse causation or confounding by other correlates of smoking such as the consumption of other tobacco products, alcohol and drugs.

### CONCLUSION

Young adults now represent an important group for tobacco control. While initiating at an earlier age increases one's risk of smoking later,<sup>30</sup> a sizable proportion of those who initiate during young adulthood still become regular smokers.<sup>6</sup> Evidence suggests that even light and intermittent smoking (which is more prevalent among young adults) has a high risk of promoting daily smoking, morbidity and mortality in adulthood.<sup>31,32</sup> Young adulthood initiation needs to be part of the focus of future tobacco control initiatives. One first step in this direction should be the systematic inclusion of young adults in Canadian youth tobacco surveillance enterprises in order to produce strong evidence on young adult smoking. In the meantime, practitioners and policy-makers should seek to incorporate young adults in their tobacco control strategies and ensure that these strategies do not contribute to widening inequalities in smoking.

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## SMOKING INITIATION AMONG YOUNG ADULTS

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## RÉSUMÉ

**OBJECTIFS** : Des données récentes suggèrent que plusieurs jeunes adultes continuent de s'initier à la cigarette à partir de 18 ans. Il existe peu de données probantes sur les tendances en matière d'initiation tabagique.

**MÉTHODES** : Nous avons examiné les taux d'initiation à la première cigarette (PC) et au tabagisme quotidien (TQ) chez les jeunes (5–17 ans) et les jeunes adultes (18–25 ans) en utilisant les données de 2001, 2003, 2005, 2007, 2009, 2011 et 2013 de l'Enquête sur la santé dans les collectivités canadiennes. Nous avons utilisé tous les participants âgés de 25–26 ans afin d'obtenir sept cohortes rétrospectives mutuellement exclusives. Nous avons ensuite examiné quatre corrélats de l'initiation tabagique – le sexe, l'éducation, le statut de pauvreté et le statut d'immigrant – et si ces facteurs modifiaient les tendances temporelles.

**RÉSULTATS** : Les taux d'initiation ont diminué au cours de la période <18 ( $p < 0,001$  pour PC,  $p = 0,02$  pour TQ), mais pas au cours de la période 18–25 ( $p = 0,94$  pour PC,  $p = 0,28$  pour TQ). Pendant cette période, nous avons constaté que les hommes et les répondants moins diplômés avaient un risque plus élevé d'initier et que ces tendances étaient constantes dans tous les sous-groupes. Les tendances au cours de la période <18 étaient cependant différentes selon le niveau d'éducation : les participants qui n'ont jamais terminé leurs études secondaires n'ont apprécié aucune diminution comparativement à ceux qui ont fait des études postsecondaires.

**CONCLUSION** : La lutte contre le tabagisme n'a pas influencé l'initiation tabagique qui se produit à l'âge du jeune adulte. Les décideurs gagneraient donc à les intégrer davantage dans leur planification.

**MOTS CLÉS** : tabagisme; jeunes adultes; facteurs socioéconomiques; Canada

**APPENDIX II. Gagné T, Ghenadenik AE, Abel T, Frohlich KL.  
Social inequalities in health information seeking among young  
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## Social inequalities in health information seeking among young adults in Montreal

Thierry Gagné<sup>1,\*</sup>, Adrian E. Ghenadenik<sup>1,2</sup>, Thomas Abel<sup>3</sup>, and Katherine L. Frohlich<sup>1</sup>

<sup>1</sup>Institut de recherche en santé publique de l'Université de Montréal (IRSPUM), Canada, <sup>2</sup>Centre de recherche du Centre hospitalier de l'Université de Montréal (CRCHUM), Canada and <sup>3</sup>Department of Social and Preventive Medicine, University of Bern, Switzerland

\*Corresponding author. E-mail: thierry.gagne@umontreal.ca

### Summary

Over their lifecourse, young adults develop different skills and preferences in relationship to the information sources they seek when having questions about health. Health information seeking behaviour (HISB) includes multiple, unequally accessed sources; yet most studies have focused on single sources and did not examine HISB's association with social inequalities. This study explores 'multiple-source' profiles and their association with socioeconomic characteristics. We analyzed cross-sectional data from the *Interdisciplinary Study of Inequalities in Smoking* involving 2093 young adults recruited in Montreal, Canada, in 2011–2012. We used latent class analysis to create profiles based on responses to questions regarding whether participants sought health professionals, family, friends or the Internet when having questions about health. Using multinomial logistic regression, we examined the associations between profiles and economic, social and cultural capital indicators: financial difficulties and transportation means, friend satisfaction and network size, and individual, mother's, and father's education. Five profiles were found: 'all sources' (42%), 'health professional centred' (29%), 'family only' (14%), 'Internet centred' (14%) and 'no sources' (2%). Participants with a larger social network and higher friend satisfaction were more likely to be in the 'all sources' group. Participants who experienced financial difficulties and completed college/university were less likely to be in the 'family only' group; those whose mother had completed college/university were more likely to be in this group. Our findings point to the importance of considering multiple sources to study HISB, especially when the capacity to seek multiple sources is unequally distributed. Scholars should acknowledge HISB's implications for health inequalities.

**Key words:** health information, youth, inequalities

### INTRODUCTION

Recent studies highlight the prominence of a number of health-deterring behaviours among young adults. These include smoking, physical inactivity, unhealthy eating, alcohol abuse and unsafe sexual practices (Mulye *et al.*,

2009; USDHHS, 2012; IOM, 2015; Stroud *et al.*, 2015). Importantly, these behaviours are unequally distributed, with higher rates evidenced among the socioeconomically disadvantaged (USDHHS, 2012; IOM, 2015). These inequalities may be in part explained by differential distributions of health-related resources, including

health information (Viswanath *et al.*, 2006, 2012). In health promotion, scholars have highlighted the role of health literacy as a key determinant of health (Kickbusch, 2001; Nutbeam, 2000; Nutbeam, 2008). Social inequalities in health literacy can be observed from early adolescence onwards (Brown *et al.*, 2007; Manganello, 2008). Health literacy can be defined as '[...] knowledge, motivation and competence to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life [...]' (Sorensen *et al.*, 2012). As can be gleaned from this definition, the ability to seek and access health information should be considered as a fundamental component of health literacy. As proposed by Sorensen *et al.* (2012), skills and preferences used by young adults when seeking health information are not only influenced by cognitive or psychosocial factors, but also by contextual and societal determinants. Therefore, studies of young adults' health information seeking behaviour (HISB) and its socioeconomic distribution can contribute to a better understanding of their capacity to adopt health-promoting practices. Although young adulthood is now considered to be critical to the establishment of these practices (IOM, 2015), research on HISB in young adults is relatively limited (Ybarra and Suman, 2008; Percheski and Hargittai, 2011; Younes *et al.*, 2015). Therefore, this paper aims to tackle two important issues pertaining to HISB in young adults.

The first issue is the identification of a theoretically informed portrait of the socioeconomic characteristics that influence HISB in young adults. Historically, HISB has been examined in terms of individual-level determinants (Lambert and Loisel, 2007), failing to conceptualize it as a social phenomenon. Hence, the examination of social patterns in HISB requires the use of theories that can account for inequalities, in particular those related to non-material resources. Drawing from Bourdieu's (1986) work on social inequalities, scholars have argued that individuals' capacity to promote their health is shaped by their access to a range of 'capitals' that can be accumulated and used towards health (Carpiano, 2006; Abel, 2007; Abel and Frohlich, 2012). Capitals can be classified into three types: economic (i.e. financial and material resources that can bring immediate benefit or be exchanged against other resources), social (i.e. resources accessible through social networks based on principles of recognition and reciprocity) and cultural (i.e. knowledge, skills and preferences accumulated through socialization in the family and school environments) (Bourdieu, 1986; Abel, 2008). Abel (2007, 2008) argued that inequalities in health literacy could be understood as the result of unequal chances to acquire

socially-valued knowledge (values, norms and preferences related to health information) through friends, peers, education and media. This knowledge provides individuals with different capacities to use health information directly and indirectly through the application of other forms of capital (e.g. buying and reading books, access to support groups), and ultimately contributes to the reproduction of social inequalities in health. We argue that a similar perspective can shed light on how HISB can be conceived as an unequally distributed health-promoting resource.

In young adults, economic, social and cultural capitals are first acquired through parents' wealth, social connections and education, and later during the transition towards adulthood through socialization in family, school and work settings (Furstenberg, 2008; Abel and Frohlich, 2012; Gagné *et al.*, 2015). Since capitals are unequally distributed in the population, there is reason to believe that young adults' HISB may also be unequally distributed. Percheski and Hargittai (2011) found that among college students, young adults with a higher education level (cultural capital) sought health professionals, friends and family more often than those with a lower educational attainment. Beck *et al.* (2014) also found that manual labour status and income (economic capital) were negatively associated with seeking health information online and through health professionals. HISB is likely to be associated with the breadth and quality of one's social network (social capital), the financial means to access health care professionals and physical means of transportation (Savolainen, 1995; Ackerson and Viswanath, 2009). Individuals develop different information skills and preferences over their lifetime because in addition to health concerns, they routinely seek information on multiple issues (e.g. on personal interests, employment, family or friends) (Chelton and Cool, 2007). Individuals are also more inclined to seek their close relationships (e.g. family and friends) when they perceive them to be knowledgeable about health and when they practice healthy activities (Savolainen, 1995; Ter Huurne and Gutteling, 2008; Dobransky and Hargittai, 2012).

A second issue that requires examination is the operationalization of young adults' HISB beyond the seeking of single sources of information. To date, most studies in this area have focused on specific health issues and on single sources (e.g. health care professionals, peers, family, printed media and the Internet) (Lambert and Loisel, 2007; Weaver *et al.*, 2010; Anker *et al.*, 2011). Information seeking, however, is a dynamic process that weaves together multiple sources in response to different illness and wellness concerns (Brashers *et al.*, 2002;

Goldsmith and Hsieh, 2002; Lambert and Loiselle, 2007; Weaver *et al.*, 2010; Horgan and Sweeney, 2012). Health issues and their related needs (e.g. online anonymity, social support on Internet forums, trust and quality of information) inherently call for the use of different sources (Ruppel and Rains, 2012). Single-source research has been informed by a ‘substitution hypothesis’, which proposes that seeking a specific source of information reduces the probability of seeking other sources. In contrast, Dutta-Bergman (2004, 2005) proposed that when possible people use multiple sources of information (‘complementary hypothesis’). For example, individuals may be directed towards online sources following a medical consultation, may seek a health professional after having acquired information from a family member or may avoid seeking one if they receive advice against (Brashers *et al.*, 2002; Fox and Fallows, 2003; Beck *et al.*, 2014). We propose that individuals who seek multiple sources of health information have the best capacity to address health-related concerns and information needs. A growing body of literature supports this hypothesis (Ybarra and Suman, 2008; Ruppel and Rains, 2012; Beck *et al.*, 2014; Cunningham *et al.*, 2014; Younes *et al.*, 2015), and suggests that the use of multiple sources may be beneficial to health (Redmond *et al.*, 2010).

In light of these two issues, the objectives of this paper are (1) to better understand young adults’ HISB patterns by examining multiple sources of information and (2) to examine the unequal distribution of HISB by exploring a set of socioeconomic indicators and their association with these patterns. To do this, we first describe HISB patterns by modelling profiles based on young adults’ propensity to seek different information sources, and then examine whether these profiles are unequally distributed using indicators of young adults’ economic, social and cultural capitals.

## METHODS

### Data

We analyzed cross-sectional data from the 2011 to 2012 panel of the *Interdisciplinary Study of Inequalities in Smoking* (ISIS), a cohort study established with the objective of better understanding the joint contribution of individual and neighbourhood factors to social inequalities in smoking among young adults (Frohlich *et al.*, 2015). The target population was non-institutionalized young adults aged 18–25 living in Montreal, Canada, who had resided at their current address for at least 1 year at the time of first contact. From an initial sample

of 6020 randomly selected individuals obtained from the provincial health insurance program (RAMQ), individuals were contacted between November 2011 and August 2012 through a nominalized letter. Questionnaires were completed online, with other administration methods made available upon request. At the end of the recruitment period, 349 had refused to participate, 458 were declared ineligible and 3111 could not be reached, for a total sample size of 2093 participants. The final response rate was 37.6%. Full details on sampling and survey procedures are available elsewhere (Frohlich *et al.*, 2015). This study received ethics approval by the provincial information access committee (*Commission d’accès à l’information du Québec*) and the Université de Montréal’s ethics board (*Comité d’éthique de la recherche en santé de la Faculté de Médecine*).

### Measures

HISB was operationalized based on the following question: ‘When you have questions about your health, who do you ask first? Choose *all* the answers (Y/N) that apply to you’. Five non-exclusive sources were offered: ‘A health professional’, ‘A member of the family’, ‘A friend or another person’, ‘You look for answers on the Internet’ and ‘You don’t ask anyone’. These variables were created by the ISIS team and adapted from the NORC General Social Survey and other measures of HISB in young adults (Cotten and Gupta, 2004; Dobransky and Hargittai, 2012).

Social, economic and cultural capitals were operationalized using seven indicators (question labels and responses for independent variables are available in the [Supplementary material](#)). For social capital, two indicators of personal social networks were used: *friend satisfaction* (four-point Likert scale) and *social network size*. *Social network size* was computed as the sum of three items asking participants how many friends they (1) could confide in, (2) could receive help from in case of an emergency and (3) felt close to ( $\alpha = 0.74$ , range = 0–15, mean = 10.39, SD = 3.92). The sum was standardized before modelling. For economic capital, two indicators were used: presence of *financial difficulties* and whether participants had *no transportation means*. Participants were categorized as having *financial difficulties* (Y/N) if the head of their household (i.e. themselves, a parent or tutor) encountered difficulties in paying for rent, for utilities, or for food in the past year, or if they were on welfare ( $\alpha = 0.65$ ). *No transportation means* (Y/N) measured whether participants had access to a car or a monthly transit pass. For cultural capital,



we examined *individual, father's and mother's education*, extensively validated indicators of cultural capital in young adults (Gagné et al., 2015). Responses included twelve choices ranging from 'No school' to 'Earned doctorate' and were recoded into two categories: 'High school completed or less' and 'CEGEP completed or more'. CEGEP (*Collège d'enseignement général et professionnel*) is a post-secondary educational institution between high school and university that provides mandatory pre-university education or vocational training in Quebec, Canada. A dichotomous variable was created because in the Province of Quebec, mandatory schooling finishes when an individual obtains a high school diploma.

### Statistical analyses

We analysed HISB patterns using latent class analysis (LCA). LCA is a statistical technique that infers a categorical latent variable (i.e. HISB profiles) from the interrelationships between discrete measurement indicators (i.e. the five HISB indicators). We explored the optimal number of classes representing these interrelationships by computing models with an increasing number of classes and comparing them using three model fit indices: entropy, BIC and Vuong-Lo-Mendell-Rubin (VLRM) (see class probabilities and fit indices in [Supplementary File S1](#)). Entropy is a measure of the quality of participants' classification within their most likely class, BIC is an index that compares model fit between class solutions, and VLRM is a likelihood ratio test that compares a  $k$  class solution with its  $(k-1)$  counterpart (Nylund et al., 2007). LCA models were estimated using 1000 random starts, checking for best log-likelihood replication to ensure that no local maxima were inadvertently derived. Because LCA provides a probability of class membership, we attributed a class to each individual based on their most likely class. Associations between capital indicators and HISB classes (modelled here as the dependent variable) were examined using multinomial logistic regression models, controlling for *age* and *sex*.

Missing values for the independent variables used in this study were below 5% in all cases except for *financial difficulties*, *mother's education* and *father's education*. In the case of the two education variables, this is because data were extracted from a second collection wave that followed 73% of the sample (Frohlich et al., 2015). To handle missing data and make full use of our sample in regression models, we used a multiple imputation procedure that accounted for variables' categorical or continuous nature with 10 imputed sets (Graham

et al., 2007). For parental education variables, we included all variables found to be associated with attrition at follow-up to improve the quality of our imputation. Descriptive analyses were performed in SPSS 21 (IBM, 2011). Latent class analysis, multiple imputation and regression analyses were performed in MPlus 7 (Muthén and Muthén, 1998–2013).

## RESULTS

[Table 1](#) describes the study sample. We excluded participants who did not provide valid answers to HISB indicators ( $n=12$ ), resulting in a final analytical sample of 2081 individuals. Participants' mean age was 21 years old ( $SD=2.3$ ) and 56% were females. When having questions about health, 57% declared seeking a health professional, 71% their family, 43% a friend, 56% the Internet and 4% no one. We also found that 1% sought no sources, 30% one, 26% two, 27% three and 16% sought all four available information sources.

### HISB profiles

Based on the available degrees of freedom and BIC values, the number of profiles that provided the best model fit was a 5-class solution (see [Supplementary material](#)). The entropy value of the model was 0.97, indicating that participants were extremely well classified by their profile attribution based on their most likely class. [Figure 1](#) presents the distribution of HISB patterns according to participants' most likely class. The largest group (42.1%), labelled 'all sources', had a high probability of seeking all available information sources when having questions about health. Class 2 (28.9%), labelled 'health professional centred', represents young adults who tended to resort to health professionals when seeking health information, but also had a high probability of seeking family members and the Internet. Class 3 (13.8%), labelled 'family only', represents young adults who resorted only to family members when seeking health information. Class 4 (13.7%), labelled 'Internet centred', represents young adults who tended to look online when having questions about health, with a moderate probability of also using family members as a source. Class 5 (1.5%), labelled 'no sources', represents young adults who did not seek anyone when having questions about health. We made a distinction between 'centred' and 'only' labels to highlight that the 'family only' group is the only class with a very low probability of seeking other sources whereas other classes had at least a moderate probability ( $\geq 40\%$ ) of seeking an additional source.

**Table 1:** Descriptive statistics of the ISIS analytical sample ( $n = 2081$ )

Variables	N (%)	Missing (%)
When you have questions about your health, who do you ask first?		0
A health professional	1182 (56.6)	
A member of your family	1485 (71.1)	
A friend or another person	897 (42.9)	
You look online	1176 (56.3)	
You don't ask anyone	88 (4.2)	
Number of sought sources (max. four)		0
0	26 (1.2)	
1	625 (30.0)	
2	544 (26.1)	
3	553 (26.6)	
4	333 (16.0)	
Sex		0
M	902 (43.3)	
F	1179 (56.7)	
Age		0
Mean (SD)	21.5 (2.3)	
Friend satisfaction		11 (0.5)
Very satisfied	15 (0.7)	
Somewhat satisfied	117 (5.7)	
Somewhat dissatisfied	1032 (49.9)	
Very dissatisfied	906 (43.8)	
Friend network size		19 (0.9)
Mean (SD)	10.38 (3.91)	
Financial difficulties		199 (9.6)
Experienced difficulties	298 (14.3)	
Have not experienced difficulties	1584 (76.1)	
Access to car or bus pass		49 (2.4)
No car/transit pass	139 (6.7)	
Access to one or both	1893 (91.0)	
Individual education		10 (0.5)
High school or less	809 (39.0)	
Post-secondary education	1262 (61.0)	
Mother's education		718 (34.5)
High school or less	426 (31.3)	
Post-secondary education	937 (68.7)	
Father's education		758 (36.4)
High school or less	439 (33.2)	
Post-secondary education	884 (66.8)	

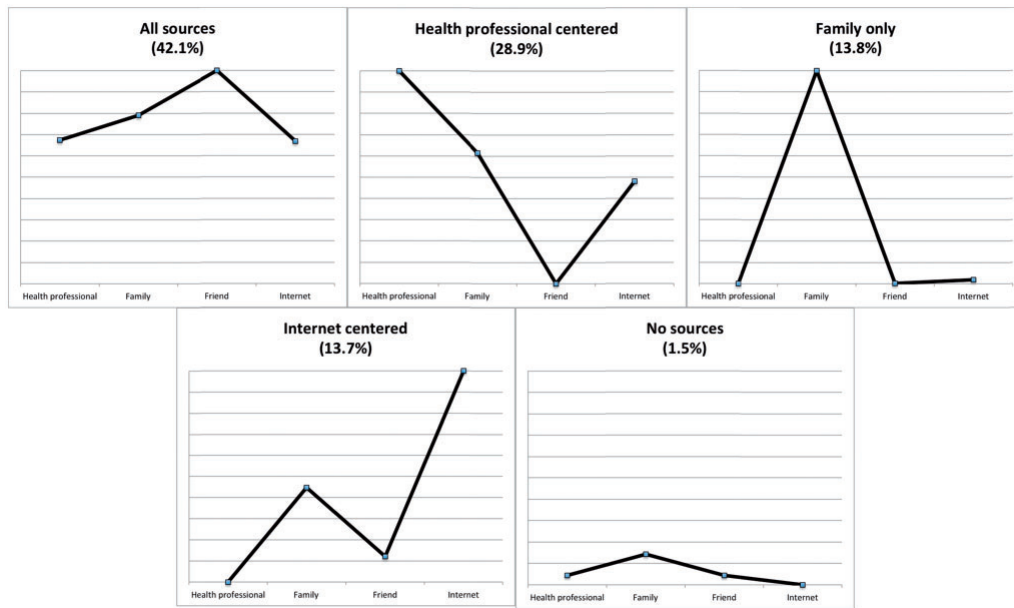
### Association between young adults' HISB profiles and socioeconomic characteristics

We proposed that individuals who seek multiple sources of health information had the best capacity to address health-related concerns and information needs. Therefore, based on the LCA results, the 'all sources' profile was used as the reference category in multinomial logistic regressions.

Table 2 presents associations between participants' capital indicators and HISB profile membership. In

bivariate analyses (results not shown), we found that age was not significantly associated with class membership, but that women were more likely to be members of the 'all-sources' group in comparison to the 'no sources' (OR = 4.70, 95%CI (2.08, 10.62)), 'health professional centred' (OR = 1.28, 95%CI (1.04, 1.58)), 'Internet centred' (OR = 1.92, 95%CI (1.47, 2.52)) and 'family only' (OR = 1.32, 95%CI (1.00, 1.72)) groups.

In our full model, we examined the adjusted odds of membership in each HISB class using the 'all sources'



**Fig. 1:** Health information seeking behaviour profiles—individual probabilities of seeking a health information source. The dots constituting the bolded lines represent individuals' probability (%) of seeking a health information source for each group. Each gray line represents a 10% increase in individual probability. Percentages under each class name represent their estimated prevalence given participants' most likely class membership. Although the indicator 'You don't ask anyone' has been used in model construction, class probabilities for this indicator are not shown here. Probabilities for all indicators are presented in [Supplementary File S1](#).

**Table 2:** Socioeconomic variables associated with HISB profiles in comparison to the 'all sources' class ( $n = 2081$  with 10 imputed sets)

Variables	Classes (in order of prevalence)							
	Health professional centred		Family only		Internet centred		No source	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Social								
Friend satisfaction	1.00	(0.90, 1.12)	0.89	(0.77, 1.03)	0.81	(0.65, 0.88)	0.73	(0.48, 1.11)
Social network <sup>a</sup>	<b>0.80</b>	(0.71, 0.90)	0.86	(0.74, 0.99)	0.76	(0.70, 0.93)	0.54	(0.36, 0.82)
Economic								
Financial difficulties	0.90	(0.64, 1.26)	0.63	(0.40, 0.98)	0.81	(0.54, 1.22)	1.68	(0.61, 4.62)
No transport means	0.69	(0.45, 1.07)	0.61	(0.36, 1.05)	0.89	(0.50, 1.61)	0.47	(0.15, 1.49)
Cultural (Has post-secondary diploma)								
Individual	0.88	(0.68, 1.13)	0.63	(0.46, 0.86)	1.19	(0.86, 1.64)	0.68	(0.27, 1.72)
Mother	0.99	(0.73, 1.35)	<b>1.99</b>	(1.23, 3.24)	1.18	(0.79, 1.76)	1.72	(0.58, 5.19)
Father	1.34	(0.95, 1.85)	1.11	(0.72, 1.69)	1.17	(0.78, 1.78)	0.69	(0.20, 2.41)

Coefficients with *P* values below 0.05 are in bold. The model includes all seven independent variables plus age and sex as control variables.

<sup>a</sup>ORs for a standardized variable represent the modified odds of membership in a group given an increase of one SD unit in the variable's score.

class as reference category for each independent variable, controlling for all other independent variables. In comparison with the 'all sources' group, participants with a larger social network (as defined by a 1 SD increase in the variable score) had significantly lower odds of being a member of any other group: participants with a larger social network were (respectively) 0.80, 0.86 and 0.76 times as likely to be in the 'health professional centred', 'family only' and 'Internet-centred' groups. The largest difference was found with the 'no source' group, where participants with a larger social network were 0.54 times as likely to be a member of that group (95%CI (0.36, 0.82)). Additionally, controlling for participants' social network, participants who felt more satisfied with their circle of friends were found to be 0.81 times as likely to be in the 'Internet centred' group (95%CI (0.65, 0.88)).

Additional differences between the 'all sources' group and other groups were found for participants belonging to the 'family only' group. In comparison with the 'all sources' group, participants who had experienced financial difficulties were 0.63 times as likely to be in the 'family only' group (95%CI (0.40, 0.98)); those who have a diploma higher than high school were 0.63 times as likely to be in the 'family only' group (95%CI (0.46, 0.86)); and those who have a mother who obtained a post-secondary diploma were 1.99 times as likely to be in the 'family only' group (95%CI (1.23, 3.24)).

## DISCUSSION

The aims of this article were to better understand HISB patterns in young adults by examining multiple sources of information, and to explore their unequal distribution based on their association with indicators of economic, social and cultural capital. Our findings provide evidence of multiple-source HISB patterns, therefore, suggesting that HISB may be better examined by using profiles that go beyond single sources of information. These results are in line with a recent study that used a clustering approach to examine profiles in mental health information preferences among youth with mental health problems (Cunningham *et al.*, 2014). The authors found that individuals could be classified into specific groups according to their preferences regarding traditional media and virtual media. To the best of our knowledge, this study is the first to use a clustering technique to examine HISB patterns among young adults in the general population.

LCA analyses showed five different HISB profiles, pointing to the diversity in health information seeking

behaviour in young adults. These findings support the 'complementary hypothesis': when examining the profiles' estimated prevalence given participants' most likely class membership, three out of the five profiles (approximately 85% of participants) had a high probability of seeking more than one source when in need of health information, with one profile (42% of participants) having a high probability of seeking all available sources. Moreover, these results show that alternative sources of information such as the Internet do not seem to substitute established sources such as friends, family or health professionals (Beck *et al.*, 2014; Younes *et al.*, 2015). This suggests that asking 'what sources are sought?' instead of 'is this particular source sought?' may be a more pertinent question for health promotion research in HISB. We also found that four out of five groups in this study resorted to family members when seeking health information. This supports hypotheses proposing that family members are likely to act as a primary layer of information among young adults (Chelton and Cool, 2007).

Building upon the multiple-source HISB profiles found in this study, our results then suggest that young adults' information seeking practices are associated with varying levels of economic, social and cultural capitals. We found that all three forms of capital were associated with young adults' propensity to seek specific sources of information. The most significant differences were found between individuals who sought only their families and those who sought all sources of information.

Regarding social capital, this study showed that having a larger social network was associated with higher odds of membership in the 'all sources' group in comparison to other groups. We also found that independent of network size, young adults more satisfied with their friends were less likely to rely on the Internet for health information. These two findings suggest that higher levels of social capital play a role in shaping individual capacity to seek multiple sources of health information. In line with our findings, a study of young adults' HISB among American college students using a similar indicator of social capital found it to be associated with higher odds of seeking health care professionals, family, and friends when in need of health information (Percheski and Hargittai, 2011). High levels of social capital were also found to be important to HISB in healthcare settings for disadvantaged groups with distinct cultural challenges (Dubbin *et al.*, 2013; Kim *et al.*, 2015).

Regarding cultural capital, we found that young adults who pursued post-secondary studies had higher odds of seeking other information sources in addition to their family. A potential explanation for this is that

those pursuing a higher education are more likely to be exposed to environments conducive to the development of new social contacts and information sources (Furstenberg, 2008; Settersten *et al.*, 2008). Higher education is also thought to promote the development of formal and informal knowledge, skills and preferences towards valuing health and using health information in order to promote it (Abel, 2007). Since parents and other family members are typically the first source of information across the lifecourse, it is possible that young adults who seek only their family may not yet have developed sufficient health-related skills and preferences to seek a greater number of sources. Influences from individual education and social capital suggest that the development of health information skills and preferences during young adulthood may constitute a mechanism behind the reproduction of social inequalities in individuals' capacity to promote their health. Conversely, we found that having a mother who pursued post-secondary studies increased young adults' propensity to seek only their family. Young adults may resort more often to their mother when they perceive her as well educated and knowledgeable about health (Dobrinsky and Hargittai, 2012). The fact that only mother's education (and not the father's) was significantly associated with HISB suggests that gender may also play a role in shaping HISB in young adults. Scholars have proposed that in most Western cultures, women have a 'nurturing' role that makes them more likely to seek health information on behalf of their family (Renahy *et al.*, 2010; Ek, 2015). Our results, however, cannot tell us whether those who have more educated mothers and declared seeking only their family are not able to seek additional sources when necessary.

Finally, regarding economic capital, we found that experiencing financial difficulties in the household was associated with higher odds of seeking information sources outside the family. Other studies have found that financial resources represent an obstacle to the utilization of health services, but not to other sources of information including the Internet (Younes *et al.*, 2015). Young adults might be inclined to seek other information sources when their parents are socioeconomically disadvantaged, suggesting that economic resources may not represent such a strong obstacle in seeking and accessing health information in this population.

### Limitations

Our study has certain limitations. First, given its cross-sectional design, no causal links could be established between independent variables and HISB profiles. Second,

HISB in this study is based on one question only and this question asks where the respondents turn when they need health-related information, whereas information seeking behaviour is often considered to include many more dimensions (e.g. frequency of use, trust in the sources) than source preference. Alternative ways of operationalizing HISB might, therefore, have yielded different results. For a review of measures and methods, please see Anker *et al.* (2011). Third, although participants sought on average 2.26 sources, the word '...first?' in the question label may have influenced participants to choose fewer sources. Finally, participants in our sample were slightly more educated and less healthy in comparison to nationally representative Canadian surveys (Frohlich *et al.*, 2015). The restriction that participants had to be resident of their current address for more than 1 year might also have biased the sample given the higher mobility of this group. Certain HISB patterns may, therefore, be under- or overrepresented.

### CONCLUSION

Health information seeking behaviour is a health-promoting practice developed by young adults during their transition to adulthood, and also a mechanism through which social inequalities may become health inequalities. In contrast with substitution hypotheses, we found that HISB in young adults was of a complementary nature, as most participants resorted to more than one source when seeking health information. These findings point to the importance of considering multiple sources of health information when studying HISB. Other studies may wish to examine how the HISB profiles found in this study may be relevant to other settings. Furthermore, we found that HISB was associated with individual indicators of social, economic and cultural capital. The skills and preferences associated with the capacity to seek multiple sources of health information are only one part of young adults' capacity to promote their health, as their association with health might also be reflective of young adults' overall disposition (i.e. knowledge, skills, values and preferences) towards health. Following a Bourdieusian perspective, this disposition towards health has been conceptualized through the concepts of health-relevant cultural capital (Abel, 2007, 2008; Abel and Frohlich, 2012; Gagné *et al.*, 2015) and cultural health capital (Shim, 2010; Dubbin *et al.*, 2013). Additional research examining links between individual capitals and HISB can contribute to shed light on the role played by health information seeking behaviour in the production of social inequalities in health.

## SUPPLEMENTARY MATERIAL

Supplementary material is available at *Health Promotion International* online.

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**APPENDIX III. Frohlich KL, Shareck M, Vallée J, et al. Cohort Profile : The Interdisciplinary Study of Inequalities in Smoking (ISIS). Int J Epidemiol. 2017; 46(2) : e4.**





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## Cohort Profile

# Cohort Profile: The Interdisciplinary Study of Inequalities in Smoking (ISIS)

Katherine L Frohlich,<sup>1\*</sup> Martine Shareck,<sup>2</sup> Julie Vallée,<sup>1,3,4</sup>  
Thomas Abel,<sup>5</sup> Rowena Agouri,<sup>1</sup> Michael Cantinotti,<sup>6</sup> Mark Daniel,<sup>7</sup>  
Clément Dassa,<sup>8</sup> Geetanjali Datta,<sup>4</sup> Thierry Gagné,<sup>1</sup> Bernard-Simon  
Leclerc,<sup>8</sup> Yan Kestens,<sup>4</sup> Jennifer O'Loughlin<sup>4</sup> and Louise Potvin<sup>1</sup>

<sup>1</sup>Université de Montréal - ESPUM/IRSPUM, Montreal, Quebec, Canada, <sup>2</sup>London School of Hygiene, London, United Kingdom, <sup>3</sup>CNRS - Géographie-cités, Paris, France, <sup>4</sup>Université de Montréal - ESPUM/CRCHUM, Montreal, Quebec, Canada, <sup>5</sup>University of Berne - Institute of Social and Preventive Medicine, Berne, Switzerland, <sup>6</sup>Université du Québec à Trois Rivières - Département de psychologie - Sciences sociales, Trois Rivières, Quebec, Canada, <sup>7</sup>University of South Australia - School of Health Sciences, Adelaide, Australia and <sup>8</sup>Université de Montréal - ESPUM, Montreal, Quebec, Canada

\*Corresponding author. Université de Montréal - ESPUM/IRSPUM, C.P. 6128, succursale Centre-Ville, Montreal, Quebec H3C 3J7, Canada. E-mail: Katherine.frohlich@umontreal.ca

### Abstract

The Interdisciplinary Study of Inequalities in Smoking (ISIS) is a cohort study investigating the joint effects of residents' socio-demographic characteristics and neighbourhood attributes on the social distribution of smoking in a young adult population. Smoking is a behaviour with an increasingly steep social class gradient; smoking prevalence among young adults is no longer declining at the same rate as among the rest of the population, and there is evidence of growing place-based disparities in smoking. ISIS was established to examine these pressing concerns. The ISIS sample comprises non-institutionalized individuals aged 18–25 years, who are proficient in English and/or French and who had been living at their current address in Montréal, Canada, for at least 1 year at time of first contact. Two waves of data have been collected: baseline data were collected November 2011–September 2012 ( $n=2093$ ), and a second wave of data was collected January–June 2014 ( $n=1457$ ). Data were collected from respondents using a self-administered questionnaire, developed by the research team based on sociological theory, which includes questions concerning social, economic, cultural and biological capital, and activity space as well as smoking behaviour. Data are available upon request from [katherine.frohlich@umontreal.ca].

### Key Messages

- The unique combination of individual resident characteristics and street-section attributes in ISIS will allow examination of their interaction over time along with their joint effects on social inequalities in smoking.
- At wave 1 there was a non-random social distribution of smoking outcomes according to residential-level material deprivation.
- Where young adults live and conduct daily activities (i.e. their activity spaces) are socially graded; less educated respondents live and conduct activities in areas of higher deprivation than their more educated counterparts.
- Poor mental health was associated with having fewer commercial and recreational resources in one's activity space whereas the number of resources available in one's residential neighbourhood was not.

### Why was the Interdisciplinary Study of Inequalities in Smoking (ISIS) cohort set up?

Although the overall population prevalence of cigarette smoking in North America is at an all-time low, smoking rates are increasingly socially stratified.<sup>1–5</sup> Smoking prevalence is consistently higher among young people in their early twenties compared with any other age group.<sup>6</sup> As well, proportionally more people from lower socioeconomic status (SES) groups smoke for more years and experience less success in quitting than higher SES smokers.<sup>7,8</sup> Lower SES smokers suffer a higher burden of illness associated with smoking and their children are more likely to initiate smoking than higher SES youth.<sup>9–12</sup>

Growing evidence of place-based disparities in smoking<sup>10,13–26</sup> has created an area of enquiry which posits that general social inequalities in smoking may also be related to neighbourhood inequalities in smoking. The overarching aim of the ISIS study is thus to understand: (i) why do lower SES smokers not follow the secular trend in smoking reduction at the same rate as the rest of society; and (ii) what attributes of neighbourhoods are associated with social inequalities in smoking.

The ISIS project grapples with an unanswered question in place and health inequalities research: Can we better understand how shared characteristics of neighbourhood residents (for example, their education level), also called 'compositional factors', interact with neighbourhood-level characteristics or 'contextual factors' (for example, availability of green space) in shaping inequalities in health? The ISIS project was specifically designed to capture the complexity of this interaction using a theoretical model developed by our research team<sup>27–29</sup> (Figure 1). ISIS characterizes neighbourhoods as unique configurations of five domains in which health-related resources can be accessed: the economic, institutional, community organization, local sociability and physical domains. With regard to compositional factors, we view them conceptualized as capitals, including economic, cultural,<sup>30</sup> social<sup>31,32</sup> and biological capital.<sup>33,34</sup> We posit that neighbourhood resources made

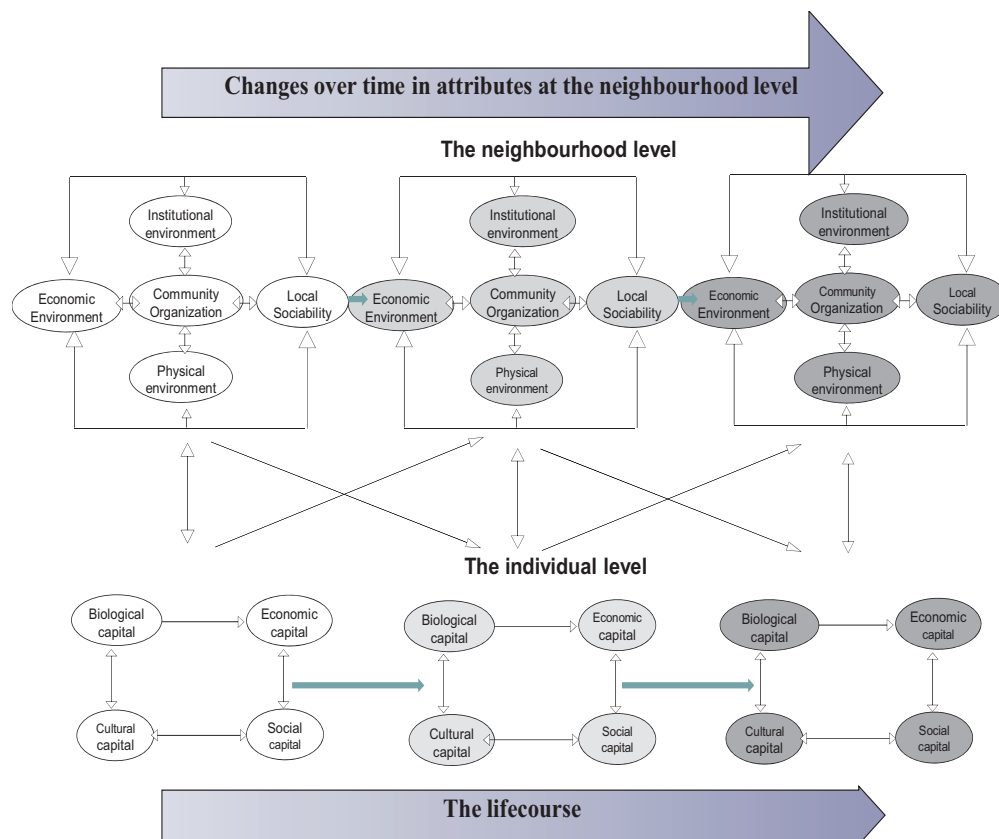
available (or not) through the five domains are shaped by residents' capital levels over time, and hence the need for longitudinal data.

ISIS takes place in Montréal, Canada, at the École de Santé Publique de l'Université de Montréal (ESPUM) and the Institut de recherche en santé publique de l'Université de Montréal (IRSPUM). The project received pilot funding from the Canadian Tobacco Control Research Initiative (2008) and the Public Health Agency of Canada (2011) to develop a questionnaire and a neighbourhood observation grid, as well as 4-year funding (2011–15) in an operating grant from the Canadian Institutes of Health Research (CIHR) for the first two waves of data collection. Our multidisciplinary team includes 12 researchers with diverse expertise, graduate students, post-doctoral fellows, staff, visiting scholars and an advisory board composed of governmental partners [www.isis-montreal.ca].

### Who is in the ISIS cohort?

ISIS is a cross-lag panel study of individuals embedded in their residential neighbourhood. Our study population is a sample of non-institutionalized young adults aged 18–25, proficient in English and/or French, who have resided at their current address for at least 1 year at time of first contact. We requested that the Régie de l'Assurance Maladie du Québec (RAMQ), the publicly funded health insurance programme in Quebec, draw an equal-size simple random sample of 172 individuals between the ages of 18 and 25 years from each of the 35 Centres Locaux de Santé Communautaire (CLSC) territories on the Island of Montreal ( $n=6020$ ). CLSCs were used as the primary sampling units since they are related to postal code area and variability in area-level deprivation has been documented.<sup>35</sup>

Given that smoking rates vary by sex,<sup>36,37</sup> we also ensured that each CLSC sample was divided into equal numbers of males and females. The RAMQ provided the names, mailing addresses, sex, preferred language of



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Figure 1. The ISIS theoretical framework © Les Presses de l'Université de Montréal.

correspondence and date of birth of each potential respondent. Given the decreasing number of young adults who use landlines,<sup>38</sup> the strengths of nominalized address-based sampling frames and the dramatically declining rates of success for studies attempting to recruit by telephone using polling firms,<sup>39</sup> we chose to contact potential respondents via mail. Four response options for questionnaire completion (online, by mail, by phone or in person) were offered. Respondents gave informed consent before completing their questionnaire.

Recruitment was undertaken in two phases for logistical reasons (Figure 2). In the first phase, 50% of the initial sample ( $n = 6020$ ) was randomly selected taking into account respondent sex, CLSC territory and the deprivation level of the dissemination area (DA) in which they lived.

DAs are small, geographical units composed of one or more adjacent dissemination blocks with a population of 400–700 persons.<sup>40</sup> Deprivation was measured using the material dimension of the Pampalon Index which combines education, employment and income indicators.<sup>41</sup> DAs were divided into quartiles based on their deprivation scores. This allowed the research team to track participation according to residential deprivation, adjust recall strategies and ensure that the final sample would be as representative as possible of the entire range of deprivation levels in Montréal. On 23 November 2011, letters were sent to the first group ( $n = 3010$ ) inviting them to become part of the ISIS project. Three weeks after the initial mail-out, a reminder letter was sent to non-respondents and telephone calls were made to individuals whose phone

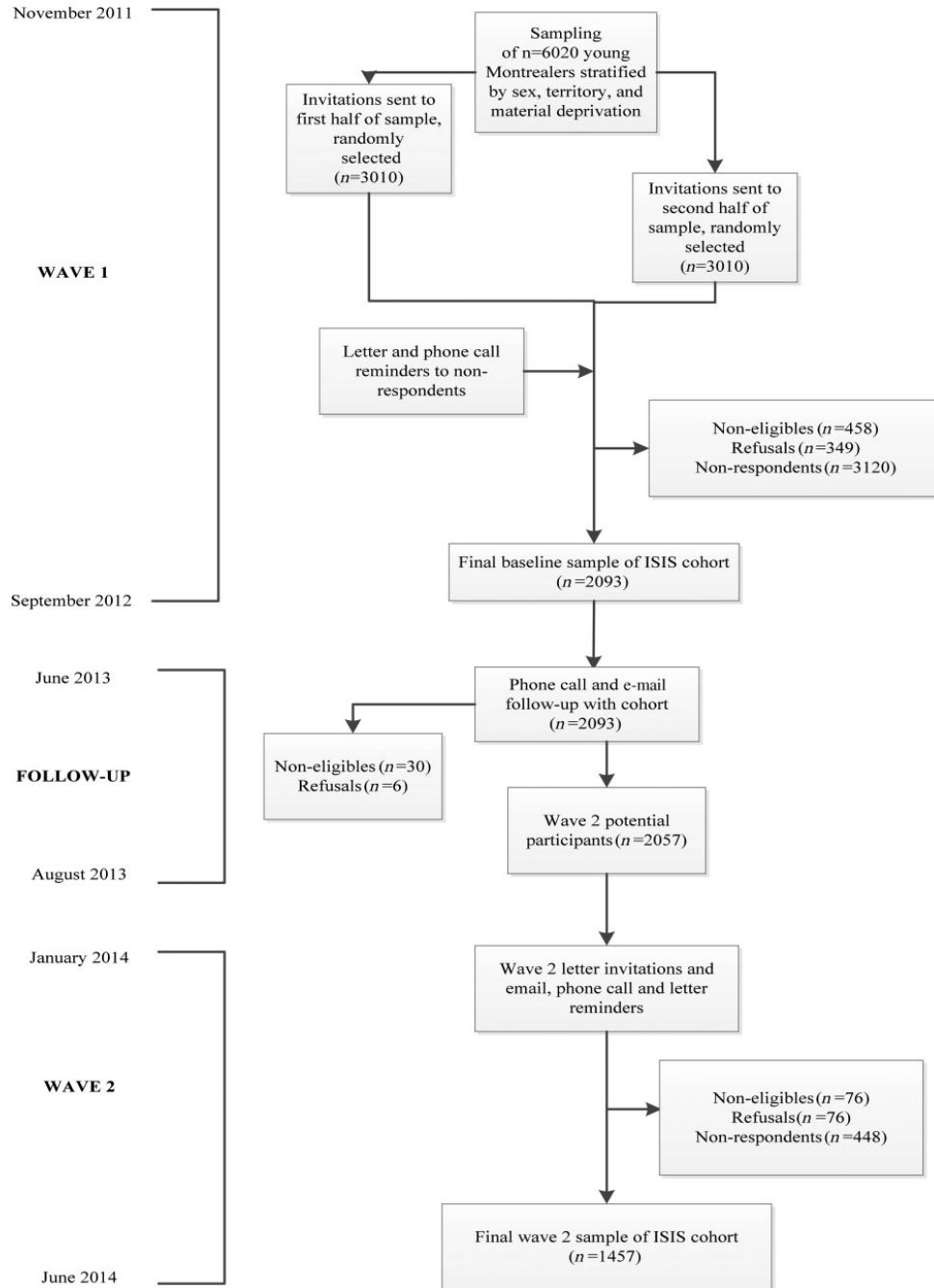


Figure 2. Recruitment, follow-up and participation in the ISIS study waves one and two.

number was listed in the online telephone registry (approximately 60% of the sample) to encourage participation. In January 2012 the second phase of recruitment began with invitation letters sent to the remaining 3010 potential participants. The same follow-up procedure was used for this group as with the first.

For both groups, direct contact with potential respondents (or other residents at their address) in the telephone follow-ups permitted ascertainment of unanticipated ineligibility factors such as temporary or permanent moves outside Montréal, physical or mental disability impeding autonomous completion of the questionnaire, and death. In total, three reminders were sent to non-respondents and as many as 10 phone calls per non-respondent were made. Baseline data collection ended on 4 September 2012. The final sample at baseline is 2093. Of these respondents, 90% completed their questionnaire online. Non-eligible individuals ( $n=458$ ) were removed from the denominator for the computation of the response proportion. There were 349 individuals who explicitly refused to take part in the study, whereas 3111 others simply did not respond to our invitation, making for a final response proportion of 37.6%. The response proportion, while relatively low, is not uncommon in observational studies and could be attributed to unreported moves, inaccurate mailing addresses or a lack of interest in the study.

Respondents were well distributed across habitable areas on the Island of Montréal (Figure 3). Table 1 offers a description of the characteristics of ISIS respondents at baseline compared with those of a representative sample of Montréal residents aged 18–24 pooled from five consecutive waves of the Canadian Community Health Survey (CCHS) for the years 2007–12. CCHS is an annual health survey of the Canadian population and is designed to provide reliable estimates at the health region level.<sup>42</sup> The baseline ISIS sample was similar to CCHS respondents in age and sex although proportionally the former tended to be more educated and reported poorer physical and/or mental health. This unusual combination has been found elsewhere (France and the USA) with individuals of higher SES frequently reporting poorer health when they have the same objective health status as those with lower SES.<sup>43–45</sup> The baseline ISIS sample also had a lower percentage of daily smokers and a higher percentage of non-smokers than the CCHS (Table 1).

### How often have they been followed up?

Two waves of data have been collected to date (Figure 2). To encourage retention between waves, birthday cards and a newsletter were sent to respondents. At each wave, ISIS respondents were given a \$10 gift certificate for their

involvement in the study. The ISIS website is also updated regularly with news, information and publications. In the summer of 2013, an intensive follow-up was undertaken by sending e-mails and calling respondents to update contact information and inform them of the upcoming second wave of data collection. Following this, 2057 respondents were identified as being potentially eligible to take part in the second wave of the project. We sent this sample up to two letters and three mass e-mails and called those who had provided a valid phone number up to 10 times.

After the second wave of data collection, which took place between 3 January and 1 June 2014, there were 1457 respondents, making for a 73.3% retention rate. Ineligibility criteria at wave two included death ( $n=1$ ) or having moved outside the Greater Montréal Region ( $n=75$ ). Attrition was due to explicit refusal to take part in the study ( $n=82$ ) and non-response ( $n=448$ ). Table 2 provides a description of loss to follow-up by comparing wave two respondents and non-respondents on selected baseline individual- and area-level characteristics. Wave two respondents and non-respondents were similar on many of our socio-demographic capital indicators including age, physical health and neighbourhood deprivation level. Compared with respondents, non-respondents were more likely to be men, in lower educational categories and to smoke. They were also more likely to report excellent or fair/poor self-rated mental health.

## What has been measured?

### Individual-level data

Table 3 offers a summary of individual-level data available in the ISIS study. Respondents' characteristics have been operationalized as capitals.<sup>31,46</sup> We collected capital data as well as several indicators of smoking in a 98-variable closed questionnaire. Examples of capitals include employment status, crowding within the home, home ownership (economic capital), satisfaction with relationships with friends, number of friends who smoke (social capital), highest level of education attained by respondents and their parents (cultural capital) and self-perceived health and ability to do various physical activities (biological capital). Outcome variables of interest include: smoking status, defined as being a daily, occasional, never or ex-smoker; age at initiation, defined as age when first whole cigarette smoked; age of initiation to daily smoking, defined as age started smoking cigarettes daily; and number of cigarettes smoked daily. Smoking cessation outcomes include: intention to quit; smoking abstinence; quit attempts; and time since last smoked a cigarette or smoked daily. The questions used to assess smoking status were

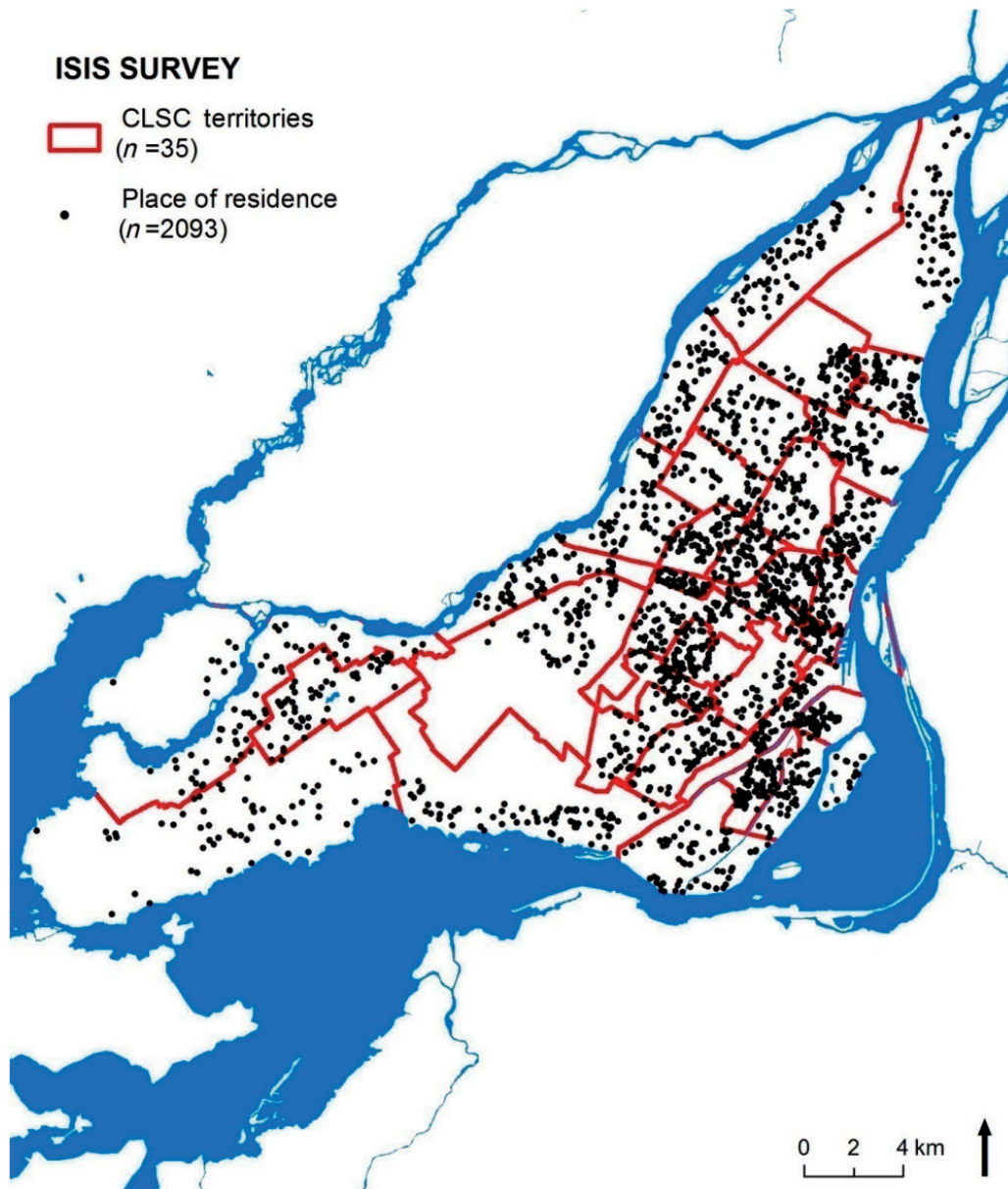


Figure 3. ISIS respondents at baseline ( $n = 2093$ ) as distributed across CLSC territories.

taken from the validated and widely used Canadian Community Health Survey questionnaire.

Our questionnaire also included a list of questions with regard to respondents' activity space, i.e. the locations where they regularly: study; work; shop for groceries;

practise sports or physical activity and leisure activity; up to two other unspecified activities (waves one and two); and health service provider location (wave two). At wave one, respondents were invited to provide information on the location where the activity usually took place (name,

**Table 1.** Comparison of ISIS respondents at baseline with a representative sample of Montréal young adults (pooled CCHS data 2007–12)

Variable	ISIS wave 1 ( <i>n</i> = 2093)	CCHS (2007–12) Montreal ( <i>n</i> = 779)	<i>P</i> -value (significance)
Age	2093	779	0.059 <sup>a</sup>
18–19 years, (%)	547 (26.1)	231 (29.7)	
20–25 years, (%)	1546 (73.9)	548 (70.3) <sup>b</sup>	
Sex	2093	779	0.286 <sup>a</sup>
Women, (%)	1183 (56.5)	423 (54.3)	
Men, (%)	910 (43.5)	356 (45.7)	
Highest level of education attained	2083	760	*0.003 <sup>a</sup>
Less than secondary school, (%)	150 (7.2)	59 (7.8)	
Secondary school, n (%)	663 (31.8)	291 (38.3)	
Post-secondary education, n (%)	1270 (61.0)	410 (53.9)	
Physical health	2082	775	*0.000 <sup>a</sup>
Excellent or very good, n (%)	1026 (49.3)	543 (70.1)	
Pretty good, n (%)	724 (34.8)	201 (25.9)	
Fair or poor, n (%)	332 (15.9)	31 (4.0)	
Mental health	2076	772	*0.000 <sup>a</sup>
Excellent, n (%)	600 (28.9)	281 (36.4)	
Very good, n (%)	858 (41.3)	306 (39.6)	
Pretty good, n (%)	429 (20.7)	155 (20.1)	
Fair or poor, n (%)	189 (9.1)	30 (3.9)	
Smoked 100 cigarettes or more	2085	778	*0.002 <sup>a</sup>
Yes, n (%)	532 (25.5)	224 (31.4)	
No, n (%)	1553 (74.5)	534 (68.6)	
Age of first smoked cigarette	942	386	0.078 <sup>a</sup>
5 – 11 years, n (%)	37 (3.8)	17 (4.4)	
12 – 14 years, n (%)	243 (25.8)	116 (30.1)	
15 – 17 years, n (%)	425 (45.2)	179 (46.4)	
18 – 19 years, n (%)	164 (17.4)	58 (15.0)	
20 – 24 years, n (%)	73 (7.8)	16 (4.1)	
Smoking status	2083	777	*0.000 <sup>a</sup>
Daily smokers, n (%)	207 (9.9)	129 (16.6)	
Occasional smokers, n (%)	270 (13.0)	106 (13.6)	
Non-smokers, n (%)	1606 (77.1)	542 (69.8)	
Age when started smoking daily	207	129	0.860 <sup>a</sup>
11 years or less, n (%)	1 (0.5%)	N.A.	
12 – 14 years, n (%)	35 (16.9)	25 (19.4)	
15 – 17 years, n (%)	102 (49.3)	65 (50.4)	
18 – 19 years, n (%)	47 (22.7)	28 (21.7)	
20 – 24 years, n (%)	22 (10.6)	11 (8.5)	
Number of cigarettes smoked per day (daily smokers only)	207	129	0.383 <sup>c</sup>
Per cigarette, mean (SD)	11.1 (6.9)	12.1 (7.2)	

<sup>a</sup>Chi-square test.<sup>b</sup>CCHS sample only includes ages 20–24 years.<sup>c</sup>t-test.\**P*-value < 0.05.

address, street, closest intersection or landmark, city).<sup>47</sup> Respondents' activity locations were then precisely geolocated with x,y coordinates with an online geocoder which uses the GoogleMaps application programming interface (API).<sup>48</sup> At wave two, we relied on a novel web-mapping application, VERITAS (Visualization and

Evaluation of Route Itineraries, Travel Destinations and Activity Spaces), to collect activity space data and perceived neighborhood delimitation.<sup>49</sup> Respondents could directly search for, and situate on a map, their activity locations which were automatically geocoded with the GoogleMaps API.

**Table 2.** Loss-to-follow up: comparison of ISIS wave 2 respondents and non-respondents on selected baseline characteristics

	Variable	ISIS wave 2 Respondents (n = 1457)	ISIS wave 2 Non-respondents (n = 636)	P-value (significance) <sup>a</sup>
Socio-demographic characteristics	Age	1457	636	0.763
	18–19 years, (%)	378 (25.9)	169 (26.6)	
	20–25 years, (%)	1079 (74.1)	467 (73.4)	
	Sex			*0.003
	Women, (%)	854 (58.6)	329 (51.7)	
	Men, (%)	603 (41.4)	307 (48.3)	
Cultural capital	Highest level of education attained	1453	630	*0.000
	Less than secondary school, (%)	84 (5.8)	66 (10.5)	
	Secondary school, (%)	460 (31.7)	203 (32.2)	
	Post-secondary school, (%)	909 (62.6)	361 (57.3)	
	Number of books in childhood household	1404	597	0.807
	Less than 10, (%)	89 (6.3)	45 (7.5)	
	10 to 49, (%)	442 (31.5)	188 (31.5)	
	50 to 199, (%)	496 (35.3)	215 (36.0)	
	200 to 399, (%)	233 (16.6)	90 (15.1)	
	400 or more, (%)	144 (10.3)	59 (9.9)	
Biological capital	Physical health	1452	630	0.056
	Excellent or very good, (%)	693 (47.7)	333 (52.9)	
	Pretty good, (%)	513 (35.3)	211 (33.5)	
	Fair or poor, (%)	246 (16.9)	86 (13.7)	
	Mental Health	1444	632	*0.042
	Excellent, (%)	409 (28.3)	191 (30.2)	
	Very good, (%)	625 (43.3)	233 (36.9)	
	Pretty good, (%)	282 (19.5)	147 (23.3)	
	Fair or poor, (%)	128 (8.9)	61 (9.7)	
Social capital	Satisfaction with friend relationships	1452	630	0.133
	Very satisfied, (%)	619 (42.6)	291 (46.2)	
	Other, (%)	833 (57.4)	339 (53.8)	
	Number of friends who smoke	1430	621	*0.004
	None, (%)	232 (16.2)	93 (15.0)	
	One or a few, (%)	800 (55.9)	307 (49.4)	
	About half, (%)	224 (15.7)	117 (18.8)	
	Most or all, n(%)	174 (12.2)	104 (16.7)	
	Number of family members who smoke	1446	629	0.215
	None, (%)	643 (44.5)	262 (41.7)	
One or a few, (%)	635 (43.9)	278 (44.2)		
About half or more, (%)	168 (11.6)	89 (14.1)		
Economic capital	Home ownership	n = 1449	630	*0.045
	Owner, (%)	830 (57.3)	331 (52.5)	
	Renter, (%)	619 (42.7)	299 (47.5)	
	Enough money to pay for rent or mortgage	1363	585	0.369
Yes, (%)	1210 (88.8)	511 (87.4)		
No, (%)	153 (11.2)	74 (12.6)		
Smoking	Smoked 100 cigarettes or more	1453	632	*0.000
	Yes, (%)	334 (23.0)	198 (31.3)	
	No, (%)	1119 (77.0)	434 (68.7)	
	Smoking status	1451	632	*0.000
	Smoker, (%)	299 (20.6)	178 (28.2)	
	Non-smoker, (%)	1152 (79.4)	454 (71.8)	
	Smoking status (nuanced)	1451	632	*0.000
	Daily smokers, (%)	124 (8.5)	83 (13.1)	
	Occasional smokers, (%)	175 (12.1)	95 (15.0)	
	Non-smokers, (%)	1152 (79.4)	454 (71.8)	
Neighbourhood deprivation	Neighbourhood deprivation level	1407	613	0.062
	Q <sub>1</sub> (least deprived), (%)	360 (25.6)	172 (28.1)	
	Q <sub>2</sub> , (%)	378 (26.9)	130 (21.2)	
	Q <sub>3</sub> , (%)	327 (23.2)	151 (24.6)	
	Q <sub>4</sub> (most deprived), (%)	342 (24.3)	160 (26.1)	

<sup>a</sup>Chi-square test.

\*P-value &lt; 0.05.



**Table 3.** Summary of data collected from individuals at waves 1 and 2 of ISIS

Construct	Variable	Wave 1	Wave 2
Economic capital	Number of people residing in home	X	X
	Household composition	X	X
	Home ownership	X	X
	Number of rooms in home	X	X
	Lacked money to pay rent or mortgage	X	X
	Lacked money to pay for electricity, hot water or heating	X	X
	Lacked money to pay for food	X	X
	Possibility of urgently borrowing \$500 from mother, father, partner/spouse, sibling, grandparent, friend, co-worker and/or other	X	X
	Personal income, before tax deductions	X	X
	Financial investments	X	
Cultural capital	Received social assistance	X	X
	Highest level of education completed	X	X
	Current education status	X	X
	Paternal education		X
	Maternal education		X
	People consulted for health information	X	
	Parental value of healthy lifestyle	X	
	Place of birth	X	
	Age of immigration to Canada	X	
	Parents' country of birth	X	
	Languages spoken at home	X	X
	Number of books in childhood home	X	
	Identification to a religion	X	X
	Importance of religion	X	X
	Frequency of participation to religious activities, services or meetings	X	X
	Possibility for employment improvement through family contacts	X	X
	Employment status	X	X
Social capital	Satisfaction with friendships	X	X
	Presence and number of people within social circle to confide in	X	
	Presence and number of people within social circle to help with a problem	X	
	Presence and number of people within social circle to be affectionate with and considered close	X	
	Number of friends who smoke	X	X
	Number of family members who smoke	X	X
Biological capital	Marital status	X	X
	Self-rated physical health	X	X
	Self-rated mental health	X	X
	Ability to do selected physical activities	X	X
	Date of birth	X	
Smoking	Suffer from chronic bronchitis, persistent cough or asthma	X	X
	Status: daily, occasional, ex- or never smoker	X	X
	Number of cigarettes smoked daily or occasionally	X	X
	Number of days smoked in past month	X	X
	Ever smoked 100 cigarettes or more	X	X
	Ever smoked an entire cigarette	X	X
	Age of first entire cigarette smoked	X	X
	Age started to smoke daily	X	X
	Past 30-day smoking (yes/no and number of days)		X
	Smoked cigarettes daily in the past	X	X
	Time when stopped smoking cigarettes daily	X	X
	Time last smoked a cigarette	X	X
	Intention to quit smoking in next 30 days		X
	24-h smoking abstinence in past 12 months (yes/no and number of times)		X
	Cigarettes bought where and in what format		X

(continued)

Table 3. Continued

Construct	Variable	Wave 1	Wave 2
Local sociability domain	Mutual aid between neighbours	X	X
	Trust neighbours	X	X
	Feel safe going out at night alone in neighbourhood	X	X
Residential neighbourhood	Perceived neighbourhood boundaries	X	X
	Perceived service availability		X
	Time lived at current address	X	X
Activity space	Name and address of educational establishment	X	X
	Geographical location of place of study		X
	Hours per week spent at educational establishment	X	X
	Perceived availability of services around educational establishment		X
	Workplace name and address (multiple workplaces may apply)	X	X
	Main location of employment (office, home, on the road)	X	
	Geographical location of workplace		X
	Hours per week spent at workplace	X	X
	Perceived availability of services around workplace		X
	Person in household responsible for groceries	X	X
	Name and address of up to two grocery stores most often visited	X	
	Geographical location of up to two grocery stores most often visited		X
	Number of groceries store visits in a month	X	X
	Regularly engage in physical activity or sport	X	X
	Name and address of place where regularly engage in physical activity or sport	X	
	Geographical location of place where engage in physical activity		X
	Hours per week spent at physical activity place	X	X
	Regularly engage in leisure activities	X	X
	Name and address of place where regularly engage in leisure activities	X	
	Geographical location of place where engage in leisure activity		X
	Hours per week spent at leisure activity place	X	X
	Other places for other types of activities	X	X
	Name and address of up to two places where regularly spend time	X	
	Geographical location of other activity place		X
	Hours per week spent at other activity place	X	X
	Has regular medical doctor		X
	Type, name and geographical location of place where receive medical services		X
Type of activity	X	X	
Has driver's licence	X	X	
Owns/has access to a car	X	X	
Has monthly public transit pass	X	X	
Capability	Satisfaction with life		X
	Perceived life possibilities		X
Family's socio-demographics	Mother's age		X
	Father's age		X

### Area-level data

Concerning contextual factors, ISIS relies on a combination of two data collection tools to measure area-level attributes of the five domains (economic, institutional, local sociability, community organization and physical domains<sup>27</sup>). First, secondary data are available through the MEGAPHONE<sup>50</sup> geographical information system (GIS) for characterizing the social and physical environment in the Greater Montréal Metropolitan Region.

MEGAPHONE includes a large selection of databases containing land use information, satellite images, transportation data, the location of institutions, services and businesses and crime data, as well as National Census data, which can be aggregated at various spatial scales and which are frequently updated.

Second, area-level data have been collected using an observation grid developed and validated by the ISIS team.<sup>51</sup> We randomly selected one street section within each of the

**Table 4.** Variability in smoking behaviours across neighbourhood deprivation quartiles

Variable	Total	Q <sub>1</sub> (Least deprived)	Q <sub>2</sub>	Q <sub>3</sub>	Q <sub>4</sub> (Most deprived)	P-value	Trend test P-value <sup>z</sup>
<b>Wave 1 (n = 2020)</b>							
Smoked 100 cigarettes or more	2012	532	508	473	499	*0.031 <sup>x</sup>	*0.007
Yes, (%)	508 (25.2)	121 (22.7)	113 (22.2)	130 (27.5)	144 (28.9)		
No, (%)	1504 (74.8)	411 (77.3)	395 (77.8)	343 (72.5)	355 (71.1)		
Smoking status	2010	531	508	472	499	*0.048 <sup>x</sup>	*0.012
Smoker, (%)	455 (22.6)	105 (19.8)	104 (20.5)	121 (25.6)	125 (25.1)		
Non-smoker, (%)	1555 (77.4)	426 (80.2)	404 (79.5)	351 (74.4)	374 (74.9)		
Smoking status (nuanced)	2010	531	508	472	499	*0.041 <sup>x</sup>	NA
Daily smokers, (%)	197 (9.8)	35 (6.6)	47 (9.3)	57 (12.1)	58 (11.6)		
Occasional smokers, (%)	258 (12.8)	70 (13.2)	57 (11.2)	64 (13.6)	67 (13.4)		
Non-smokers, (%)	1555 (77.4)	426 (80.2)	404 (79.5)	351 (74.4)	374 (74.9)		
Number of cigarettes smoked per day (daily smokers only)	197	35	47	57	58	0.416 <sup>y</sup>	NA
Per cigarette, mean (SD)	11.0 (6.9)	9.5 (4.8)	11.7 (8.8)	11.8 (6.8)	10.7 (6.2)		
		Q <sub>1</sub> (Least deprived)	Q <sub>2</sub>	Q <sub>3</sub>	Q <sub>4</sub> (Most deprived)		
<b>Wave 2 (n = 1401)</b>							
Smoked 100 cigarettes or more	1396	352	319	320	405	0.751 <sup>x</sup>	0.329
Yes, (%)	346 (24.8)	84 (23.9)	75 (23.5)	79 (24.7)	108 (26.7)		
No, (%)	1050 (75.2)	268 (76.1)	244 (76.5)	241 (75.3)	297 (73.3)		
Smoking status	1397	352	320	320	405	0.598 <sup>x</sup>	0.474
Smoker, (%)	283 (20.3)	65 (18.5)	70 (21.9)	61 (19.1)	87 (21.5)		
Non-smoker, (%)	1114 (79.7)	287 (81.5)	250 (78.1)	259 (80.9)	318 (78.5)		
Smoking status (nuanced)	1397	352	320	320	405	0.566 <sup>x</sup>	NA
Daily smokers, (%)	122 (8.7)	23 (6.5)	30 (9.4)	26 (8.1)	43 (10.6)		
Occasional smokers, (%)	161 (11.5)	42 (11.9)	40 (12.5)	35 (10.9)	44 (10.9)		
Non-smokers, (%)	1114 (79.7)	287 (81.5)	250 (78.1)	259 (80.9)	318 (78.5)		
Number of cigarettes smoked per day (daily smokers only)	121	23	30	26	42	0.773 <sup>y</sup>	NA
Per cigarette, mean (SD)	10.6 (7.6)	9.7 (6.0)	11.6 (9.2)	9.8 (6.6)	10.8 (7.7)		

Although waves 1 and 2 samples included 2093 and 1457 respondents, respectively, these analyses were based on a maximum of 2020 and 1401 respondents, respectively, due to missing material deprivation scores.

NA, not applicable.

<sup>x</sup>Chi-square test.

<sup>y</sup>ANOVA.

<sup>z</sup>Cochran-Armitage Exact Trend test.

\*P-value < 0.05.

dissemination areas in which at least one of our respondents lived at baseline. From June to September 2012, five trained observers evaluated the quality of 1399 street sections with the observation grid which comprised 86 indicators<sup>51</sup> (see Appendix 1 for a detailed list of characteristics measured with the observation grid, available as [Supplementary data](#) at *IJE* online). Since ISIS aims to follow both individuals and their neighbourhood longitudinally, a second round of street section observations will be undertaken in 2016.

### What has ISIS found?

Table 4 demonstrates the non-random social distribution of selected smoking outcomes for respondents in wave one according to residential-level material deprivation quartile. We tested for trend across deprivation levels using the Cochran-Armitage Trend Test,<sup>52</sup> which assesses the presence of an ordering when analysing categorical data. At wave one, there was a marked social gradient across deprivation levels for the variables 'smoked 100 cigarettes or more in one's life' and 'smoking status', with Quartile 1 representing the most well-off areas and Quartile 4 the most deprived. Less variation was found, however, for the number of cigarettes smoked per day among smokers. At wave two, there was some variation in smoking behaviours across neighbourhood deprivation levels although trends were less strong across the four neighbourhood deprivation quartiles. However, proportionately more people living in the most deprived areas smoked and were daily smokers than people living in more advantaged neighbourhoods.

A complete list of ISIS publications, as well as the two questionnaires, can be found on the study website: [www.isis-montreal.ca]. Papers have been published describing our theoretical framework,<sup>27,28</sup> as well as reporting on the development and validation of our neighbourhood observation grid<sup>51</sup> and activity space questionnaire.<sup>47</sup> A noteworthy result from the baseline data collection was the large number of respondents who chose to complete the questionnaire online. In a pilot study which sought to determine whether including a paper version of the questionnaire with our mailed invitation affected response, we found that almost half of the individuals who were sent a paper copy chose to complete the questionnaire online.<sup>53</sup> This is an important finding given that web-completion reduces mailing and administration costs.

Two papers have also been published describing baseline activity space. In a paper by Shareck *et al.*,<sup>54</sup> the authors found that where young adults lived and conducted activities of daily life is socially graded: less educated respondents tended to live, but also to conduct activities, in areas of higher deprivation than their more educated

counterparts. In another paper, Vallée *et al.*<sup>55</sup> showed that whereas mental health was not associated with number of commercial and recreational resources available in one's residential neighbourhood, having fewer resources in one's activity space was associated with poorer mental health.

### What are the main strengths and weaknesses?

The first strength of the ISIS study is the relationship between our theoretical model and data collection instruments. A second strength pertains to our interdisciplinary research team which addresses the research and questions from the perspectives of epidemiology, geography, biostatistics and sociology. Thirdly, loss to follow-up was low. We were able to retain as much as 73.3% of the initial sample, after accounting for residential moves outside the Greater Montréal Region. Lastly, the fact that we have respondents' residential addresses enables us to be more precise about residential contextual exposures and to explore different neighbourhood units without a priori assuming which one is best.<sup>56</sup>

A limitation of ISIS is that the overall response rate was low at baseline (37.6%). This response rate is, however, a conservative estimate as we do not know how many of the non-respondents were actually eligible. Moreover, we failed to reach the tail end of the social distribution at wave one or lost it to follow-up. These concerns, along with the specific profile of non-respondents at wave two, may somewhat limit the generalizability of our findings and the statistical power to detect associations with smoking outcomes. These observations, which are rather common in social epidemiological studies, will be studied further in the ISIS project. For instance, we will undertake sensitivity analyses to explore whether the lack of a gradient in smoking across deprivation levels arises from the way we geographically defined neighbourhood.

### Can I get hold of the data? Where can I find out more?

Enquiries related to the use of ISIS data are welcome and will be reviewed with interest. More information on the ISIS study is provided at: [www.isis-montreal.ca]. Requests to use data may be forwarded to the project's principal investigator [katherine.frohlich@umontreal.ca].

### Supplementary Data

Supplementary data are available at *IJE* online.

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**Conflict of interest:** None declared.

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**APPENDIX IV. ISIS Consent form**

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Consent form

ISIS – Health and Neighbourhoods

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**Principal Investigator :**

Katherine L. Frohlich  
Département de médecine sociale et préventive  
Institut de recherche en santé publique  
Université de Montréal  
(514) 343-6430  
katherine.frohlich@umontreal.ca

**Co-Investigators :**

Thomas Abel, Mark Daniel, Clément Dassa,  
Geetanjali Datta, Yan Kestens, Bernard-Simon  
Leclerc, Jennifer O’Loughlin, Louise Potvin,  
Martine Shareck

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**Objective of the project:** The aim of the ISIS study is to examine the link between young Montrealers’ health and their neighbourhoods. We also want to understand why tobacco use remains high in low-income groups and what it is, in a neighbourhood, that most influences differences related to tobacco use. You are one of 6,000 Montrealers who have been invited to take part in this University of Montreal study.

**How it works:** If you agree to take part in the ISIS study, we will ask you to fill out a questionnaire on different aspects of your life, such as the neighbourhood in which you live, your cigarette consumption, your social network, your work and your studies. This questionnaire will take about 20 minutes to complete. You can choose to fill out the questionnaire by: 1. completing it online on a password-protected website; 2. filling out a paper version yourself; 3. filling it out over the phone with one of our team members or; 4. doing a face-to-face interview at the time and place of your choice. Once you have submitted your completed questionnaire, we will send you a \$10 gift certificate redeemable at the retailer of your choice: iTunes, Renaud-Bray or Cineplex Odeon. In two years, in order to find out if there have been any changes in your neighbourhood and your health, we will contact you again to ask you to complete a similar questionnaire. Your continued participation is extremely important. For this reason, someone in charge of interviews might contact you at home, by phone or in person as part of this study at a future date.

**Participation:** We obtained your contact information from the Quebec Health Insurance Board (*Régie de l’assurance-maladie du Québec*), with authorization from Quebec’s Commission on Access to Information. Your participation in the ISIS study is entirely voluntary. You can choose to participate or not. If any of the questions make you uncomfortable, or if you feel they might cause you psychological harm, you can also refuse to answer them. If you do not agree to participate, or decide to withdraw from the study at any time, you do not need to give us your reason and there will be no negative consequences. You may withdraw from the study at any time by contacting the study’s coordination team (Michael Cantinotti or Rowena Agouri, at (514) 343-2414 or by email at info@isis-montreal.ca). If you decide to withdraw from the study, all information about you will be destroyed.

**Who can be in this study:** You are eligible to participate in the study if: 1) you are between the age of 18 and 25 at the time you answer the questions; 2) you know either French or English well enough to





answer the questions; and 3) you have lived in your current residence for at least one year or more at the time you answer the questions.

**Confidentiality:** We assure you that all the information you give us will be treated in a strictly confidential manner. The principal investigator and the research coordinators are the only people who will have access to your data. All data will be kept in locked cabinets at the University of Montreal, or in password-protected electronic files, for a maximum of 7 years after the project is completed. The general results of the ISIS study, which will be published in journals and on the website ([www.isis-montreal.ca](http://www.isis-montreal.ca)), and presented at conferences, will make it impossible to identify any of the participants. As part of the monitoring of the research project, your file may be consulted by a person mandated by the Research Ethics Committee of the University of Montreal's Faculty of Medicine or by representatives of the Canadian Institutes of Health Research. All of these follow strict policies of confidentiality.

**Benefits and inconveniences:** Your answers to this questionnaire will help us to better understand the link between neighbourhoods and health among young adults. This will help us develop better strategies to improve the health and well-being of Montreal's population. In addition, we will share with you the general results of the study by sending you newsletters over the course of the study. There is no inconvenience to you associated with taking part in the ISIS study, except for the time it takes you to answer the questionnaire.

**Possible suspension from the study:** The principal investigator can decide to suspend anyone's participation in the study if she believes it is in the participant's best interest, if the participant no longer meets the inclusion criteria, or for any other reason the principal investigator deems valid.

**Contact persons:** If you have any questions or concerns about your rights as a participant in this study, feel free to contact the Research Ethics Committee of the University of Montreal's Faculty of Medicine ([cerfm@umontreal.ca](mailto:cerfm@umontreal.ca), (514) 343-6111, ext. 2604). If you have a complaint about this study, you can contact the University of Montreal's ombudsman at (514) 343-2100, or by email at [ombudsman@umontreal.ca](mailto:ombudsman@umontreal.ca). The ombudsman accepts collect calls.

**Consent:** By signing this form, you confirm that you have read and understood its content. You understand that your participation is voluntary and that you are free to withdraw from the study at any time. Finally, you accept being contacted by members of the research team at any time, as needed, either for follow-up or to get your feedback.

We thank you in advance for your collaboration in this important project!

The ISIS team,

*Katherine L. Frohlich*  
Chercheuse principale

*Michael Cantinotti*  
Coordonnateur

*Rowena Agouri*  
Adjointe de coordination





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**Please complete the section below and send the form back to us.  
The duplicate copy is yours to keep.**

- I agree** to participate in the ISIS study
- I do not agree** to participate in the ISIS study

---

**Your name (in CAPITAL letters)**

---

**Your signature**

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**Date**

**APPENDIX V. Gagné T, Agouri R, Cantinotti M, Boubaker A, Frohlich KL. How important are paper copies of questionnaires? Testing invitation modes when studying social inequalities in smoking among young adults. Int J Public Health. 2014; 59(1) : 207-210.**

## How important are paper copies of questionnaires? Testing invitations modes when studying social inequalities in smoking among young adults

Thierry Gagné · Rowena Agouri · Michael Cantinotti · Anis Boubaker · Katherine L. Frohlich

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### Introduction

Using the internet to administer questionnaires for data collection has triggered interest in the past decade of survey research (Israel 2009). In Canada, the general population with access to the internet has grown from 60 % in 2005 to 80 % (Statistics Canada 2011), with young adults following the same trend (Lenhart et al. 2010). However, this trend is not evident across population subgroups as only 54 % of households in the lowest income quartile have access to the internet (Statistics Canada 2011).

It is thought that web questionnaire administration can help in countering low response rates and growing research costs, but we were concerned that it should not create socio-economic selection bias problems. Researchers have questioned the influence of invitations that promote access to web versions of questionnaires only, hereby defined as “Web-only” invitations (Kwak and Radler 2002). Indeed, “Mixed-mode” invitations, hereby defined as invitations promoting additional modes of response (paper copy, phone or face-to-face interviews, etc.), have had relative success in increasing response rates (Shih and Fan 2007;

Zuidegeest et al. 2011; Van den Berg et al. 2011). With the internet use trends changing rapidly, few recent studies have examined whether response rate and socio-economic status are associated with invitation methods in a population of young adults.

In this paper, we report results from a study in which we tested whether adding a paper version of a questionnaire to a mailed invitation (a Mixed-mode invitation) will lead to a sample with different modes of response (i.e. telephone, mail or web), rates of response and socio-demographic characteristics when compared with a Web-only mailed invitation. This study was undertaken within the purview of a larger study entitled the Interdisciplinary Study of Inequalities in Smoking (ISIS), whose goal is to better understand the effects of neighbourhood and individual characteristics in the inequitable socio-economic distribution of smoking across Montreal neighbourhoods.

### Methods

#### Sampling and recruitment

Recruitment of the ISIS sample in Montreal, Canada took place between November 2011 and August 2012. We sought a representative sample of individuals aged 18–25 residing in Montreal, Canada who spoke either French or English and who had been living at their current address for a year or more (recent residential mobility was important for our main hypotheses). After approval from the institutional review board and the provincial information access committee (CAIQ), we requested that the provincial public health insurance programme (RAMQ) sample from their database of 6,020 individuals (by name and residential address) who corresponded to our eligibility criteria. We

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T. Gagné (✉) · R. Agouri · K. L. Frohlich  
Institut de recherche en santé publique de l'Université de Montréal, C.P. 6128, Succ. Centre-Ville, Montréal, QC H3C 3J7, Canada  
e-mail: thierry.gagne@umontreal.ca

M. Cantinotti  
Département de psychologie, Université du Québec à Trois-Rivières, Bureau 2024, Pavillon Michel-Sarrazin, 3351 Boulevard des Forges, Trois-Rivières, QC G9A 5H7, Canada

A. Boubaker  
Département d'informatique, Université du Québec à Montréal, C.P. 8888, Succ. Centre-ville, Montréal, QC H3C 3P8, Canada

also requested that they be stratified by sex and the 35 regional healthcare territories in Montreal given that smoking varies by gender (Greaves and Jategaonkar 2006) and aggregate level socio-economic status (Ellaway and Macintyre 2009).

Given our research team's somewhat limited manpower, we did not feel we could adequately recruit and follow-up 6,020 persons in one wave of invitations. Therefore, we chose to split our initial sample into two groups ( $n = 3,010$ ), accounting for the initial stratifications by sex and territory, to be contacted at a three-month interval (please see Fig. 1). In November 2011, we sent out a Web-only invitation by mail to the first half of the sample, hereby called Wave 1. In this mail-out we provided information about our project and requested that participants complete a questionnaire online. Recipients were also given the option to contact the research team to complete the questionnaire over the telephone, to be mailed a paper copy or to schedule a face-to-face interview. A \$10 incentive was offered for completing the questionnaire. A first reminder letter was sent to non-respondents by mail 3 weeks later.

For the second reminder phase 4 weeks after the first reminder, we removed the individuals who had already participated or refused and randomly divided the remaining

sample ( $n = 2,223$ ) into two groups, those to receive Web-only and those to receive Mixed-mode invitations. Between the mode of invitation assignment and the actual mail-out, 29 respondents were removed from the initial 2,223 as they had either refused or been categorized as ineligible in that period. This led to a sample of 2,194 mail-outs (1,106 for the Web-only group and 1,088 for the Mixed-mode group). The Mixed-mode version was sent in a larger envelope and included the printed questionnaire, an introduction form, two copies of a consent form and a pre-addressed and pre-paid postal envelope, while also giving the instructions for filling out the questionnaire online or by other means.

### Measures and analysis

Education was measured with the question "What is the highest level of education you have completed?" with response options ranging from "No school, or only kindergarten" to "Earned doctorate", which was collapsed into three categories: completed high school and lower, completed CEGEP (Quebec's post-secondary institution required for university) and some university degree. Income was measured with the question "Approximately what was your total personal income last year, before tax deductions?" with response options ranging from "No personal income" to "\$100,000 and more", which was collapsed into four categories: no income, \$4,999 or less, between \$5,000 and \$14,999 and \$15,000 or more. Using Student's  $t$  test for age and  $\chi^2$  tests for response rate, education, income, sex and response modes, we compared the characteristics of respondents from the Web-only group with the Mixed-mode group. We also used standardized Pearson residuals to observe the association within categories of response mode in our  $\chi^2$  results (Agresti 2002).

### Results

By the end of our recruitment phase in August 2012, we had received 188 completed questionnaires from the Web-only group and 177 from the Mixed-mode group. Among the completed questionnaires, a total of 43 questionnaires (22 for the Web-only group and 21 for the Mixed-mode group) were then excluded from our analysis due to missing data in either education and/or income variables. Our final  $n$  for each group is  $n = 166$  for the Web-only group and  $n = 156$  for the Mixed-mode group.

Table 1 presents the comparison of response rates by invitation mode. Using the American Association for Public Opinion Research (AAPOR 2011) definition of minimum response rate (RR1), response rates were 17 %

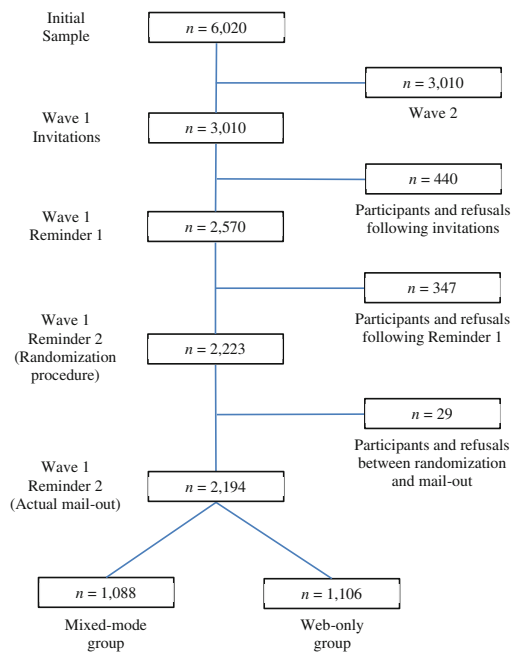


Fig. 1 Flowchart of the recruitment process

How important are paper copies of questionnaires?

**Table 1** Comparison of response rates between Web-only and Mixed-mode invitations

Invitation mode	Mail-outs ( <i>n</i> )	Eligible respondents <sup>a</sup> ( <i>n</i> )	Valid completed questionnaires ( <i>n</i> )	Response rate <sup>b</sup> (%)
Web-only	1,106	989	166	16.78
Mixed-mode	1,088	1,004	156	15.53

Differences between both groups did not differ significantly,  $\chi^2 (1, N = 1,993) = 0.65, p = 0.419$

<sup>a</sup> Ineligibility criteria were age (>25), less than 1 year residency at current address, lack of language proficiency, presence of mental disorder or death

<sup>b</sup> Following the AAPOR definition of minimum response rate (RR1) (AAPOR 2011)

for the Web-only group and 16 % for the Mixed-mode group and did not differ significantly.

Table 2 presents the comparison of sample characteristics by invitation mode. There were no statistically significant differences in age, sex, income or education between the two groups. We found a statistically significant difference ( $p < .001$ ) in response mode between Web-only and Mixed-mode groups. In the Web-only group 16 % answered by phone, 83 % answered online and 1 % by mail. In the Mixed-mode group, 10 % answered by phone, 50 % answered online and 40 % answered by mail. Based

on standardized Pearson residuals, the significant result is mainly due to the differential use of paper and internet response options between the two groups.

## Discussion

As the internet becomes more present in the lives of people, web-based questionnaires are becoming an essential tool in research. This was certainly the case in our study as, almost half of the individuals who were given a paper copy

**Table 2** Comparison of response modes and socio-demographic variables between Web-only and Mixed-mode invitations

Variable	Invitation modes		<i>t</i> (320)	<i>p</i>	
	Web-only <i>N</i> = 166	Mixed-mode <i>N</i> = 156			
Age					
Mean (SD)	21.14 (2.07)	21.22 (2.18)	-0.363	0.717	
Variable	Invitation modes		$\chi^2$	<i>df</i>	<i>p</i>
	Web-only <i>N</i> = 166	Mixed-mode <i>N</i> = 156			
Response modes			75.004	2	<0.001
Internet (%)	138 (83.1)	79 (50.6)			
Mail (%)	2 (1.2)	62 (39.7)			
Phone (%)	26 (15.7)	15 (9.6)			
Sex			0.404	1	0.525
Male (%)	75 (45.2)	76 (48.7)			
Female (%)	91 (54.8)	80 (51.3)			
Income			2.447	3	0.485
No income (%)	18 (10.8)	18 (11.5)			
Less than 4,999\$ (%)	36 (21.7)	25 (16.0)			
5,000 to 14,999\$ (%)	66 (39.8)	73 (46.8)			
15,000\$ and more (%)	46 (27.7)	40 (25.6)			
Education			0.861	2	0.650
Completed high school or less (%)	62 (37.3)	66 (42.3)			
Completed CEGEP <sup>a</sup> (%)	75 (45.2)	66 (42.3)			
University degree (%)	29 (17.5)	24 (15.4)			

<sup>a</sup> CEGEP refers to the post-secondary education institutions in Quebec, Canada which provide the programs required for entry to university (Statistics Canada 2008)

still completed the questionnaire online. Also, we found that both Web-only and Mixed-mode invitations yielded comparable results when examining response rates and socio-demographic variables.

A caveat to our study is that the sample used here is subject to other potential selection bias, given that our respondents answered after having received two reminder letters. This sample may have a different socio-demographic profile than those who answered immediately, but generally speaking these differences have been found to be small in similar studies (Selmer et al. 2003). Even if the results observed from a sample after a second reminder can be generalized to whole populations in terms of representativeness (Selmer et al. 2003), one should not hasten to generalize internet use behavior among young adults to other populations.

Despite these limitations to potential generalizability, we argue that the use of Web-only invitations alone should not change the overall response rate or socio-economic distribution of a sample among young adults when invited to complete a questionnaire online. Future studies with larger and different populations would help to further test this issue.

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**APPENDIX VI. Ethical approbation (in French)**



5 décembre 2016

Objet: Approbation éthique - « Vers une meilleure compréhension des caractéristiques socioéconomiques dans l'étude des inégalités sociales liées au tabagisme chez les jeunes adultes »

M. Thierry Gagné,

Le Comité d'éthique de la recherche en santé (CERES) a étudié le projet de recherche susmentionné et a délivré le certificat d'éthique demandé suite à la satisfaction des exigences précédemment émises. Vous trouverez ci-joint une copie numérisée de votre certificat; copie également envoyée à votre directeur/directrice de recherche et à la technicienne en gestion de dossiers étudiants (TGDE) de votre département.

Notez qu'il y apparaît une mention relative à un suivi annuel et que le certificat comporte une date de fin de validité. En effet, afin de répondre aux exigences éthiques en vigueur au Canada et à l'Université de Montréal, nous devons exercer un suivi annuel auprès des chercheurs et étudiants-chercheurs.

De manière à rendre ce processus le plus simple possible et afin d'en tirer pour tous le plus grand profit, nous avons élaboré un court questionnaire qui vous permettra à la fois de satisfaire aux exigences du suivi et de nous faire part de vos commentaires et de vos besoins en matière d'éthique en cours de recherche. Ce questionnaire de suivi devra être rempli annuellement jusqu'à la fin du projet et pourra nous être retourné par courriel. La validité de l'approbation éthique est conditionnelle à ce suivi. Sur réception du dernier rapport de suivi en fin de projet, votre dossier sera clos.

Il est entendu que cela ne modifie en rien l'obligation pour le chercheur, tel qu'indiqué sur le certificat d'éthique, de signaler au CERES tout incident grave dès qu'il survient ou de lui faire part de tout changement anticipé au protocole de recherche.

Nous vous prions d'agréer, Monsieur, l'expression de nos sentiments les meilleurs,

Dominique Langelier, présidente  
Comité d'éthique de la recherche en santé (CERES)  
Université de Montréal

DL/GP/gp

c.c. Gestion des certificats, BRDV

Katherine Leigh Frohlich, professeure titulaire, École de santé publique - Département  
de médecine sociale et préventive

Amélie Quesnel-Vallée, professeure associée, Department of Epidemiology,  
Biostatistics and Occupational Health

TGDE - PhD Santé publique

p.j. Certificat #16-162-CERES-D

adresse postale

C.P. 6128, succ. Centre-ville  
Montréal QC H3C 3J7

3744 Jean-Brillant  
4e étage, bur. 430-11  
Montréal QC H3T 1P1

Téléphone : 514-343-6111 poste 2604  
ceres@umontreal.ca  
www.ceres.umontreal.ca

Comité d'éthique de la recherche en santé

### CERTIFICAT D'APPROBATION ÉTHIQUE

*Le Comité d'éthique de la recherche en santé (CERES), selon les procédures en vigueur, en vertu des documents qui lui ont été fournis, a examiné le projet de recherche suivant et conclu qu'il respecte les règles d'éthique énoncées dans la Politique sur la recherche avec des êtres humains de l'Université de Montréal.*

Projet	
Titre du projet	<b>Vers une meilleure compréhension des caractéristiques socioéconomiques dans l'étude des inégalités sociales liées au tabagisme chez les jeunes adultes</b>
Étudiant requérant	<b>Thierry Gagné</b> [REDACTED] Candidate au Ph. D. en santé publique (option promotion de la santé), École de santé publique - Département de médecine sociale et préventive
Sous la direction de	Katherine Leigh Frohlich, professeure titulaire, École de santé publique - Département de médecine sociale et préventive, Université de Montréal & Amélie Quesnel-Vallée, professeure associée, Department of Epidemiology, Biostatistics and Occupational Health, Université McGill.

Financement	
Organisme	IRSC
Programme	Subvention de fonctionnement
Titre de l'octroi si différent	Interdisciplinary Study of Inequalities in Smoking (ISIS)
Numéro d'octroi	231010
Chercheur principal	
No de compte	N.D.

#### MODALITÉS D'APPLICATION

Tout changement anticipé au protocole de recherche doit être communiqué au CERES qui en évaluera l'impact au chapitre de l'éthique.

Toute interruption prématurée du projet ou tout incident grave doit être immédiatement signalé au CERES

Selon les règles universitaires en vigueur, un suivi annuel est minimalement exigé pour maintenir la validité de la présente approbation éthique, et ce, jusqu'à la fin du projet. Le questionnaire de suivi



Dominique Langelier, présidente  
Comité d'éthique de la recherche en santé  
Université de Montréal

**5 décembre 2016**  
Date de délivrance

**1er septembre 2018**  
Date de fin de validité

adresse postale  
C.P. 6128, succ. Centre-ville  
Montréal QC H3C 3J7

3744 Jean-Brillant  
4e étage, bur. 430-11  
Montréal QC H3T 1P1

Téléphone : 514-343-6111 poste 2604  
ceres@umontreal.ca  
www.ceres.umontreal.ca

## **APPENDIX VII. ISIS questionnaire**



## Questionnaire on the health and neighbourhoods of young adult Montrealers

Thank you very much for your interest in the ISIS Project! Your participation is very important to us.

In the following pages we will ask you questions about different aspects of your life. We would like some information from you so that we can better understand the link between neighbourhoods and health among young adult Montrealers. More specifically, the questions are about:

- Your neighbourhood
- Your health
- Your cigarette use
- Your life and your social network
- Your cultural background and religious beliefs
- Your work and your studies
- Your housing
- Your expenses
- Places where you spend time

We pledge to never publish any personal information that would make it possible to identify you. If there is any question you would rather not answer, please just go on to the next one.

### INSTRUCTIONS FOR COMPLETING THE QUESTIONNAIRE

- Most of the questions are multiple choice. Select the answer that applies to you by filling in the appropriate circle.
- Choose only one answer for each question, unless the instructions say otherwise.
- When you have finished, please mail us the questionnaire and the signed consent form in the envelope provided.

If you have any questions, please don't hesitate to contact us:

☎ (514) 343-2414 or ✉ [info@isis-montreal.ca](mailto:info@isis-montreal.ca)

## QUESTIONS ABOUT ELIGIBILITY

The following questions are to confirm that you are eligible to take part in this study.

**A1. Are you between 18 and 25 years of age?**

Yes

No → We're sorry, but you cannot take part in the study. Thank you for your time.

**A2. What is your birth date?**

\_\_\_\_\_  
DAY      MONTH      YEAR

**A3. What is your current address?**

NUMBER AND STREET NAME:

\_\_\_\_\_

CITY:

\_\_\_\_\_

PROVINCE:

\_\_\_\_\_

POSTAL CODE:

\_\_\_\_\_

**A4. How long have you been living at your current address?**

Less than 1 year → We're sorry, but you cannot take part in the study. Thank you for your time.

1 year or more → Go to question 1

## YOUR NEIGHBOURHOOD

**1. When thinking about your neighbourhood, what comes to mind?**

The street or the block where your home is located

A few streets or blocks around your home

The area covered by a 15-minute walk from your home

An area covered by a walk that is more than 15 minutes from your home

**2. In your neighbourhood, how many people can you say hello to on a regular basis?**

No one

A few people

Several people

Most people

**Please indicate how much you agree or disagree with the following three statements:**

**3. I can trust the people in my neighbourhood.**

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree
- I don't know

**4. I feel safe going out alone at night in my neighbourhood.**

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree
- I don't know

**5. The people in my neighbourhood help each other out (for example, lending tools, picking up mail, letting others use their telephone, etc.).**

- Strongly agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Strongly disagree
- I don't know

## **YOUR HEALTH**

**6. Compared to other people your age, would you say that, in general, your physical health is:**

- Excellent
- Very good
- Pretty good
- Fair
- Poor
- I don't know

**7. Compared to other people your age, would you say that, in general, your mental health is:**

- Excellent
- Very good
- Pretty good
- Fair
- Poor
- I don't know

**8. When you have questions about your health, who do you ask first? Choose all the answers that apply to you.**

- A health professional (for example, a doctor, pharmacist, or nurse)
- A member of your family
- A friend or another person (for example, a co-worker, a neighbour, or someone else you know)
- You look for answers on the Internet
- You don't ask anyone

**9. When you were a child, how much importance did your parents attribute to a healthy lifestyle?**

- No importance
- Little importance
- Some importance
- A lot of importance
- I don't know

**10. Are you able to...**  
**[Please check one answer per line]**

	Completely able	Somewhat able	Not very able	Not at all able	I don't know
Carry an 8-kg (18 lbs) weight up 3 flights of stairs (for example, 6 full bags of groceries)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raise your upper body from a lying position without using your arms (sit-up)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Carry 2 heavy suitcases up 3 flights of stairs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walk 20 minutes (about 2 kilometres or 1 mile) at a sustained pace without a break	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Run 6 minutes (about 1 kilometre or ½ mile) without a break	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Run 30 minutes (about 5 kilometres or 3 miles) without a break	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Touch the floor with your hands while sitting in a chair	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Touch the floor with your hands while standing (without bending your knees)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Touch your knees with your head while standing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Completely able	Somewhat able	Not very able	Not at all able	I don't know
Stay balanced on one leg (at least 15 seconds) without holding on to anything	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Do a somersault	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jump over a 1-meter (3-foot) high fence by supporting yourself on it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11. Do you suffer from one of the following health problems: chronic bronchitis, persistent cough or asthma?

- Yes
- No
- I don't know

### YOUR CIGARETTE USE

12. In your life, have you smoked a total of 100 cigarettes or more (around 4 packs)?

- Yes → go to question 14
- No

13. Have you ever smoked an entire cigarette?

- Yes
- No → go to question 29

14. How old were you when you smoked an entire cigarette for the first time?

\_\_\_\_\_ years

15. Currently, do you smoke cigarettes every day, sometimes or never?

- Every day
- Sometimes → go to question 20
- Never → go to question 26

*If you smoke every day*

16. How old were you when you started smoking cigarettes every day?

\_\_\_\_\_ years

17. Currently, how many cigarettes do you smoke each day?

\_\_\_\_\_ cigarette(s) per day



**18. How do you get your tobacco products (cigarettes, rolling tobacco, cigarillos)? Choose all the answers that apply to you.**

- At the convenience store (dépanneur) or the tobacco store
- At the grocery store
- From friends, co-workers or other people you know
- From members of your family
- On an Indian reserve
- Other, specify: \_\_\_\_\_

**19. In what form do you get cigarettes? Choose all the answers that apply to you.**

- As singles → go to question 29
- By the pack → go to question 29
- As a carton → go to question 29
- In a plastic bag (Ziploc®-type) → go to question 29
- As rolling tobacco → go to question 29
- Other, specify: \_\_\_\_\_ → go to question 29

***If you smoke sometimes***

**20. On the days when you smoke, how many cigarettes do you usually smoke?**

\_\_\_\_\_ cigarette(s) per day

**21. In the past month, how many days did you smoke one cigarette or more?**

\_\_\_\_\_ day(s)

**22. How do you get your tobacco products (cigarettes, rolling tobacco, cigarillos)? Choose all the answers that apply to you.**

- At the convenience store (dépanneur) or the tobacco store
- At the grocery store
- From friends, co-workers or other people you know
- From members of your family
- On an Indian reserve
- Other, specify: \_\_\_\_\_

**23. In what form do you get cigarettes? Choose all the answers that apply to you.**

- As singles
- By the pack
- As a carton
- In a plastic bag (Ziploc®-type)
- As rolling tobacco
- Other, specify: \_\_\_\_\_

**24. Have you ever smoked cigarettes every day?**

- Yes
- No → go to question 29

**25. When did you stop smoking every day?**

- Less than 1 year ago → go to question 29
- From 1 year ago to less than 2 years ago → go to question 29
- From 2 years ago to less than 3 years ago → go to question 29
- 3 or more years ago → go to question 29

***If you never smoke***

**26. Have you ever smoked cigarettes every day?**

- Yes
- No → go to question 28

**27. When did you stop smoking every day?**

- Less than 1 year ago → go to question 29
- From 1 year ago to less than 2 years ago → go to question 29
- From 2 years ago to less than 3 years ago → go to question 29
- 3 or more years ago → go to question 29

**28. When was the last time you smoked a cigarette?**

- Less than 1 year ago
- From 1 year ago to less than 2 years ago
- From 2 years ago to less than 3 years ago
- 3 or more years ago

**29. How many of your friends smoke?**

- None
- One or a few
- About half
- Most
- All
- I don't know

**30. How many members of your immediate family smoke?**

- None
- One or a few
- About half
- Most
- All
- I don't know

## YOUR LIFE AND YOUR SOCIAL NETWORK

**31. What is your marital status?**

- Single
- Married
- Common-law or in a couple
- Separated or divorced
- Widowed

**32. In general, how satisfied are you with your relationships with your friends?**

- Very satisfied
- Somewhat satisfied
- Somewhat dissatisfied
- Very dissatisfied

**33. Is there anyone in your social circle (your friends or family, or other people you trust) that you can confide in and talk openly with about your problems?**

- Yes
- No → go to question 35
- I don't know → go to question 35

**34. How many people?**

- 1
- 2
- 3
- 4
- 5 or more

**35. Is there anyone in your social circle (your friends or family) who can help you if you have a problem?**

- Yes
- No → go to question 37
- I don't know → go to question 37

**36. How many people?**

- 1
- 2
- 3
- 4
- 5 or more

**37. Is there anyone in your social circle (friends or family) that you feel close to and is affectionate toward you?**

- Yes
- No → go to question 39
- I don't know → go to question 39

**38. How many people?**

- 1
- 2
- 3
- 4
- 5 or more

### **YOUR CULTURAL BACKGROUND AND RELIGIOUS BELIEFS**

**39. Were you born in Canada?**

- Yes → go to question 42
- No

**40. In what country were you born?**

Name of country: \_\_\_\_\_

**41. How old were you when you immigrated to Canada?**

\_\_\_\_\_ year(s)

**42. In what country/countries were your parents born?**

Mother: \_\_\_\_\_

Father: \_\_\_\_\_

**43. What language(s) do you speak most often at home? Choose all the answers that apply to you.**

- French
- English
- Other, specify: \_\_\_\_\_

**44. Do you identify with any religion?**

- Yes
- No → go to question 47

**45. How important is your religion to you?**

- Not at all important
- Not very important
- Somewhat important
- Very important

**46. In the past 12 months, how often did you attend or participate in religious activities, services or meetings, aside from weddings or funerals?**

- At least once a week
- At least once a month
- At least 3 times a year
- Once or twice a year
- Never

## **YOUR WORK AND YOUR STUDIES**

**47. If needed, can anyone in your family put you in contact with people who can help you improve your employment situation?**

- Most probably
- Probably
- Not very probably
- Not at all probably
- Does not apply (no contact, deceased, etc.)
- I don't know

**48. Please estimate how many books were in your home when you were a child. Were there...**

- Fewer than 10 books
- Between 10 and 49 books
- Between 50 and 199 books
- Between 200 and 399 books
- 400 books or more
- I don't know

**49. What is the highest level of education you have completed?**

- No school, or only kindergarten
- Elementary school
- Secondary 4 or less (10<sup>th</sup> grade or less)
- Secondary 5 (11<sup>th</sup> grade)
- Diploma or certificate of studies in a technical program at a CEGEP, a trade school, a commercial or private college, a technical institute, or a nursing school
- Diploma or certificate of studies in a general program at a CEGEP
- University undergraduate certificate
- Bachelor's degree
- Degree in medicine, dentistry, veterinary medicine, optometry or chiropractic
- University graduate certificate
- Master's degree
- Earned doctorate

## YOUR HOUSING

50. **Including yourself**, how many people currently live or reside at your address?

- 1 → go to question 52
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 or more

51. **Who do you currently live with? Choose all the answers that apply to you.**

**I live...**

- With both my parents
- With one of my parents
- With my brothers and sisters
- With grandparents or other members of my family
- With my partner/spouse
- With my children or my partner/spouse's children
- With roommates, friends or other people I know
- Other

52. **Who owns the home you live in?**

**I am / a member of my family is the ...**

- Owner of the home
- Tenant in the home

53. **How many rooms are there in the home you live in?**

Please include all the rooms except the bathroom and hallway(s).

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9 or more

## YOUR EXPENSES

54. With the following questions we want to find out whether, in the **past 12 months**, you ever didn't have enough money to pay for various things needed for daily life. If this has happened to you, we would like to know how serious that situation was.

[On each line, please check one answer in the first section; if your answer is "yes", please also check one box in the second section]

	In the <b>past 12 months</b> , did you, or the person responsible for this expense, ever not have enough money to...			If <b>yes</b> , how serious was this lack of money?				
	Yes	No	I don't know	Not at all serious	A little serious	Somewhat serious	Very serious	I don't know
... pay the rent or mortgage?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... pay for electricity, hot water, or heat?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
... buy food?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

55. If you needed money urgently, could you borrow \$500 quickly from the following persons?

[Please check one answer on each line]

	Yes	No	Does not apply (no contact, deceased, etc.)	I don't know
Your mother	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your father	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your partner/spouse	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A brother or sister	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A grandparent	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A friend	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A co-worker	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## PLACES WHERE YOU SPEND TIME

Your neighbourhood and the places where you spend time might affect your health. The following questions are about the places where you spend time on a regular basis. For each category, please identify as precisely as possible the place where you do the activity in question, giving the exact address if you know it or the intersection and/or a landmark closest to the place, as well as the neighbourhood and the city. For some types of activities, you can indicate two places, starting with the one you go to most often.

### Studies

56. Are you currently a student (either full-time, part-time, or in an internship program)?

Yes

No → go to question 60

57. What is the name of the institution you attend for your studies, including the campus and the building (if these apply)?

NAME OF THE INSTITUTION:

\_\_\_\_\_

NAME OF THE CAMPUS :

\_\_\_\_\_

NAME OF THE BUILDING :

\_\_\_\_\_

58. What is the address of this study location? If you are studying at home or doing a distance learning program, please indicate it here.

NUMBER AND/OR STREET NAME:

\_\_\_\_\_

INTERSECTION :

\_\_\_\_\_ AND \_\_\_\_\_

CLOSEST LANDMARK :

\_\_\_\_\_

NEIGHBOURHOOD :

CITY:

\_\_\_\_\_

59. In a typical 7-day week, how many hours do you spend at this place for school purposes?

\_\_\_\_\_ hour(s) per week



**Work**

**60. Are you currently in paid employment?**

This includes full-time work or part-time work, whether you are an employee, self-employed, a freelancer, on contract, in an internship, on vacation, on parental leave, on sick leave or work-accident leave, on strike or lock-out situation.

- Yes
- No → go to question 71

**61. If you are currently in paid employment, do you work... Choose all the answers that apply to you.**

- Full-time
- Part-time
- On contract or freelance

**62. Where do you work? You can name up to two jobs or workplaces, if necessary.**

**Job or workplace 1**

NAME OF COMPANY OR EMPLOYER:

\_\_\_\_\_

**63. Usually, do you work mostly :**

- from home → go to question 65
- on the road → go to question 66
- neither at home nor on the road

**64. What is the address of this workplace?**

NUMBER AND/OR STREET NAME:

\_\_\_\_\_

INTERSECTION :

\_\_\_\_\_ AND \_\_\_\_\_

CLOSEST LANDMARK :

\_\_\_\_\_

POSTAL CODE :

\_\_\_\_\_

NEIGHBOURHOOD :

CITY:

\_\_\_\_\_

**65. In a typical 7-day week, how many hours do you spend at this place for work purposes?**

\_\_\_\_\_ hour(s) per week

**66. Do you work anywhere else, either as part of this job, or for another job?**

- Yes, I have another job
- Yes, I work somewhere else as part of this same job → go to question 68
- No, I always work in the same place → go to question 71

**Job or workplace 2**

**67. Where do you work mostly?**

NAME OF COMPANY OR EMPLOYER:

\_\_\_\_\_

**68. Usually, do you work :**

- from home → go to question 70
- on the road → go to question 71
- neither at home nor on the road

**69. What is the address of this second workplace?**

NUMBER AND/OR STREET NAME:

\_\_\_\_\_

INTERSECTION :

\_\_\_\_\_ AND \_\_\_\_\_

CLOSEST LANDMARK :

\_\_\_\_\_

POSTAL CODE :

\_\_\_\_\_

NEIGHBOURHOOD :

CITY:

\_\_\_\_\_

**70. In a typical 7-day week, how many hours do you spend at this place for work purposes?**

\_\_\_\_\_ hour(s) per week

**Grocery shopping**

**71. In your household, who does the grocery shopping?**

- Only you
- Partly you
- Someone other than you → go to question 77

**72. When you are the one doing the grocery shopping, where do you go? You can name up to two places (if necessary), starting with the place you go to most often.**

**Primary place:**

NAME OF THE PLACE (example: "Such-and-such" grocery store, "Such-and-such" convenience store, "Such-and-such" public market) :

\_\_\_\_\_

NUMBER AND/OR STREET NAME:

\_\_\_\_\_

INTERSECTION :

\_\_\_\_\_ AND \_\_\_\_\_

CLOSEST LANDMARK :

\_\_\_\_\_

NEIGHBOURHOOD :

CITY:

\_\_\_\_\_

**73. In the past month, how many times have you gone to this place to buy groceries?**

\_\_\_\_\_ time(s) in the past month

**74. Is there another place where you regularly do your grocery shopping?**

Yes

No → go to question 77

**Second place**

**75. What are the name and the address of this second place where you do your grocery shopping?**

NAME OF THE PLACE (example: "Such-and-such" grocery store, "Such-and-such" convenience store, "Such-and-such" public market) :

\_\_\_\_\_

NUMBER AND/OR STREET NAME:

\_\_\_\_\_

INTERSECTION :

\_\_\_\_\_ AND \_\_\_\_\_

CLOSEST LANDMARK :

\_\_\_\_\_

NEIGHBOURHOOD :

CITY:

\_\_\_\_\_

**76. In the past month, how many times have you gone to this place to buy groceries?**

\_\_\_\_\_ time(s) in the past month

**Physical activities and sports**

**77. Do you regularly engage in physical activity or sports?**

- Yes
- No → go to question 81

**78. Do you usually engage in physical activity or sports in a particular place?**

- Yes, I usually do these types of activities at home → go to question 80
- Yes, I usually do these types of activities other than at home, in one specific place that I go to regularly
- No, I do not do these types of activities at one specific place on a regular basis → go to question 81

**79. Where do you usually engage in physical activity or sports?**

NAME OF THE PLACE :

\_\_\_\_\_

NUMBER AND/OR STREET NAME:

\_\_\_\_\_

INTERSECTION :

\_\_\_\_\_ AND \_\_\_\_\_

CLOSEST LANDMARK :

\_\_\_\_\_

NEIGHBOURHOOD :

CITY:

\_\_\_\_\_

**80. In a typical 7-day week, how many hours do you spend at this place doing physical activity or sports?**

\_\_\_\_\_ hour(s) per week

**Leisure activities**

**81. Do you regularly engage in leisure activities?**

- Yes
- No → go to question 85

**82. Do you usually engage in leisure activities in a particular place?**

- Yes, I usually do these types of activities at home → go to question 84
- Yes, I usually do these types of activities other than at home, in one specific place that I go to regularly
- No, I do not do these types of activities at one specific place on a regular basis → go to question 85

**83. Where do you usually engage in leisure activities?**

NAME OF THE PLACE :

\_\_\_\_\_

NUMBER AND/OR STREET NAME:

\_\_\_\_\_

INTERSECTION :

\_\_\_\_\_ AND \_\_\_\_\_

CLOSEST LANDMARK :

\_\_\_\_\_

NEIGHBOURHOOD :

CITY:

\_\_\_\_\_

**84. In a typical 7-day week, how many hours do you spend at this place doing leisure activities?**

\_\_\_\_\_ hour(s) per week

**Other places where you spend time**

**85. Aside from the places you've already mentioned, are there other places where you regularly spend time?**

These could be public places or private homes (yours or someone else's). They could be places where you spend time with friends, your partner/spouse or members of your family, or where you engage in sports or leisure, or where you are doing a study or professional internship, volunteering, or engaging in social or religious activities.

Yes

No → go to question 93

**86. What are the name and address of this place where you regularly spend time? You will be able to name up to two places (if necessary), starting with the one where you spend the most time.**

NAME OF THE PLACE :

\_\_\_\_\_

NUMBER AND/OR STREET NAME:

\_\_\_\_\_

INTERSECTION :

\_\_\_\_\_ AND \_\_\_\_\_

CLOSEST LANDMARK :

\_\_\_\_\_

NEIGHBOURHOOD :

CITY:

\_\_\_\_\_

**87. In a typical 7-day week, how many hours do you spend at this place?**

\_\_\_\_\_ hour(s) per week

**88. What do you usually do there?**

\_\_\_\_\_

**89. Is there another place where you regularly spend time?**

Yes

No → go to question 93

**90. What are the name and address of this other place where you regularly spend time?**

NAME OF THE PLACE :

\_\_\_\_\_

NUMBER AND/OR STREET NAME:

\_\_\_\_\_

INTERSECTION :

\_\_\_\_\_ AND \_\_\_\_\_

CLOSEST LANDMARK :

\_\_\_\_\_

NEIGHBOURHOOD :

CITY:

\_\_\_\_\_

**91. In a typical 7-day week, how many hours do you spend at this place?**

\_\_\_\_\_ hour(s) per week

**92. What do you usually do there?**

\_\_\_\_\_

**The following three questions are about your access to different means of transportation.**

**93. Do you have a driver's license?**

Yes

No

**94. Do you own a car, or have a car at your disposal (for example, the car of a friend or family member, or membership in a car sharing system such as *Communauto*, etc.)?**

Yes

No

95. Do you have a monthly public transit pass (bus, metro and/or train)?

- Yes
- No

### A FEW LAST QUESTIONS

Even though healthcare expenses are partly covered by Quebec's public health insurance program, there continues to be a link between health status and income. We would appreciate it if you could answer the three following questions so that we can study this link. Please be assured that all the information collected as part of this study will be treated strictly confidentially.

96. Approximately what was your total personal income LAST YEAR, before tax deductions? Please include any financial aid you may have received (for example, a scholarship, employment insurance benefits, CSST or other insurance benefits, etc.)

- No personal income
- \$1 to \$4,999
- \$5,000 to \$9,999
- \$10,000 to \$14,999
- \$15,000 to \$19,999
- \$20,000 to \$29,999
- \$30,000 to \$39,999
- \$40,000 to \$49,999
- \$50,000 to \$99,999
- \$100,000 and more
- I don't know

97. Do you have any financial investments (for example, savings bonds, RRSPs, TFSAs, certificates of deposit, stocks, etc.)?

- Yes
- No

98. In the past 12 months, have you received any social assistance, that is, financial aid provided as a last resort (also known as welfare assistance)?

- Yes
- No

**END OF THE QUESTIONNAIRE**

**SELECT YOUR GIFT CERTIFICATE**

As a way to thank you for completing this questionnaire, the ISIS team will give you a \$10 gift certificate redeemable at one of the following retailers. Please choose the retailer for which you would like a gift certificate (only one selection per participant).

- iTunes
- Renaud-Bray
- Cineplex Odeon

**YOUR CONTACT INFORMATION**

We might contact you again within the next two years to find out whether your address has changed before sending you the new questionnaire. We might also email you to share the results of the study. We will contact you a maximum of three times per year, and you can choose at any time to stop these contacts. We would therefore appreciate it very much if you would give us your email address and telephone number, as well as the contact information of a person close to you, so that we can make sure to reach you for the next phase of the study. This person will only be contacted if we are having trouble reaching you.

Your email address: \_\_\_\_\_

Your telephone number: \_\_\_\_\_

The name of a person close to you who we can contact if we are having trouble reaching you:

\_\_\_\_\_

Your relationship with this person: \_\_\_\_\_

This person's email address: \_\_\_\_\_

This person's telephone number: \_\_\_\_\_

I will inform this person about this study and the reasons why I gave his/her contact information

**COMMENTS**

If you have any comments or suggestions about this questionnaire, please feel free to write them below:

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**APPENDIX VIII. Gagné T, Ghenadenik A, Shareck M, Frohlich  
KL. Expected or Completed? Comparing Two Measures of  
Education and their Relationship to Social Inequalities in Health  
Among Young Adults. Soc Indic Res. 2018; 135(2) : 549-562.**

## Expected or Completed? Comparing Two Measures of Education and Their Relationship with Social Inequalities in Health Among Young Adults

Thierry Gagné<sup>1,4</sup>  · Adrian E. Ghenadenik<sup>1,2,4</sup> ·  
Martine Shareck<sup>3</sup> · Katherine L. Frohlich<sup>1,4</sup>

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**Abstract** Similarly to other age groups, there are significant social inequalities in health among young adults (YA). Education is thought to be the most appropriate indicator of YA socioeconomic status (SES), yet it is often in progress at that age and may not be representative of future achievement. Therefore, scholars have explored YA ‘expected’ education as a proxy of SES. However, no study has examined how it compares to the more common SES indicator, ‘completed’ education. Using data from 1457 YA surveyed twice over a two year period, we describe associations between participants’ completed and expected education at baseline and completed education at follow-up. We then compare associations between these two measures and three health outcomes—smoking status, self-rated mental health, and participation in physical activity and sports—at baseline and followup using regression models. At baseline, half of the participants were imputed a higher ‘expected’ level than that ‘completed’ at that time. In regression models, ‘expected’ and ‘completed’ education were strongly associated with all outcomes and performed slightly differently in terms of effect size, statistical significance, and model fit. ‘Expected’ education offers a good approximation of future achievement. More importantly, ‘expected’ and ‘completed’ education variables can be conceptualized as complementary

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✉ Thierry Gagné  
thierry.gagne@umontreal.ca

<sup>1</sup> Département de Médecine Sociale et Préventive, École de Santé Publique de l’Université de Montréal (ESPUM), 7101, Av. du Parc, Montreal, QC H3N 1X9, Canada

<sup>2</sup> Centre de Recherche du Centre Hospitalier de l’Université de Montréal (CRCHUM), 850 Saint Denis Street, Montreal, QC H2X 0A9, Canada

<sup>3</sup> London School of Hygiene and Tropical Medicine (LSHTM), 15–17 Tavistock Place, London WC1H 9SH, UK

<sup>4</sup> Institut de Recherche en Santé Publique de l’Université de Montréal (IRSPUM), École de Santé Publique de l’Université de Montréal (ESPUM), 7101, Av. du Parc, Montreal, QC H3N 1X9, Canada

indicators associated with inequalities in health in YA. Using both may help better understand social inequalities in health in YA.

**Keywords** Young adults · Education · Social inequalities · Measurement

## 1 Introduction

Public health research is increasingly focusing on young adults as a distinct population of interest (IOM 2014; Stroud et al. 2015). Several important educational, social, and economic milestones occur during young adulthood (typically defined as the period between ages 18 and 25 years): pursuing higher education; engaging in full-time work; leaving the parental household; entering conjugal relationships; and having children (Cote and Bynner 2008). Increases in the prevalence and incidence of certain health outcomes and behaviours that can become established later in adulthood are also evidenced during this period (IOM 2014). For example, approximately 75% of mental disorders are diagnosed before 24 years of age, hours devoted to physical activity decrease significantly, overweight and obesity rates increase threefold in comparison to those of adolescents, and substance misuse often becomes established in young adulthood (IOM 2014). Moreover, smoking initiation rates are on the rise among young adults who also have the highest smoking prevalence and lowest cessation rates of all age groups (IOM 2014; Bonnie et al. 2007; Freedman et al. 2011).

As is the case in other age groups, there are significant social inequalities in health among young adults for outcomes including smoking (Kestila et al. 2006a; Caban-Martinez et al. 2011; O'Loughlin et al. 2014), physical activity and obesity (Mulye et al. 2009), self-rated health (Kestila et al. 2006b), substance abuse (Redonnet et al. 2012), and sexually-transmitted diseases (Harling et al. 2013). Different indicators of socioeconomic status (SES) have been used to examine these inequalities. For example, studies have documented socioeconomic differences in smoking among young adults based on their employment status, income, school enrolment, educational attainment, and parental education (Caban-Martinez et al. 2011; Lawrence et al. 2007; Dietz et al. 2013; Pampel et al. 2014). Although these indicators can be used to examine social inequalities in health among young adults, several scholars have underlined the need to use SES measures relevant to the age group of interest (Braveman et al. 2005; Galobardes et al. 2006a, b). Indicators used to measure SES in adolescents and adults, such as parental education for the former and income and occupational class for the latter (Galobardes et al. 2006a), may be less relevant to young adults given their growing independence during their transition towards adulthood.

Even though there are few explicit conceptual and empirical guidelines for the measurement of SES in young adults, those in place suggest that educational attainment may be the most appropriate indicator, at least in developed countries (Braveman et al. 2005; Galobardes et al. 2006a, b). Education is thought to capture several mechanisms linking SES and health, as it promotes health-related knowledge, values, skills and preferences and provides future occupational opportunities and financial resources as well as psychosocial resources (e.g.: social support, social standing, and sense of control) that allow individuals to avoid unhealthy behaviours and successfully deal with stressors (Braveman et al. 2011; Pampel et al. 2010).

Nonetheless, there are some limitations to its use, chiefly because education is often not completed in a significant proportion of this population. For instance, in the province of

Quebec, Canada, approximately 50% of young adults are enrolled in studies in any given year (Lavoie et al. 2010). Moreover, departures from a “standard” duration of studies (e.g.: in Quebec, five years for high school, three years for an undergraduate degree) are increasingly common because of part-time work, health issues, and maternity/paternity leave (Bowen et al. 2011). To overcome these limitations and acknowledge that young adults may not have completed their education, certain scholars have turned to using the highest level ‘expected’ to be attained as a measure of education (Kestila et al. 2006a, b; Shareck et al. 2014, 2015; De Grande et al. 2015; Widome et al. 2013). With this approach, education is measured as the highest level between the level of studies completed and that in which students are enrolled at the time of survey. For example, someone who completed high school and is currently pursuing a bachelor’s degree would be coded as having “some university completed”.

The use of this transformation is based on two hypothetical advantages. First, the use of ‘expected education’ has the potential to reduce SES misclassification that may arise due to the attribution of a lower educational attainment than that actually achieved later on. Second, from a conceptual standpoint, ‘expected education’ may better represent the meaning of education as an indicator of SES as it taps into young adults’ current learning and aspirations as well as the physical and social environments that are being experienced during their ongoing studies. These aspirations and environments are associated with young adults’ health behaviours and may mediate the influence of their socioeconomic background beyond their educational attainment at the time of measurement (Tyas and Pederson 1998; Pedersen and von Soest 2014). Nonetheless, even though the use of this indicator has grown over the last decade or so, to our knowledge no studies have empirically tested these hypotheses.

In keeping with the increasing number of studies exploring these two indicators, we propose to address these two knowledge gaps and examine how ‘expected education’ compares to ‘completed education’ in the context of social inequalities in health in young adults. We therefore asked the following two questions. The first is methodological: does ‘expected education’ accurately estimate later ‘completed education’? The second question goes back to the above-mentioned public health research needs: does the assessment of social inequalities in health among young adults differ when using ‘expected’ compared to ‘completed’ education?

## 2 Methods

### 2.1 Data

We analyzed baseline and two-year follow-up data from the interdisciplinary study of inequalities in smoking (ISIS), a cohort study established in 2011–2012 with the objective of better understanding the joint contribution of individual and neighborhood factors in shaping social inequalities in smoking among young adults (Frohlich et al. 2015). The target population was non-institutionalized individuals aged 18–25 years living in Montreal, Canada, who had resided at their current address for at least one year at the time of first contact. From an initial sample of 6020 individuals randomly selected from the provincial health insurance program, 2093 completed the questionnaire (baseline response rate = 38%). Two years later, 1457 individuals took part in a second wave of data collection (follow-up response rate = 74%). Full details on the cohort sampling and survey procedures are available elsewhere (Frohlich et al. 2015). This study received ethics

approval from the provincial information access committee (*Commission d'accès à l'information du Québec*) and the Université de Montréal's ethics board (*Comité d'éthique de la recherche en santé de la Faculté de Médecine*).

## 2.2 Measures

### 2.2.1 Education Variables

'Highest educational level *completed*' was assessed by asking participants "What is the highest level of schooling that you have completed?", with possible answers ranging from 'No school' to 'Earned doctorate'. To measure 'highest educational level *expected* to be completed', we relied on responses to this question, as well as to the question "Are you currently a student (either full-time, part-time, or in an internship program)?" Students were subsequently asked to report the name of the institution they attended. We used the name of the institution reported in this latter question to establish the level taught at the institution, and compared it with their completed level of education. For non-students and students enrolled in an establishment that did not provide an increase in educational level over that completed, the expected level was the same as the completed level. For students enrolled in an establishment that provided an educational level higher than that already completed, their expected level was coded as the level provided by the establishment in which they were enrolled. For each measure of education, four categories were created: 'Did not finish high school', 'High school completed', 'CEGEP completed' and 'University completed'. CEGEPs (*Collège d'enseignement général et professionnel*) are post-secondary educational institutions which provide mandatory pre-university education or vocational training in Quebec, Canada. Details regarding the sources, question labels and value labels for education variables are presented in the Supplementary Material file.

### 2.2.2 Health Outcomes

Based on their relevance to young adults (IOM 2014), three health outcomes were studied: *current smoking status*, *self-rated mental health* and *participation in physical activity and sports*. *Current smoking status* was assessed by asking respondents who had smoked at least one entire cigarette in their lifetime whether they currently smoked 'every day', 'occasionally' or 'never'. Those who smoked daily or occasionally were considered to be 'current smokers' while 'non smokers' consisted of never smokers and former smokers. *Self-rated mental health* was measured using the following question: 'Compared to other people your age, would you say that, in general, your mental health is:' with responses on a five-point Likert scale ranging from 'Poor' to 'Excellent'. This variable was dichotomized to compare those in good health ('Excellent', 'Very good' and 'Good') to those in less than good health ('Fair' and 'Poor'). *Participation in physical activity and sports* was assessed by asking respondents whether they regularly engaged in physical activity or sports (yes or no). Details regarding the sources, question labels and value labels for the three outcome variables are presented in the Supplementary Material file.

## 2.3 Analyses

We first used univariate statistics to describe the sample in terms of age, sex, completed and expected education and health outcomes at each time point. Descriptive statistics were

then used to assess: (1) at baseline, how many young adults were expected to attain a level of education higher than that already completed; and (2) how many young adults attained their expected level of education two years later. We used a Cohen's kappa as an estimate of overall agreement between measures in cross-tabulations, with results ranging from 0.60 to 0.75 deemed to provide evidence of a satisfactory level of agreement (Landis and Koch 1977; Fleiss 1981).

Associations between each education variable and the likelihood of: (1) being a current smoker (vs. non-smoker); (2) reporting fair or poor mental health (vs. good, very good or excellent) and; (3) not regularly engaging in physical activity (PA) or sports (vs. regularly engaging in such activities) were examined using multivariate Poisson regression models with robust variance estimation. Poisson regression was chosen over logistic regression because it allows for the direct estimation of risk ratios in the form of prevalence ratios (PR) when the outcome is common (usually >10%) as is the case for the smoking (>20%) and participation in physical activities and sports (>40%) outcomes (Barros and Hirakata, 2003; McNutt et al., 2003). Analyses were performed for dependent variables at baseline and at follow-up, in both cases controlling for sex and age at baseline. To compare results we examined point estimates and their 95% confidence intervals in addition to Bayesian information criterion (BIC) values, where lower values are indicative of better model fit. BIC differences between 2 and 6 are considered to provide 'positive' evidence of better model fit, while differences of 6 or higher are deemed to provide 'strong' evidence of better model fit (Raftery 1995). Because there were very few missing cases for each variable, analyses were done using listwise deletion. Descriptive analyses and regression analyses were performed in SPSS and MPlus respectively (IBM 2011; Muthén and Muthén 2013).

### 3 Results

#### 3.1 Sample Characteristics

Fifty-eight (3.9%) of the 1,457 participants for whom data was available at both time points reported inconsistencies on education variables (either having attained a lower or an unlikely higher level of education at follow-up than that reported at baseline) and were excluded from the analyses, for a final sample of 1399 participants.

Descriptive statistics are presented in Table 1. At baseline, participants were on average 21 years old ( $SD = 2.3$ ) with 58.8% of them being women. Most participants completed post-secondary studies: 41% completed CEGEP and 20% completed some university studies. Twenty percent of participants were smokers at each time point, 9 and 10% declared to be in fair or poor mental health at baseline and follow-up respectively, and 42 and 44% declared not participating in PA and sports at each time point.

#### 3.2 Completed and Expected Levels of Education

Table 2 presents the correspondence between participants' completed and expected levels of education at baseline. Out of the 1399 participants, 1015 (73%) were students. Among these, 713 (70%) were expected to complete a higher level of education than that completed at baseline. The Cohen's kappa value between education variables at baseline (T1) was 0.28.

**Table 1** Descriptive statistics for 1,399 young adults participating in the *Interdisciplinary Study of Inequalities in Smoking*, Montreal, Canada, 2011-2014

Variable	Baseline (T1) <i>n</i> (%)	Two-year follow-up (T2) <i>n</i> (%)
Sex		
Woman	822 (58.8)	822 (58.8)
Man	577 (41.2)	577 (41.2)
Age		
<i>Mean</i> (SD)	21.4 (2.3)	23.4 (2.3)
Completed education		
Less than high school	83 (5.9)	52 (3.7)
High school	456 (32.6)	221 (15.8)
CEGEP	575 (41.1)	684 (48.9)
Some university	281 (20.1)	437 (31.2)
<i>Missing</i>	4 (0.3)	5 (0.4)
Expected education		
Less than high school	49 (3.5)	–
High school	151 (10.8)	–
CEGEP	549 (39.2)	–
Some university	646 (46.2)	–
<i>Missing</i>	4 (0.3)	–
Currently studying	1,105 (72.6)	777 (55.5)
<i>Missing</i>	9 (0.6)	13 (0.9)
Current smokers	286 (20.4)	279 (19.9)
<i>Missing</i>	5 (0.4)	5 (0.4)
Self-rated mental health (fair or poor)	123 (8.8)	146 (10.4)
<i>Missing</i>	10 (0.7)	9 (0.6)
Not participating in PA or sports	581 (41.5)	681 (44.2)
<i>Missing</i>	21 (1.5)	24 (1.7)

PA Physical activity, SD Standard deviation

**Table 2** Correspondence between education variables at baseline (T1)

Level of education <i>completed</i> at baseline (T1)	Level of education <i>expected</i> at baseline (T1)				Total <i>n</i> (%)
	Less than High School <i>n</i> (%)	High School <i>n</i> (%)	CEGEP <i>n</i> (%)	University <i>n</i> (%)	
	Cohen's Kappa = 0.28 (n = 1,395)				
Less than high school	<i>49 (3.5)</i>	<b>29 (2.1)</b>	<b>5 (0.4)</b>	<b>0</b>	83 (5.9)
High School	0	<i>122 (8.7)</i>	<b>314 (22.5)</b>	<b>20 (1.4)</b>	456 (32.7)
CEGEP	0	0	<i>230 (16.5)</i>	<b>345 (24.7)</b>	575 (41.2)
University	0	0	0	<i>281 (20.1)</i>	281 (20.1)

The italic values (n = 682) on the diagonal represents participants who were not imputed a higher level of education because they were not studying or because the institution where their studies took place did not award a higher level of education. The bold values (n = 713) above the diagonal represents participants who were imputed a higher level of education based on their student status and the institution where they were studying

**Table 3** Comparison of education variables at baseline (T1) regarding their correspondence with completed education at follow-up (T2)

Level of education <i>completed</i> at baseline (T1)	Less than high School <i>n (%)</i>	High school <i>n (%)</i>	CEGEP <i>n (%)</i>	University <i>n (%)</i>	Total <i>n (%)</i>
Level of education <i>completed</i> at follow-up (T2) Cohen's Kappa = 0.53 ( <i>n</i> = 1390)					
Less than high school	50 (3.6)	27 (1.9)	4 (0.3)	0	81 (5.8)
High school	0	194 (14.0)	256 (18.4)	6 (0.4)	456 (32.8)
CEGEP	0	0	422 (30.4)	151 (10.9)	573 (41.2)
University	0	0	0	280 (20.1)	280 (20.1)
Level of education <i>completed</i> at follow-up (T2) Cohen's Kappa = 0.61 ( <i>n</i> = 1390)					
Less than high school	<i>36 (2.6)</i>	11 (0.8)	2 (0.1)	0	49 (3.5)
High school	<b>13 (0.9)</b>	<i>113 (8.1)</i>	24 (1.7)	0	150 (10.8)
CEGEP	<b>1 (0.1)</b>	<b>85 (6.1)</b>	<i>457 (32.9)</i>	4 (0.3)	547 (39.4)
University	<b>0</b>	<b>12 (0.9)</b>	<b>199 (14.3)</b>	<i>433 (31.1)</i>	644 (46.3)

The italic values on the diagonal represents participants who were correctly classified by the expected variable based on their completed education two years later; the bold values (*n* = 310) below the diagonal represents participants who expected a higher level of education that was not completed two years later

Table 3 presents the correspondence between the two education variables at baseline and the level of education completed two years later. We compared participants' expected education at baseline to the level completed at follow-up (T2) by examining whether participants were found on the diagonal (indicating that their completed education two years later was 'correctly' estimated from baseline information) or below the diagonal (indicating that their completed education two years later was 'incorrectly' estimated). Analyses revealed that, using the 'expected' codification approach, 397 participants (56%) were attributed an expected level of education at T1 in line with that completed two years later at T2. On the other hand, 310 participants (44%) were attributed an expected level of education at T1 that was not reached two years later at T2. Bivariate tests (not shown) showed that students who did not complete the educational level expected at baseline were more often men ( $p < 0.001$ ). No significant differences were found with regard to age and the three health variables compared to other students. Cohen's kappa values revealed a small increase in agreement going from 0.53 (between education completed at baseline and completed at follow-up) to 0.61 (between education expected at baseline and completed at follow-up), indicating that the baseline 'expected' education variable provided a moderately better approximation of 'completed' education two years later than the baseline 'completed' education did.

### 3.3 Associations Between Education Variables and Health Outcomes

Table 4 presents prevalence ratios for associations between completed or expected levels of education and each health outcome measured at baseline. Both education variables were significantly associated with all health outcomes. Compared to participants who had completed or were expected to complete some university, those who did not finish high school or were not expected to do so and those who completed only high school or were



**Table 4** Associations between health outcomes at baseline (T1) and education variables

	Current smoking		Fair or poor mental health		Not participating in PA or sports	
	PR	95% CI	PR	95% CI	PR	95% CI
Educational level <i>completed</i> at baseline (T1)						
Less than high school	<b>3.37</b>	<b>2.35, 4.84</b>	<b>3.53</b>	<b>1.60, 7.77</b>	<b>1.44</b>	<b>1.10, 1.88</b>
High school	<b>1.68</b>	<b>1.18, 2.39</b>	<b>2.73</b>	<b>1.35, 5.53</b>	<b>1.29</b>	<b>1.04, 1.59</b>
CEGEP	1.12	0.81, 1.56	<u>2.09</u>	<u>1.15, 3.79</u>	1.09	0.91, 1.32
Some University	Ref.		Ref.		Ref.	
BIC	1480.038*		868.976		2195.183	
Educational level <i>expected</i> at baseline (T1)						
Less than high school	<b>3.33</b>	<b>2.45, 4.53</b>	<b>2.51</b>	<b>1.26, 5.01</b>	<b>1.41</b>	<b>1.08, 1.86</b>
High school	<b>1.76</b>	<b>1.29, 2.41</b>	<b>2.01</b>	<b>1.18, 3.42</b>	<b>1.30</b>	<b>1.08, 1.58</b>
CEGEP	1.24	0.96, 1.60	1.18	0.77, 1.84	1.04	0.89, 1.20
Some University	Ref.		Ref.		Ref.	
BIC	1484.757		870.397		2194.745	
BIC $\Delta$	4.72		1.42		0.44	

Multivariate Poisson regression with a robust variance estimation; adjusted for age and sex at baseline; bolded regression coefficients are significant at the  $\alpha = 0.05$  level; models with the lowest BIC value are considered to better fit the data; underlined regression estimates are considered statistically significant for only one of the two education variables

PA Physical activity

PR Prevalence ratio, CI Confidence interval, BIC Bayesian Information Criteria

\* BIC  $\Delta \geq 2$  = positive evidence of better model fit

expected to do so had higher odds of smoking, of having poor self-rated mental health and of not participating in PA or sports. One difference was found between measures of education when examining point estimates and their statistical significance, but none with regard to their 95% confidence intervals: those who completed CEGEP had significantly higher odds of having poor mental health in comparison to those with some university completed [PR = 2.09, 95%CI (1.15, 3.79)]. There was, however, no statistically significant difference among those expected to finish CEGEP and those expected to have some university completed [PR = 1.18, 95%CI (0.77, 1.84)]. A comparison of BIC values provided positive evidence of better fit for models predicting current smoking status using 'completed' education as the independent variable.

Prevalence ratios for associations between participants' level of education expected at baseline, completed at follow-up, and health outcomes measured at follow-up are shown in Table 5. In this analysis, education variables were not as systematically associated with the outcomes as in the cross-sectional setting. Examining the educational level completed at follow-up as predictor (the top portion of Table 5), participants who did not complete high school or who only completed high school had higher odds of smoking and not participating in PA in comparison to participants who had some university completed. Using expected educational attainment measured at baseline, participants who were not expected to finish high school or CEGEP also had higher odds of smoking and of not participating in PA and sports at follow-up. We found again one difference in point estimates with regard to statistical significance but no differences in 95% confidence intervals: participants who were expected to have their CEGEP completed had higher odds of not participating in PA

**Table 5** Associations between health outcomes at follow-up (T2) and education variables

	Current smoking		Fair or poor mental health		Not participating in PA or sports	
	PR	95% CI	PR	95% CI	PR	95% CI
<b>Educational level completed at follow-up (T2)</b>						
Less than high school	<b>3.33</b>	<b>2.37, 4.68</b>	1.62	0.78, 3.37	<b>1.58</b>	<b>1.22, 2.05</b>
High school	<b>1.57</b>	<b>1.13, 2.19</b>	1.40	0.85, 2.32	<b>1.28</b>	<b>1.06, 1.55</b>
CEGEP	1.21	0.91, 1.61	0.94	0.61, 1.43	1.14	0.97, 1.34
Some University	Ref.		Ref.		Ref.	
BIC	1462.947		979.437**		2248.620	
<b>Educational level expected at baseline (T1)</b>						
Less than high school	<b>2.92</b>	<b>2.11, 4.06</b>	1.61	0.81, 3.21	<b>1.38</b>	<b>1.05, 1.83</b>
High school	<b>1.60</b>	<b>1.16, 2.19</b>	1.07	0.63, 1.82	<b>1.41</b>	<b>1.18, 1.68</b>
CEGEP	1.12	0.86, 1.45	0.93	0.63, 1.38	<b>1.16</b>	<b>1.00, 1.34</b>
Some University	Ref.		Ref.		Ref.	
BIC	1456.016**		987.382		2245.580*	
BIC Δ	6.93		7.95		3.04	

Multivariate Poisson regression with a robust variance estimation; adjusted for age and sex at baseline; bolded regression coefficients are significant at the  $\alpha = 0.05$  level; models with a lower BIC value are considered to better fit the data; underlined regression estimates are considered statistically significant for only one of the two education variables

PA Physical activity

PR Prevalence ratio, CI Confidence interval, BIC Bayesian Information Criteria

\* BIC Δ  $\geq 2$  = positive evidence of better model fit; \*\* BIC Δ  $\geq 6$  = strong evidence of better model fit

or sports compared to participants with some university completed or expected to be completed [PR = 1.16, 95% CI (1.00, 1.34)] whereas there was no significant difference between those who completed their CEGEP and those who completed some university [PR = 1.14, 95% CI (0.97, 1.34)]. A comparison of BIC indices provided strong evidence of a better model fit for models using the ‘expected’ variable to predict current smoking status, strong evidence of better model fit using the ‘completed’ variable to predict self-rated mental health and positive evidence of better model fit using the ‘expected’ variable to predict participation in physical activity and sports.

## 4 Discussion

Research on social inequalities in health among young adults faces certain unique challenges. One of these is the usefulness of indicators commonly used to operationalize their socioeconomic status. To advance knowledge in this area, we compared a common measure of education, completed education, with an alternative, expected education, which acknowledges that many young adults may still be pursuing studies. Specifically, we examined whether: (1) ‘expected education’ accurately estimated later ‘completed education’ and (2) the assessment of social inequalities in health among young adults differed when using these two measures of education.

### 4.1 ‘Expected’ Educational Attainment as a Proxy of Future Achievement

A little over half of the sample (i.e. 70% of the 73% who were students) were expected to attain a level of education higher than that completed at baseline. This is likely a reasonable expectation in an urban setting such as Montreal, home to four universities and more students than the provincial average. When compared to the level of education completed two years later, we found that ‘expected education’ provided a moderately better approximation of future educational achievement than ‘completed education’ at baseline. This suggests that the ‘expected education’ measure provides a reasonable estimate of future educational achievement.

Nonetheless, the use of this variable requires the consideration of certain issues. First, many young adults may pursue continuing education or elective classes that do not lead to a diploma, or new diplomas that do not confer a higher level of education. Second, it must be acknowledged that a considerable proportion of young adults will not graduate, even if it was their initial intention (e.g.: in Quebec, Canada, post-secondary graduation rates are 70%) (CRÉPUQ 2006). Finally, given the potential for misclassification, we suggest that researchers exercise care in attributing higher levels of education based on ‘expected’ education, notably when the establishment in which students were enrolled is not known and attribution of a higher level of education is based solely on student status (i.e. enrolled in studies or not).

### 4.2 ‘Expected’ Education as an Alternative Measure for Studying Social Inequalities in Health Among Young Adults

Beyond its accuracy as a proxy for future educational achievement, we suggested that young adults’ expected education encompassed beyond their achieved level their learning, educational aspirations and the physical and social environments in which they were

studying. In the cross-sectional and prospective scenarios, we found noticeable differences between the two measures, but none allowed us to identify a distinct pattern in their ability to predict the chosen health outcomes. There is reason to believe that a measure of young adults' completed education may not fully capture the sociocultural, financial and psychological resources that it aims to operationalize, and that using the complementary measure of expected educational attainment can contribute to do so. Measures of expected educational attainment may better reflect young adults' social aspirations and current social milieu, and in turn, may allow for a more accurate measurement of social inequalities in health (van Soest and Pedersen 2014). Scholars have previously advocated for such a perspective by identifying different health-promoting mechanisms based on what is obtained and what is concurrently incorporated with regard to education (Abel 2008; Gagné et al. 2015).

In our study, we found that both education variables were strongly associated with smoking, self-rated mental health, and participation in physical activity and sports. For instance, participants who have not finished high school had more than a three-fold risk of being smokers and reporting poor mental health in comparison to those who continued onwards to university. These results are in line with a rapidly growing literature highlighting young adulthood as an important target group to tackle health inequalities (IOM 2014; Mulye et al. 2009; Redonnet et al. 2012; Pampel et al. 2014). When comparing results, we found one important difference between educational variables with regard to self-rated mental health in the cross-sectional scenario: those in lower educational categories had a much higher risk of reporting poor mental health when we used those who had completed some university as the reference category instead of those who were expected to in the near future. This suggests that participants who were undertaking undergraduate studies (i.e. who had 'CEGEP' as their completed education but 'some university completed' as their expected education) had a higher risk of reporting poor mental health. Other demographic, socioeconomic and psychosocial characteristics might explain these differences given that college students normally show comparable levels of mental health to most non-college-attending students (Blanco et al. 2008; Kovess-Masfety et al. 2016). However, this is a perfect example to help us understand that educational inequalities in health might be conditional on the transitional stages (in this case, ongoing studies) that young adults experience towards adulthood.

### 4.3 Limitations

This study has three limitations that should be discussed. First, time between measurements should be considered a potential limitation chiefly due to the time required to obtain certain diplomas. In some cases the 2-year follow-up may have been insufficient to achieve the expected educational level: among the 85 CEGEP and 199 university-level students that were imputed a higher level of education, those who were in their first year of studies at T1 would have been in their third year of studies at follow-up and therefore would not have been able to yet complete their degree. Because 85% of these 284 participants were still studying two years later, a later time point would have allowed for a better assessment of their actual 'completed' education. Second, whereas results may be representative of urban areas similar to Montreal, Canada (i.e. regions in developed countries with similar education systems and outcomes), they may not be generalizable to other regions with substantially different contexts. Third, we adopted a parsimonious approach to modelling and addressed confounding by controlling only for age and sex. It is possible that omitted

variables might have influenced our results relative to the association between educational measures and health outcomes.

## 5 Conclusion

There is a large scholarship dedicated to understanding and tackling health inequalities in public health, and more work in the operationalization and measurement of socioeconomic characteristics is needed to support it. To our knowledge, this study is the first to inquire into the methodological and conceptual assumptions associated with using ‘expected’ education to examine social inequalities in health among young adults in comparison to the ubiquitous operationalization of education, ‘completed’ education. Our findings suggest that the use of ‘expected’ education as a measure of SES can be a valuable addition to the study of social inequalities in health in young adults, by providing a more reliable appreciation of adult education achievement and tapping into the current aspirations and school environments that young adults continue to experience during their ongoing studies. This is of particular importance in young adults given the many different transitions experienced during this life period and their potential impact on health behaviours and outcomes. We therefore recommend that researchers not only use completed education when the other is available, but that they use these two measures in conjunction whenever possible and report complete results so that readers might compare them. This can be done in projects explicitly examining the mechanisms linking educational achievement and health but also in many others when performing sensitivity analyses.

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**APPENDIX IX. Statistics Canada microdata access contract (in  
French)**



Numéro de contrat : 17-SSH-MCG-3152-S003  
Titre : Mieux comprendre le rôle des caractéristiques socioéconomiques dans les inégalités sociales liées au tabagisme des jeunes adultes

**CONTRAT DE RECHERCHE POUR L'UTILISATION DE MICRODONNÉES**

(ci-après appelé le « contrat »)

**ENTRE :**

SA MAJESTÉ LA REINE DU CHEF DU CANADA, représentée par le ministre responsable de Statistique Canada,

(ci-après appelé « Statistique Canada »),

**ET :**

Thierry Gagné ; Université de Montréal

Amélie Quesnel-Vallée ; Université McGill

(ci-après appelés le ou les chercheurs)

Désignés individuellement par la « partie » ou collectivement par les « parties ».

**Attendus**

1. Statistique Canada requiert les services du ou des chercheurs pour fournir des services spéciaux de recherche et d'analyse statistiques, conformément à la description figurant dans le présent document, en vertu de la *Loi sur la statistique*, L.R.C. 1985, ch. S-19;
2. La prestation de ces services spéciaux exige que le ou les chercheurs aient accès à l'information décrite à l'annexe D;
3. Aux termes du paragraphe 5(3) de la *Loi sur la statistique*, les personnes engagées à contrat pour fournir des services spéciaux au ministre en vertu de la *Loi sur la statistique*, de même que les employés et les agents de ces personnes, aux fins de la *Loi sur la statistique*, sont réputées être des personnes employées en vertu de la *Loi sur la statistique* pendant qu'elles rendent ces services;
4. Aux termes du paragraphe 6(1) de la *Loi sur la statistique*, toute personne réputée être employée en application de la *Loi sur la statistique*, avant d'entrer en fonctions, prête le serment ou fait l'affirmation solennelle comprise dans ce paragraphe;
5. Pour fournir ces services et avoir accès aux renseignements confidentiels, le ou les chercheurs doivent devenir des personnes réputées être employées de Statistique Canada et doivent prêter le serment de discrétion et respecter les exigences en matière de sécurité et de confidentialité de Statistique Canada;
6. Le produit proposé et tous les documents (à l'exclusion des données d'autres sources) apportés dans les locaux de Statistique Canada (y compris les centres de données de

Numéro de contrat : 17-SSH-MCG-3152-S003

recherche) par le ou les chercheurs dans le cadre de la prestation des services spéciaux seront assujettis à la *Loi sur l'accès à l'information*, L.R.C., 1985, ch. A-1, et à la *Loi sur la protection des renseignements personnels*, L.R.C., 1985, ch. P-21;

7. Les données d'autres sources apportées dans les locaux de Statistique Canada par le ou les chercheurs dans le cadre de la prestation des services spéciaux seront assujetties aux dispositions en matière de confidentialité de la *Loi sur la statistique*.
8. Statistique Canada souhaite établir les modalités selon lesquelles le ou les chercheurs seront retenus pour fournir les services spéciaux au ministre en vertu de la *Loi sur la statistique*, et plus particulièrement pour assurer l'utilisation appropriée et la protection de la confidentialité de l'information à laquelle le ou les chercheurs auront accès pendant la prestation de ces services spéciaux;

EN CONSÉQUENCE, les parties conviennent de ce qui suit :

## 1. DÉFINITIONS ET INTERPRÉTATIONS

### 1.1 Définitions

Dans le présent contrat, les termes portant la majuscule ont la signification qui leur est donnée dans la présente section, à moins que le contexte ne s'y oppose :

**« Personne réputée être employée »**

Une personne réputée être employée est une personne qui n'est actuellement pas une employée de Statistique Canada et qui est retenue pour fournir des services spéciaux à Statistique Canada en vertu de la *Loi sur la statistique*, pour lesquels elle doit avoir accès à de l'information protégée en vertu de la *Loi sur la statistique*.

**« Information »**

Information signifie les microdonnées confidentielles identifiables fournies au ou aux chercheurs par Statistique Canada et figurant à l'annexe D du présent contrat, ainsi que les données statistiques agrégées en découlant qui pourraient permettre d'identifier directement ou indirectement une personne.

**« Données d'autres sources »**

Les données d'autres sources sont les données apportées dans les locaux de Statistique Canada par le ou les chercheurs en vue de leur utilisation pour la prestation des services spéciaux et figurant à l'annexe C.

**« Personne »**

Personne signifie une personne, une entreprise constituée en société en vertu d'une loi du Canada, d'une province ou d'un territoire, un partenariat, une association ou une entreprise non constituée en société.

**« Produit proposé »**

Produit proposé signifie le produit ou les travaux créés par la ou les personnes réputées être employées dans le cadre des services spéciaux fournis, qui sont énoncés à l'annexe C.

**« Services spéciaux »**

Désignent l'énoncé des travaux décrit à l'annexe C.

### 1.2 Interprétation des annexes

Le présent contrat comprend les annexes suivantes, qui en font partie intégrante :

Numéro de contrat : 17-SSH-MCG-3152-S003

- a) Annexe A - Exigences en matière de sécurité
- b) Annexe B - Exigences opérationnelles
- c) Annexe C - Description des services spéciaux devant être fournis à Statistique Canada par le ou les chercheurs
- d) Annexe D - Information et documentation connexe fournies au ou aux chercheurs
- e) Annexe E - Documents devant être passés en revue par le ou les chercheurs
- f) Annexe F - Formulaire de déclaration de conflit d'intérêts

En cas d'incompatibilité ou de conflit entre une disposition figurant dans toute partie du contrat précédant les signatures et une disposition de l'une ou l'autre des annexes, la disposition figurant dans la partie du contrat précédant les signatures prévaudra.

## **2. ÉNONCÉ DES TRAVAUX**

- 2.1 En vertu de la *Loi sur la statistique*, le ou les chercheurs sont retenus pour fournir au ministre les services spéciaux documentés à l'annexe C.
- 2.2 Les services spéciaux comprennent l'exécution du projet de recherche et la fourniture du produit proposé décrit à l'annexe C, conformément aux exigences comprises dans le présent contrat.

## **3. INFORMATION À LAQUELLE ONT ACCÈS LA OU LES PERSONNES RÉPUTÉES ÊTRE EMPLOYÉES**

En vertu du présent contrat, Statistique Canada doit donner aux personnes réputées être employées accès à l'information requise pour fournir les services spéciaux à Statistique Canada.

## **4. MODALITÉS DE L'ACCÈS AUX MICRODONNÉES**

- 4.1 Sous réserve des modalités comprises dans la présente section et des exigences en matière de sécurité de l'annexe A, ainsi que des exigences opérationnelles de l'annexe B, Statistique Canada donnera accès à l'information au ou aux chercheurs aux fins de la prestation des services spéciaux.
- 4.2 Cet accès sera accordé uniquement dans la mesure nécessaire, à la discrétion de Statistique Canada, pour la prestation des services spéciaux.
- 4.3 Cet accès sera accordé uniquement dans les locaux de Statistique Canada et au moyen de l'équipement fourni et/ou désigné de façon particulière par Statistique Canada.
- 4.4 Afin d'avoir accès à l'information et de maintenir cet accès, le ou les chercheurs reconnaissent et conviennent qu'ils doivent se conformer aux exigences suivantes précédant l'accès :
  - 4.4.1 S'être vu accorder, au minimum, la cote de « fiabilité » conformément à la définition de la Politique sur la sécurité du gouvernement fédéral;
  - 4.4.2 Avoir prêté le serment professionnel, conformément à l'article 6 de la *Loi sur la statistique*;
  - 4.4.3 Avoir lu et compris les politiques, directives, guides et lignes directrices pertinents de Statistique Canada énumérés à l'annexe E et s'y conformer;

- 4.4.4 Avoir lu et compris le *Code de valeurs et d'éthique du secteur public*, le Code de conduite – Statistique Canada et la Politique sur les conflits d'intérêts et l'après-mandat figurant à l'annexe E et s'y conformer;
- 4.4.5 Avoir déclaré à l'annexe C :
  - 4.4.5.1 Que le seul objectif du projet de recherche est la recherche statistique;
  - 4.4.5.2 Les sources de soutien financier ou en nature qu'ils reçoivent pour mener le projet de recherche;
- 4.4.6 Le ou les chercheurs affirment qu'ils ont compris les sanctions qui pourraient s'appliquer s'ils contreviennent aux modalités d'accès aux données et les sanctions applicables s'ils contreviennent à la *Loi sur la statistique*, à la *Loi de l'impôt sur le revenu* ou à la *Loi sur la taxe d'accise*.

## 5. LIMITES DE L'UTILISATION DE L'INFORMATION

- 5.1 Le ou les chercheurs qui participent à l'exécution du présent contrat ne peuvent utiliser quelque renseignement que ce soit obtenu grâce à l'accès à l'information à des fins autres que celles prévues dans le présent contrat.
- 5.2 L'accès à l'information est accordé aux fins statistiques et de recherche comprises dans l'énoncé des travaux de l'annexe C.
- 5.3 Le ou les chercheurs ne peuvent divulguer l'information à quiconque d'autre que les employés actuels de Statistique Canada participant à l'examen ou à l'évaluation de l'un ou l'autre des aspects du projet de recherche.
- 5.4 Le ou les chercheurs doivent s'assurer qu'aucune tentative n'est faite pour coupler l'information fournie à tout autre fichier, en vue de rattacher les détails obtenus à une personne identifiable.

## 6. PEINES

En tant que personnes réputées être employées de Statistique Canada ayant fait le serment ou l'affirmation solennelle de discrétion énoncés dans l'article 6 de la *Loi sur la statistique*, le ou les chercheurs :

- 6.1 Demeurent assujettis au serment ou à l'affirmation solennelle de discrétion, même après la fin du présent contrat.
- 6.2 Sont exposés à toutes les peines applicables prévues dans la *Loi sur la statistique* en cas d'infraction à toute disposition relative à la confidentialité et peuvent encourir, sur déclaration de culpabilité par procédure sommaire, toute amende ou peine d'emprisonnement applicable.
- 6.3 Ne sont pas autorisés à divulguer de l'information concernant une personne (paragraphe 17(1) de la *Loi sur la statistique*) obtenue en vertu de la *Loi sur la statistique*. Le ou les chercheurs qui contreviennent au paragraphe 17(1) de la *Loi sur la statistique* sont coupables d'une infraction et passibles, sur déclaration de culpabilité par procédure sommaire, d'une amende maximale de mille dollars ou d'un emprisonnement maximal de six mois, ou de ces deux peines (alinéa 30(c) de la *Loi sur la statistique*).
- 6.4 Ne sont pas autorisés à divulguer des renseignements confidentiels qu'ils ont obtenus dans l'exercice de leurs fonctions et qui pourraient avoir une influence sur la valeur marchande d'actions, d'obligations ou autres valeurs ou d'un produit ou article, ou de se servir de tels renseignements pour spéculer sur des actions, obligations ou autres valeurs ou sur un produit ou article (article 34 de la *Loi sur la statistique*).

Numéro de contrat : 17-SSH-MCG-3152-S003

Le ou les chercheurs qui contreviennent à l'article 34 de la *Loi sur la statistique* sont coupables d'une infraction et passibles, sur déclaration de culpabilité par procédure sommaire, d'une amende maximale de cinq mille dollars ou d'un emprisonnement maximal de cinq ans, ou de ces deux peines.

- 6.5 Doivent se souvenir que, s'ils accèdent à des données d'autres sources que Statistique Canada, en conformité avec le présent contrat, ils sont assujettis à toutes les peines pertinentes prévues dans les lois connexes et applicables pour la contravention à l'une ou l'autre des dispositions en matière de confidentialité, et peuvent encourir, sur déclaration de culpabilité par procédure sommaire, toute amende ou peine d'emprisonnement applicable.

## **7. PROPRIÉTÉ ET DROITS D'AUTEUR CONCERNANT L'INFORMATION**

- 7.1 Statistique Canada est le propriétaire et/ou le gérant de l'information et de la documentation connexe figurant à l'annexe D, et les parties conviennent que le présent contrat s'applique à l'utilisation de l'information et de la documentation connexe pour fournir le produit proposé à Statistique Canada. Aucune clause du présent contrat n'est réputée attribuer au ou aux chercheurs un titre ou un droit de propriété quelconque sur l'information ou la documentation connexe.
- 7.2 Des droits d'auteur relatifs au produit proposé seront dévolus à Sa Majesté la Reine du chef du Canada. Le ou les chercheurs pourraient devoir fournir à Statistique Canada, à l'achèvement du contrat ou à tout autre moment où peut l'exiger Statistique Canada, une renonciation écrite permanente aux droits moraux de la part de tout auteur qui a contribué au produit proposé.
- 7.3 Les droits d'auteur relatifs aux travaux subséquents créés par le ou les chercheurs à partir du produit proposé seront dévolus au ou aux chercheurs.

## **8. UTILISATION ET PUBLICATION DU PRODUIT PROPOSÉ**

- 8.1 La diffusion du produit proposé par Statistique Canada peut être envisagée par Statistique Canada en consultation avec le chercheur principal.
- 8.2 Statistique Canada se réserve le droit :
- 8.2.1 De publier en tout ou en partie le produit proposé, ou une version modifiée ou dérivée de ce produit;
- 8.2.2 De ne publier aucune partie du produit proposé.
- 8.3 L'utilisation du produit proposé par le ou les chercheurs sera assujettie aux modalités de l'entente de licence ouverte de Statistique Canada, qui est accessible à partir du lien ci-après. Cette entente de licence permet au ou aux chercheurs d'utiliser l'information de Statistique Canada sans restriction concernant le partage et la redistribution, à des fins commerciales et non commerciales.

<http://www.statcan.gc.ca/fra/reference/licence-fra>

## **9. CONFLIT D'INTÉRÊTS**

Numéro de contrat : 17-SSH-MCG-3152-S003

- 9.1 Le ou les chercheurs recrutés comme personnes réputées être employées pour l'exécution du présent contrat doivent se conduire selon les principes et l'esprit du *Code de valeurs et d'éthique du secteur public*, du Code de conduite – Statistique Canada et de la Politique sur les conflits d'intérêts et l'après-mandat figurant à l'annexe E.
- 9.2 Le ou les chercheurs doivent remplir le formulaire de déclaration de conflit d'intérêts figurant à l'annexe F.
- 9.3 Si le chercheur a un conflit, il doit remplir un rapport confidentiel qui lui sera fourni par le représentant de Statistique Canada. Ce rapport doit être approuvé par le directeur général, Direction des ressources humaines, Statistique Canada, qui peut exiger que des mesures correctives soient prises avant de fournir son approbation.

#### **10. REPRÉSENTANTS DÉSIGNÉS**

- 10.1 Tout avis destiné à Statistique Canada en vertu du présent contrat doit être adressé à :

Directeur/Directrice  
Division de l'accès aux microdonnées  
Statistique Canada  
9A, immeuble R.-H.-Coats  
Ottawa (Ontario) K1A 0T6

- 10.2 Tout avis destiné au ou aux chercheurs doit être adressé à :

Thierry Gagné  
Université de Montréal  
6519 Pérodeau, Montréal, QC, H1M 1J2, CAN  
(514)259-7705

#### **11. PAIEMENT**

Les modalités de financement et de paiement aux fins du présent contrat sont énoncées dans une lettre d'entente distincte entre Statistique Canada et le ou les chercheurs.

#### **12. DURÉE**

Le présent contrat entre en vigueur au moment de sa signature par toutes les parties, à compter de la date de la dernière signature, et se poursuit jusqu'au 2019-08-31, à moins qu'il ne soit résilié plus tôt conformément à l'article 13.

#### **13. RÉSILIATION**

- 13.1 L'une ou l'autre partie pourra mettre fin au présent contrat, pour quelque raison que ce soit, en donnant un préavis écrit de résiliation de trente (30) jours à l'autre partie, ou à une autre date convenue par les parties. La résiliation prendra effet à l'expiration de la période de préavis.
- 13.2 Statistique Canada résiliera le présent contrat immédiatement après avoir fourni un avis écrit au ou aux chercheurs si ceux-ci manquent à leurs engagements aux termes du présent contrat.

#### **14. AVIS DE CHANGEMENT**

Le ou les chercheurs doivent informer Statistique Canada par écrit, dans les trente (30) jours, de tout changement apporté à leurs programmes et politiques, de même qu'à toute loi ou tout règlement susceptible d'avoir une incidence sur le présent contrat.

#### **15. MODIFICATION**

Numéro de contrat : 17-SSH-MCG-3152-S003

Pour devenir exécutoire, toute modification au présent contrat devra être formulée par écrit et signée par les personnes occupant les postes de signataires du présent contrat.

## 16. GÉNÉRALITÉS

- 16.1 **Aucune cession**  
Le ou les chercheurs reconnaissent que le présent contrat ne saurait faire l'objet d'une cession, en tout ou en partie, sans le consentement écrit préalable de Statistique Canada, et toute cession effectuée sans ce consentement sera considérée comme nulle et non avenue
- 16.2 **Avis**  
Sauf indication contraire dans le présent contrat, tout avis ou autre communication qui doit être donné ou fait par l'une ou l'autre partie en vertu du présent contrat, se fait par écrit et prend effet s'il est expédié par courrier recommandé, par courriel, par télécopieur, par affranchissement du courrier ou s'il est remis en personne, à l'autre partie, aux coordonnées indiquées à l'article 10 du présent contrat. Tout avis ou autre communication est réputé avoir été donné s'il est expédié par courrier recommandé au moment où l'autre partie en accuse réception, s'il est envoyé par courriel ou télécopieur le lendemain de l'envoi du courriel ou de la télécopie ou s'il est transmis par la poste le huitième (8<sup>e</sup>) jour civil suivant l'envoi postal.
- 16.3 **Survie**  
Les articles du présent contrat concernant les restrictions ayant trait à l'utilisation, à la confidentialité, au conflit d'intérêt, aux infractions et peines, à l'exonération de garantie, à la résiliation et aux généralités, ainsi que toutes les autres dispositions qui, en raison de leur nature, sont appelées à survivre à la résiliation ou l'expiration du présent contrat, resteront en vigueur après la résiliation ou l'expiration du présent contrat.
- 16.4 **Dispositions législatives**  
Le présent contrat est régi et interprété conformément aux lois de la province de l'Ontario et aux lois du Canada qui s'y appliquent.
- 16.5 **Accord indivisible**  
Le contrat constitue l'intégralité de l'accord conclu entre les parties relativement à l'objet décrit dans le présent document et remplace toutes les négociations et communications antérieures sur le même sujet, à moins qu'elles ne soient incorporées par renvoi au présent contrat.
- 16.6 **Renonciation**  
Toute tolérance ou indulgence manifestée par une partie à l'égard de l'autre, ou tout exercice partiel ou limité d'un droit conféré à une partie, ne constitue pas une renonciation des droits, à moins que cette partie y ait renoncé expressément et par écrit.
- 16.7 **Divisibilité**  
Si quelque disposition du présent contrat, en totalité ou en partie, est déclarée nulle ou non exécutoire par un tribunal compétent, la disposition ou partie de disposition déclarée invalide ou non exécutoire sera réputée divisible et supprimée du présent accord, et toutes les autres modalités du présent contrat resteront valides et exécutoires.

Numéro de contrat : 17-SSH-MCG-3152-S003

EN FOI DE QUOI, le présent contrat a été exécuté au nom de :

**POUR STATISTIQUE CANADA :**

\_\_\_\_\_  
[Directeur/Directrice], Division  
de l'accès aux microdonnées

\_\_\_\_\_  
Nom en lettres moulées

\_\_\_\_\_  
Témoin

\_\_\_\_\_  
Nom en lettres moulées

SIGNÉ à Ottawa, dans la province de l'Ontario, ce \_\_\_\_\_ jour de (mois) \_\_\_\_\_  
\_\_\_\_\_ (année).

**POUR LE CHERCHEUR PRINCIPAL ET LE OU LES COCHERCHEURS :**

\_\_\_\_\_  
Chercheur principal (signé ici)

**Thierry Gagné**  
\_\_\_\_\_  
Nom en lettres moulées

\_\_\_\_\_  
Témoin (signé ici)

\_\_\_\_\_  
Nom en lettres moulées

SIGNÉ à \_\_\_\_\_, ce \_\_\_\_\_ jour de (mois) \_\_\_\_\_ (année).

\_\_\_\_\_  
Cochercheur (signé ici)

**Amélie Quesnel-Vallée**  
\_\_\_\_\_  
Nom en lettres moulées

\_\_\_\_\_  
Témoin (signé ici)

\_\_\_\_\_  
Nom en lettres moulées

SIGNÉ à \_\_\_\_\_, ce \_\_\_\_\_ jour de (mois) \_\_\_\_\_  
\_\_\_\_\_ (année).

**(Remplir pour toutes les personnes réputées être employées signataires du contrat)**



**ANNEXE A**  
**EXIGENCES EN MATIÈRE DE SÉCURITÉ**

L'information est désignée comme confidentielle. Les exigences en matière de sécurité décrites ci-dessous constituent les exigences minimales auxquelles les chercheurs doivent se conformer.

1. Le ou les chercheurs ne doivent sortir aucune information ou aucun renseignement statistique de nature délicate fourni en vertu du présent contrat à l'extérieur des locaux de Statistique Canada.
2. Le ou les chercheurs peuvent demander le retrait de l'information, sous réserve des conditions suivantes :
  - a) Tout matériel que le ou les chercheurs doivent sortir des locaux de Statistique Canada doit d'abord être passé en revue par Statistique Canada, afin d'éliminer tout risque de divulgation de renseignements confidentiels, y compris toute information qui pourrait permettre de dévoiler l'identité d'une personne, conformément à la définition de l'article 17 de la *Loi sur la statistique*.
3. Le ou les chercheurs doivent prendre toutes les précautions nécessaires pour éviter la divulgation de renseignements confidentiels.
4. Le ou les chercheurs doivent utiliser uniquement l'équipement qui est fourni dans les locaux sécuritaires de Statistique Canada. Cet équipement ne doit jamais sortir des locaux de Statistique Canada, y compris les centres de données de recherche.
5. Le ou les chercheurs ne doivent pas tenter d'altérer la configuration et les dispositifs de sécurité des postes de travail informatisés qui sont mis à leur disposition pour fournir les services spéciaux.
6. Le ou les chercheurs ne doivent pas tenter de compromettre la sécurité de l'environnement informatique. Sans limiter la portée générale de ce qui précède, cela comprend l'utilisation de logiciels ou de dispositifs de copie et de partage d'écran, et le fait de permettre à des personnes non autorisées de consulter les données.
7. Si le ou les chercheurs constatent ou soupçonnent une infraction à la sécurité, une divulgation non autorisée ou un accès non autorisé aux données confidentielles, ils doivent informer le représentant de Statistique Canada sans délai.
8. **Utilisation du réseau**  
Conformément à la Politique sur la sécurité informatique de Statistique Canada, définie dans la Politique d'utilisation des réseaux, le ou les chercheurs reconnaissent que les limites suivantes s'appliquent à toutes les utilisations du réseau étendu des centres de données de recherche :

Les chercheurs ne doivent pas entreprendre la moindre activité illégale ou inacceptable. Parmi les exemples figurent les suivants :

Numéro de contrat : 17-SSH-MCG-3152-S003

- Tentative de percer les dispositifs de sécurité des systèmes informatiques, notamment en utilisant des programmes antisécurité, en se servant du mot de passe, du code d'utilisateur ou du compte informatique de quelqu'un d'autre, en donnant son mot de passe, des renseignements sur la configuration du réseau ou des codes d'accès à quelqu'un d'autre ou en désactivant des programmes antivirus (Politique sur la sécurité du gouvernement).
- Destruction, modification ou cryptage de données sans autorisation, dans l'intention d'en interdire l'accès à d'autres ayant un besoin légitime d'y accéder.

## **APPENDIX X. NPHS derived variables**

## Derived variables in the National Population Health Survey (NPHS)

### “Highest Level of Education – 4 Levels”

#	Description	Condition	Recoding
1	Less than secondary school graduation	No Schooling; Elementary school; Some secondary school (no diploma)	High school or less
2	Secondary school graduation	Secondary school graduation	High school or less
3	Some post-secondary	Some trade school; Some community college; Some university; Other post-secondary	Pursued post-secondary education
4	Post-secondary graduation	Diploma/certificate - trade school; Diploma/certificate - community college, CEGEP*; Bachelor degree (includes LLB, LLJ); Master's/Degree in medicine/Doctorate	Pursued post-secondary education

xcvi

### “Current Labour Force Status – 3 Levels”

#	Description	Condition	Recoding
1	Employed	Had a job - at work last week; Had a job - absent from work last week	Employed
2	Unemployed	Did not have a job last week	Not employed
3	Not in the labor force	Permanently unable to work	Not employed

### “Living Arrangement of the Selected Respondent”

#	Description	Condition	Recoding
1	Unattached individual living alone	Selected respondent lives alone. Household size=1.	Living without parents, without children

2	Unattached individual living with others	Selected respondent lives with others. S/he cannot have a marital/common-law or parental relationship but other relationships such as siblings are allowed.	Living without parents, without children
3	Living with spouse/partner	Selected respondent lives with spouse/partner only. Household size=2.	Living without parents, without children
4	Parent living with spouse/partner and children	Selected respondent lives with spouse/partner and child(ren).	Living without parents, with children
5	Single parent living with children	Selected respondent lives with child(ren). No other relationships are permitted.	Living without parents, with children
6	Child living with single parent	Selected respondent is a child living with a single parent. Household size=2.	Living with parents
7	Child living with single parent and siblings	Selected respondent is a child living with a single parent and siblings.	Living with parents
8	Child living with two parents	Selected respondent is a child living with two parents. Household size=3.	Living with parents
9	Child living with two parents and siblings	Selected respondent is a child living with two parents and siblings.	Living with parents
10	Other	Selected respondent lives in a household composition not classified above.	Other

**APPENDIX XI. Associations between educational attainment and other socioeconomic characteristics in the Interdisciplinary Study of Inequalities in Smoking, controlling for age**

**Associations between educational attainment and other socioeconomic characteristics, controlling for age. Interdisciplinary Study of Inequalities in Smoking, 2011-2012.**

Socioeconomic characteristics	Completed post-secondary education (ref. = High School or less)	
	PR	(95%CI)
Having a father from whom you can borrow \$500 in case of emergency	<b>1.36</b>	<b>(1.26-1.46)</b>
Having a mother from whom you can borrow \$500 in case of emergency	<b>1.32</b>	<b>(1.24-1.41)</b>
Having a family member who can “most probably” offer a job contact	<b>1.30</b>	<b>(1.11-1.51)</b>
Having a friend from whom you can borrow \$500 in case of emergency	<b>1.32</b>	<b>(1.16-1.49)</b>
Having a partner from whom you can borrow \$500 in case of emergency	<b>1.22</b>	<b>(1.03-1.43)</b>
Reporting any income in the past year	<b>1.05</b>	<b>(1.01-1.08)</b>
Reporting \$20,000 or more in the past year	1.16	(0.94-1.44)
Having financial difficulties in the past year	<b>0.45</b>	<b>(0.37-0.56)</b>
Having a social support network of 15+ peers	<b>1.20</b>	<b>(1.00-1.45)</b>
Living with parents	1.02	(0.98-1.07)
Living with children	<b>0.38</b>	<b>(0.21-0.66)</b>
Studying	<b>1.31</b>	<b>(1.23-1.40)</b>
Working full-time	1.04	(0.86-1.26)
Being in a relationship	1.01	(0.88-1.17)

*PR = Prevalence Ratio; CI = Confidence Interval. Models were Poisson regressions with robust variance estimation using listwise deletion and only controlling for age. Bolded coefficients are significant at the .05 level.*

**APPENDIX XII. Associations between socioeconomic characteristics and current smoking status in the Interdisciplinary Study of Inequalities in Smoking, controlling for education and personal income**



**Associations between socioeconomic characteristics and smoking status among young adults, controlling for education and personal income. Interdisciplinary Study of Inequalities in Smoking, 2011-2012. (n = 2,083)**

Variable	Model 1		Model 2		Model 3		Model 4	
	Association + Age/Sex		Model 1 + Education		Model 1 + Income		Full Model	
	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI
<b>Education</b>								
High school or less	<b>2.38</b>	<b>(1.84-3.10)</b>	---	---	<b>2.42</b>	<b>(1.86-3.16)</b>	<b>2.37</b>	<b>(1.79-3.12)</b>
CEGEP completed	<b>1.42</b>	<b>(1.09-1.84)</b>	---	---	<b>1.71</b>	<b>(1.43-2.04)</b>	<b>1.45</b>	<b>(1.11-1.89)</b>
Some university completed (ref.)	---	---	---	---	---	---	---	---
Personal annual income *	<b>1.11</b>	<b>(1.06-1.17)</b>	<b>1.11</b>	<b>(1.06-1.17)</b>	---	---	<b>1.11</b>	<b>(1.05-1.17)</b>
Financial difficulties in the last year	<b>1.45</b>	<b>(1.19-1.76)</b>	<b>1.27</b>	<b>(1.05-1.54)</b>	<b>1.47</b>	<b>(1.22-1.78)</b>	<b>1.24</b>	<b>(1.01-1.53)</b>
Father's capacity to provide \$500	<b>0.76</b>	<b>(0.65-0.90)</b>	0.88	(0.75-1.04)	<b>0.76</b>	<b>(0.64-0.89)</b>	0.88	(0.73-1.07)
Mother's capacity to provide \$500	<b>0.83</b>	<b>(0.70-0.99)</b>	0.96	(0.81-1.14)	<b>0.82</b>	<b>(0.69-0.97)</b>	1.07	(0.87-1.32)
Partner's capacity to provide \$500	0.90	(0.74-1.08)	0.91	(0.76-1.10)	0.84	(0.69-1.02)	0.83	(0.67-1.04)
Friends' capacity to provide \$500	1.01	(0.86-1.19)	1.10	(0.94-1.29)	0.98	(0.83-1.15)	1.07	(0.90-1.27)
Family's capacity to provide a job contact *	1.02	(0.94-1.11)	1.05	(0.97-1.14)	1.02	(0.94-1.11)	1.07	(0.98-1.16)
Social network size *	0.99	(0.97-1.01)	1.00	(0.98-1.02)	0.99	(0.97-1.01)	0.99	(0.98-1.02)
Living with your parents	<b>0.76</b>	<b>(0.62-0.94)</b>	<b>0.75</b>	<b>(0.61-0.92)</b>	<b>0.80</b>	<b>(0.64-0.98)</b>	<b>0.75</b>	<b>(0.60-0.95)</b>
Studying	<b>0.75</b>	<b>(0.63-0.89)</b>	<b>0.83</b>	<b>(0.70-0.99)</b>	<b>0.80</b>	<b>(0.66-0.96)</b>	0.89	(0.72-1.09)
Working full-time	<b>1.24</b>	<b>(1.01-1.50)</b>	<b>1.23</b>	<b>(1.01-1.49)</b>	1.01	(0.80-1.27)	0.95	(0.75-1.21)
Being in a relationship	1.00	(0.85-1.20)	0.99	(0.84-1.18)	0.96	(0.81-1.15)	1.02	(0.83-1.26)
Living with children	0.90	(0.53-1.53)	0.70	(0.42-1.18)	0.91	(0.54-1.55)	<b>0.54</b>	<b>(0.32-0.94)</b>

\* Modelled as a continuous variable. PR = Prevalence ratio; CI = Confidence Interval. Models were Poisson regressions with a robust variance estimator on 20 imputed datasets. Bolded coefficients are statistically significant at the .05 level.

**APPENDIX XIII. Steinmetz-Wood M, Gagné T, Sylvestre MP, Frohlich KL. Do social characteristics influence smoking uptake and cessation during young adulthood? Int J Public Health. 2018; 63: 115-123.**



## Do social characteristics influence smoking uptake and cessation during young adulthood?

Madeleine Steinmetz-Wood<sup>1</sup>  · Thierry Gagné<sup>2,4</sup> · Marie-Pierre Sylvestre<sup>2,3</sup> · Katherine Frohlich<sup>2,4</sup>

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### Abstract

**Objectives** This study uses a Bourdieusian approach to assess young adults' resources and examines their association with smoking initiation and cessation.

**Methods** Data were drawn from 1450 young adults participating in the Interdisciplinary Study of Inequalities in Smoking, a cohort study in Montreal, Canada. We used logistic regression models to examine the association between young adults' income, education, and peer smoking at baseline and smoking onset and cessation.

**Results** Young adults where most or all of their friends smoked had greater odds of smoking onset. Young adults that had completed pre-university postsecondary education also had higher odds of smoking onset after controlling for social support, employment status, and lacking money to pay for expenses. Income and the sociodemographic variables age and sex were not associated with smoking onset. Young adults where half of their friends smoked or where most to all of their friends smoked had lowers odds of

smoking cessation. Men were more likely to cease smoking than women. Education, income and age were not associated with cessation.

**Conclusions** Interventions focusing on peer smoking may present promising avenues for tobacco prevention in young adults.

**Keywords** Young adults · Smoking · Smoking onset · Cessation · Social characteristics · Bourdieu

### Introduction

Tobacco smoking is one of the leading causes of mortality and morbidity (Lim et al. 2013). It is well established that people who smoke have higher risks of death from cardiovascular disease, cancer, diabetes, chronic obstructive pulmonary disease, and pneumonia (Carter et al. 2015). In Canada and the United States, young adults have the highest smoking prevalence of any age group (Statistics Canada 2016; US Department of Health and Human Services 2012). In addition, their cessation rates have not increased in the last 30 years and smoking initiation rates may also have been increasing during this period (O'Loughlin et al. 2014). Despite this, the predictors of tobacco initiation and cessation in young adults remain largely understudied (Freedman et al. 2012). To reduce the health burden of tobacco, it is particularly critical to reduce the pervasiveness of smoking in this age group, since young adults who smoke and persist in smoking throughout the life course risk losing a decade of their life expectancy (Jha and Peto 2014).

Young adults must make important choices related to continuing their education, starting a career, and starting a family (Bachman et al. 2014). This period of transition is

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✉ Madeleine Steinmetz-Wood  
madeleine.steinmetz-wood@mail.mcgill.ca

<sup>1</sup> Department of Geography, McGill University, Montréal, Canada

<sup>2</sup> Département de médecine sociale et préventive, École de Santé Publique de l'Université de Montréal (ESPUM), Université de Montréal, Montréal, Canada

<sup>3</sup> Centre de Recherche du Centre Hospitalier de l'Université de Montréal, Montréal, Canada

<sup>4</sup> Institut de Recherche en Santé Publique (IRSPUM), Université de Montréal, Montréal, Canada

accompanied by changes in the residence, education, and employment that provide new environments, either preventive or conducive to smoking (Furstenberg 2008; Ling and Glantz 2002). Thus, young adulthood is an important life phase during which transitions and life choices are shaping the accumulation of resources that may in turn impact upon young adults' capacity to avoid or cease smoking.

The growing body of literature investigating the determinants of smoking in young adults suggests that cumulative exposure to disadvantage contributes to smoking uptake and maintenance (Chen and Jacques-Tiura 2014; US Department of Health and Human Services 2012). To measure these determinants certain scholars have turned to the work of sociologist Pierre Bourdieu (Bourdieu 1979, 1986) to guide their operationalization of social characteristics and understand how their unequal distribution is associated with health in the population (Abel et al. 2011; Gagné et al. 2015; Veenstra and Abel 2015). Bourdieu's theory explains the creation and maintenance of social inequalities through capital theory. The theory is based on three forms of capital: economic (the financial and material resources that can bring immediate benefit or that can be exchanged against another resource), social (the potential resources that are accessible through the quality and extent of one's social network based on the principles of recognition and reciprocity), and cultural (educational credentials, as well as the skills, knowledge, competencies in addition to the preferences and tastes that are accumulated through socialization in the family and school environments). The term 'capital' specifically implies that access to these resources is distributed unequally through structural processes in the family and formal institutions and these patterns of unequal distribution are reproduced through generations (Savage et al. 2005).

In previous studies theoretically guided by Bourdieu's capital theory, individuals with the most economic, cultural or social resources were hypothesized to be those with the greatest ability to avoid detrimental health behaviors (Abel et al. 2011; Gagné et al. 2015; Schori et al. 2014; Veenstra and Abel 2015). In contrast with previous research, we introduce a form of social capital, proportion of smoking peers. We hypothesize that young adults with a higher proportion of non-smoking social connections (high social capital) will have the best capacity to avoid or cease smoking and conversely young adults with a high proportion of smoking peers (low social capital) will have the least capacity to avoid or cease smoking. Although, this form of social capital has been previously unexplored by studies theoretically guided by Bourdieu's capital theory, we chose to introduce it in our study, as we believe that this capital may be a key determinant of young adults' smoking status due to the prominent role that peer smoking can play

in peer relationships and socializing. The indicator used captured two important elements of Bourdieu's conception of social capital specifically applicable to smoking in young adults. It incorporates the notion of access to resources through the social network, since non-smoking peers can provide young adults with increased social support for cessation by providing information about cessation resources (cessation programs, educational materials, and tricks to cease smoking), and the benefits of quitting or being a non-smoker. They may also promote anti-smoking norms, and may exert pressure on their friends to quit or resist smoking (Curry et al. 2007; Haas and Schaefer 2014). The proportion of smoking peers also incorporates the notion of sociability, since smoking is a social practice that often occurs in a social setting, thus when young adults have few peers to smoke with they may be more likely to cease (Christakis and Fowler 2008) or resist smoking onset.

### Objective

The effect of capital during the transition towards adulthood on smoking uptake and cessation is poorly understood. In our study, we aim to empirically examine the relationship between resources conceptualized as economic, social, and cultural capital at baseline and smoking uptake and cessation using a sample of young adults participating in the Interdisciplinary Study of Inequalities in Smoking study. We hypothesize that high economic, cultural, and social capital will be negatively associated with smoking onset and positively associated with cessation.

### Methods

#### Sample

The Interdisciplinary Study of Inequalities in Smoking is a study that was created with the goal of better understanding the interplay of individual and contextual characteristics in the production of social inequalities in smoking among young adults (Frohlich et al. 2015). Recruitment for wave 1 of the study occurred between November 2011 and September 2012, and the second wave of data collection occurred between January and June 2014. Individuals were eligible if they were a non-institutionalized individual, were 18–25 years old at contact, spoke English or French, and had been living at their current address for at least a year. A total of 6020 eligible young adults living within the 35 health service catchment areas (CLSC) of Montreal were randomly selected for participation by the Régie de l'Assurance Maladie du Québec (the publicly funded health insurance program of Quebec, Canada). More information on the sampling procedure used in the study

can be found elsewhere (Frohlich et al. 2015). Participants ( $n = 2093$ ) provided sociodemographic, smoking, and health data by completing a questionnaire using a secured website (90%), using a paper questionnaire (4.2%) or over the phone (5.8%). Participants were compensated with a \$10 gift certificate. Follow-up occurred 2 years later between January and June 2014 ( $n = 1457$ ). We restricted our analysis to participating individuals who had reported their smoking status in both waves of the study.

### Dependent variable

The dependent variable was change in smoking status from wave 1 to wave 2 and was assessed using two questions taken from the Canadian Community Health Survey (Statistics Canada 2014). Participants were first asked: Have you ever smoked a whole cigarette? Those that had smoked a whole cigarette in the past were then asked: currently, do you smoke cigarettes: (1) every day; (2) occasionally; or (3) never? Participants were classified as non-smokers if they had never smoked a whole cigarette or if they did not smoke currently. They were classified as smokers if they had reported smoking every day or occasionally. Based on the participants' responses to these questions at wave 1 and wave 2, participants were categorized as the following: persistent non-smoker (non-smoker in 2012 and 2014), and non-smoker who became a smoker (non-smoker in 2012 and smoker in 2014), smoker who became a non-smoker (smoker in 2012 and non-smoker in 2014) and persistent smoker (smoker in 2012 and 2014).

### Independent variables and covariates

We selected one indicator to represent each capital based on the following criteria: it was an appropriate operationalization of Bourdieu's definition of social, economic or cultural capital, and it was consistent with the literature on the correlates of smoking (O'Loughlin et al. 2014; US Department of Health and Human Services 2012). To measure cultural capital, we used a variable representing highest educational level completed. This variable consisted of three categories: (1) high school or less; (2) CEGEP (postsecondary institution attended after high school, in Quebec, Canada); and (3) university. Income was used to represent economic capital. This was measured using participant's self-reported total personal income before taxes from the previous year (including scholarships, employment insurance benefits, or other insurance benefits). Participants' responses were divided into three categories: (1) \$0 to \$4999; (2) \$5000 to \$19,999; (3) \$20,000 and over. In contrast with previous research using a Bourdieusian framework (Abel et al. 2011; Veenstra and

Abel 2015), we used the proportion of friends that smoke as an indicator of social capital. This was evaluated using the following question: How many of your friends smoke? Possible responses were: (1) none; (2) one or a few; (3) approximately half; (4) most; (5) all. These responses were then re-classified into the categories: (1) none to a few; (2) half; (3) most or all. Baseline sex and age were considered potential covariates in this study as they may correlate with change in smoking status (O'Loughlin et al. 2014). We considered that our main capital indicators of interest might be sensitive to young adult's other social circumstances. Therefore, we included a variable indicating if young adults were employed: (1) not employed, (2) employed part-time, (3) or employed full-time. We also included a variable indicating if they had experienced financial difficulties in the last year (Yes or No) and a variable indicating the number of people that would support the participant in a time of need with the categories: 0–2 people, 3–4 people, 5 or more people.

### Statistical analyses

The sample was stratified according to smoking status at wave 1 to form two separate cohorts "smokers at baseline" and "non-smokers at baseline". Descriptive statistics were carried out to examine the distribution of each variable at baseline and each capital variable according to smoking status. Due to the number of participants that did not report their income at wave 1 ( $n = 135$ ), before conducting the analysis we performed multiple imputation (Enders 2010) using ten imputations, as the data were assumed to be missing at random (MAR). Education at baseline was associated with having missing values for income using chi-square tests (Supplementary material). Sex, age, and the three capital variables were used as predictors for the imputation, as well as other variables we considered might improve the imputation of income. These included a variable indicating if the individual had lacked money to pay for expenses over the course of the last year, employment status, and a variable indicating if the individual would be able to borrow a sum of \$500 from friends and family if an urgent situation were to arise. Logistic regression was run to model the relationship between the three forms of capital at T1 and changes in smoking status controlling for the covariates age and gender at baseline. For each cohort, we first ran separate logistic regression models for each capital with the variables age and sex. We then modeled the relationship including all capital variables in the model at the same time. We also control for employment status, having experienced financial difficulties in the last year, and social network size in the full model. Analyses were performed using SPSS version 22.

## Results

636 people were excluded because they were lost to follow-up at time 2, and, for those who participated at wave 2, 7 people were excluded because they did not report their smoking status. 117 (10.16%) non-smokers and 18 (6.04%) smokers did not report their income. The final sample was comprised of 1450 individuals. At baseline, the average age of participants in the sample was 21.48 (SD: 2.29) most of the sample was female, had completed CEGEP, were earning between \$5000 and \$19,999, and had zero to a few friends that smoked. The sample was comprised of 1075 (74.13%) persistent non-smokers, 77 (5.31%) non-smokers that became smokers, 213 (14.69%) persistent smokers, and 85 (5.86%) smokers that became non-smokers (Table 1).

Tables 2 and 3 present the influence of participants' social characteristics on smoking onset and cessation, respectively. These results reveal that young adults where most or all of their friends smoked had greater odds of smoking onset. Young adults that had completed CEGEP also had higher odds of smoking onset after controlling for social support, employment status, and lacking money to pay for expenses. Income and the demographic variables age and sex were not associated with smoking onset. Table 3 revealed that young adults where half of their friends smoked or where most to all of their friends smoked had lowers odds of smoking cessation. Men were more likely to cease smoking than women. Education, income and age were not associated with cessation.

## Discussion

Previous literature on smoking in young adults suggests that cumulative exposure to detrimental socioeconomic conditions contributes to smoking uptake. We argued that the literature theoretically guided by Bourdieu's capital theory should also consider the proportion of friends that smoke as a form of social capital that can contribute to a young adult's smoking status. We modeled the relationship between economic, cultural, and social capital at baseline and smoking onset and cessation. Social and cultural capital were associated with becoming a smoker, and social capital was associated with cessation.

### Smoking onset

To represent social capital, researchers theoretically guided by Bourdieu's capital theory have tended to use measures of social support from family, friends, and neighbors (Abel et al. 2011) or parents arranging social contacts with people

in influential positions (Veenstra and Abel 2015) and have identified social capital as an important determinant of health. In contrast with these studies, we chose to use the proportion of friends that smoke as an indicator of social capital, as we hypothesized that this indicator would capture important elements of Bourdieu's conception of social capital specifically applicable to smoking in young adults, such as access to resources through the social network and the concept of sociability. Previous empirical findings from the smoking literature have shown that having friends that smoke is associated with being a current smoker (De Clercq et al. 2014; Huang et al. 2014; Kaai et al. 2014; Saari et al. 2014) and becoming a smoker (Chen et al. 2014; Saari et al. 2014). Our results are congruent with these findings; they demonstrate that having a high proportion of friends that smoke is significantly associated with becoming a smoker. Smoking peers may provide ready access to cigarettes for experimental or non-smokers and smoking may play an important social role in the lives of certain young individuals. In certain social contexts such as bars, cafes, and clubs, smoking with friends may promote a sense of social belonging and may contribute to the formation of a shared social identity based on shared practices of consumption (Robilliard 2010).

Bourdieu initially proposed that economic and cultural capital were the two main forms of capital contributing to circumscribing individuals' social position (Bourdieu 1979, 1986). He argued that the main mechanism through which this social position translated into a set of collectively shared practices was through the slow and life-long inculcation of distinctive knowledge, skills, preferences and tastes which, in turn, contribute through distinction to reinforce (or reproduce) one's social position (Abel and Frohlich 2012; Frohlich 2013). In our study, we used income and education to operationalize economic and cultural capital, respectively. Current evidence on the correlates of smoking observes systematic differences in smoking prevalence among young adults according to education and income (Bricard et al. 2016; Corsi et al. 2013; US Department of Health and Human Services 2012). In parallel, previous studies informed by Bourdieu's capital theory have demonstrated that high economic (Abel et al. 2011; Schori et al. 2014; Veenstra and Abel 2015) and cultural capital (Abel et al. 2011; Gagné et al. 2015; Schori et al. 2014; Veenstra and Abel 2015) are associated with the uptake of favorable health behaviors and health outcomes. A few of these studies specifically addressed the influence of economic and cultural capital on smoking in young adults (Gagné et al. 2015; Schori et al. 2014). For instance, Gagné et al. (2015) demonstrated that scoring low in cultural capital dimensions including health values, family resources, and education and knowledge was associated with being a smoker and smoking more cigarettes

**Table 1** Distribution of capital at T1 according to smoking status of young adults from Montreal, Canada, participating in the Interdisciplinary Study of Inequalities in Smoking study (2011–2014)

	Persistent non-smoker ( <i>n</i> = 1075)		Non-smoker who became a smoker ( <i>n</i> = 77)		Persistent smokers ( <i>n</i> = 213)		Smoker who became a non-smoker ( <i>n</i> = 85)		Total ( <i>n</i> = 1450)	
	<i>N</i>	% or mean (SD)	<i>N</i>	% or mean (SD)	<i>N</i>	% or mean (SD)	<i>N</i>	% or mean (SD)	<i>N</i>	% or mean (SD)
Age	1075	21.44 (2.29)	77	21.43 (2.16)	213	21.73 (2.31)	85	21.48 (2.31)	1450	21.48 (2.29)
Gender										
Female	647	60.19	41	53.25	107	50.23	56	65.88	851	58.69
Male	428	39.81	36	46.75	106	49.77	29	34.12	599	41.31
Highest level of education completed										
High school or less	377	35.07	21	27.27	107	50.23	35	41.18	540	37.24
CEGEP <sup>a</sup>	451	41.95	40	51.95	67	31.46	35	41.18	593	40.90
University	246	22.88	15	19.48	38	17.84	15	17.65	314	21.66
Missing	1	0.09	1	1.30	1	0.47	0	0.00	3	0.21
Income		0.00								
\$0–\$4999	331	30.79	19	24.68	44	20.66	19	22.35	413	28.48
\$5000–\$19,999	451	41.95	37	48.05	107	50.23	44	51.76	639	44.07
\$20,000 and over	181	16.84	16	20.78	48	22.54	18	21.18	263	18.14
Missing	112	10.42	3	3.90	14	6.57	4	4.71	133	9.17
Proportion of friends that smoke										
0 to a few	863	80.28	51	66.23	65	30.52	50	58.82	1029	70.97
Half	129	12.00	12	15.58	66	30.99	16	18.82	223	15.38
Most or all	64	5.95	13	16.88	77	36.15	19	22.35	173	11.93
Missing	19	1.77	1	1.30	5	2.35	0	0.00	25	1.72
Social support										
0–2 people	213	19.81	22	28.57	45	21.13	22	25.88	302	20.83
3–4 people	305	28.37	24	31.17	55	25.82	24	28.24	408	28.14
5 or more people	521	48.47	29	37.66	107	50.23	29	34.12	686	47.31
Missing	36	3.35	2	2.60	6	2.82	10	11.76	54	3.72
Financial situation										
Did not lack money to pay for expenses	903	84.00	63	81.82	166	77.93	67	78.82	1199	82.69
Lacked money to pay for expenses	146	13.58	13	16.88	43	20.19	17	20.00	219	15.10
Missing	26	2.42	1	1.30	4	1.88	1	1.18	32	2.21
Employment status										
Not employed	375	34.88	23	29.87	59	27.70	24	28.24	481	33.17
Freelance contract or part-time	488	45.40	36	46.75	107	50.23	43	50.59	674	46.48
Full-time	197	18.33	18	23.38	46	21.60	18	21.18	279	19.24
Missing	15	1.40	0	0.00	1	0.47	0	0.00	16	1.10

<sup>a</sup>Post-secondary institution attended after high school, in Quebec, Canada

daily. Similarly, in our sample, cultural capital was associated with smoking onset. Respondents that had completed CEGEP at baseline had higher odds of becoming a smoker. This suggests that there may not be a simple linear

relationship between cultural capital and smoking, whereby higher cultural capital may not always lead to a decreased risk of smoking. After completing CEGEP many young adults go to university or join the workforce. This period is

**Table 2** Logistic regression model of the effect of cultural, economic, and social capital on young adults from Montreal, Canada, participating in the Interdisciplinary Study of smoking onset (ref. non-smoker at baseline that stayed a non-smoker at T2) for a sample of Inequalities in Smoking study (2011–2014)

	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI				
Gender (ref. female)														
Male	1.355	0.850	2.158	1.334	1.334	0.838	2.123	1.294	1.336	0.832	2.145	1.399	0.866	2.258
Age	0.981	0.863	1.115	.948	1.073	.838	1.073	.996	.919	0.793	1.064	0.901	0.777	1.046
Education completed (ref. high school or less)														
CEGEP <sup>a</sup>	1.675	0.931	3.015						1.801	0.994	3.263	1.860*	1.020	3.392
University	1.199	0.520	2.764						1.405	0.603	3.277	1.523	0.650	3.567
Income (ref. \$0 to \$4999)														
\$5000 to \$19,999				1.569	0.854	2.883			1.419	0.766	2.628	1.335	0.695	2.565
\$20,000 and over				1.863	0.823	4.218			1.761	0.779	3.984	1.505	0.603	3.756
Proportion of friends that smoke (ref. none to a few)														
Half								1.493	0.774	2.882	2.803	1.399	0.717	2.730
Most or all								3.165*	1.634	6.129	6.542	3.189*	1.616	6.292
Social support (ref. 0–2 people)														
3–4 people												0.790	0.425	1.470
5 or more people												0.563	0.311	1.020
Employment status (ref. not employed)														
Free lance contract, or part-time												1.123	0.628	2.008
Full-time												1.490	0.679	3.268
Financial situation (ref. did not lack money to pay for expenses)														
Lacked money to pay for expenses												1.235	0.640	2.381

\* $p < 0.05$

<sup>a</sup>Post-secondary institution attended after high school, in Quebec, Canada



**Table 3** Logistic regression model of the effect of cultural, economic, and social capital on adults from Montreal, Canada, participating in the Interdisciplinary Study of Inequalities in smoking cessation (ref. smoker at baseline that stayed a smoker at T2) for a sample of young Smoker study (2011–2014)

	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Gender (ref. female)										
Male	0.554*	0.422 0.726	0.517*	0.306 0.875	0.506*	0.294 0.871	0.526*	0.304 0.911	0.526*	0.301 0.918
Age	0.910	0.795 1.040	0.943	0.825 1.077	0.939	0.836 1.053	0.903	0.767 1.064	0.883	0.745 1.046
Education completed (ref. high school or less)										
CEGEP <sup>a</sup>	1.703	0.924 3.139							1.472	0.764 2.835
University	1.521	0.649 3.563							1.309	0.528 3.243
Income (ref. \$0–\$4999)										
\$5000 to \$19,999			1.064	0.532 2.125					1.049	0.510 2.158
\$20,000 and over			1.132	.456 2.807					1.099	0.422 2.860
Proportion of friends that smoke (ref. none to a few)										
Half										
Most or all										
Social support (ref. 0–2 people)										
3–4 people					0.309*	0.158 0.605	0.307*	0.156 0.604	0.286*	0.144 0.569
5 or more people					0.311*	0.165 0.586	0.338*	0.176 0.648	0.334*	0.160 0.608
Employment status (ref. not employed)										
Free lance contract, or part-time									1.802	0.788 4.119
Full-time									1.264	0.607 2.632
Financial situation (ref. did not lack money to pay for expenses)									0.776	0.407 1.479
Lacked money to pay for expenses									0.936	0.388 2.259

\* $p < 0.05$

<sup>a</sup>Post-secondary institution attended after high school, in Quebec, Canada

characterized by decreased parental control and may lead to a transition into school or workplace settings that are conducive to smoking making young adults particularly susceptible to smoking onset (Gagné and Veenstra 2017; Hammond 2005; Ling and Glantz 2002; O'Loughlin et al. 2014).

### Smoking cessation

Previous studies have shown that low income or poor educational attainment is associated with a lower likelihood of successful cessation in young adults (Bowes et al. 2015; Corsi et al. 2013). In contrast, education and income were not significantly associated with cessation in our sample. However, our results indicated that young adults who reported that half or more of their friends smoked had lower odds of cessation. Similarly, in a systematic review, five out of seven longitudinal studies that examined peer smoking as a predictor of cessation found that having no friends that smoke is positively associated with cessation (Cengelli et al. 2011). Our findings, support our original hypothesis, that having a high proportion of non-smoking peers can facilitate cessation, as non-smoking peers could be providing young adults with information about cessation resources (cessation programs, educational materials, and tricks to cease smoking), the benefits of quitting or being a non-smoker and may also be promoting anti-smoking norms (Curry et al. 2007; Haas and Schaefer 2014).

### Limitations

We can't make any causal claims regarding the association between social characteristics and smoking. Due to our sample size, we were precluded from using several indicators per capital to capture the multidimensional nature of each capital, and to obtain a more precise estimate of their distributions. Finally, using income as an indicator of economic capital has its limitations, as many of the study participants were students and may have still been dependent on their parents' economic resources.

### Conclusion

This study filled an important gap in the literature by examining whether social characteristics during young adulthood may be of consequence for smoking initiation and cessation in young adults. We used a Bourdieusian framework to operationalize young adults' social characteristics through education, income, and peer smoking and their association with becoming a smoker and ceasing to smoke. We found that social and cultural capital influenced young adults' risk of smoking onset but that economic

capital had no significant effect on smoking initiation. Social capital was also associated with cessation. Our results imply that interventions focusing on peer smoking may present promising avenues for tobacco prevention in young adults.

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### Compliance with ethical standards

**Ethics approval** This article does not contain any studies with animals performed by any of the authors. The study was approved by the research Ethics Committee of the Université de Montréal's Faculty of Medicine (11-019-CERFM-D).

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**APPENDIX XIV. Curriculum vitae**

## ***CURRICULUM VITAE***

***Thierry Gagné***

**Address:**

**Phone (work/cell):**

**Email:**

**Web:**

**Twitter:**

### **EDUCATION**

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**Ph.D Public Health** (Health Promotion) (Candidate, 2014-)

Université de Montréal

School of Public Health – Department of Social and Preventive Medicine

Co-advisors: Katherine L. Frohlich, PhD & Amélie Quesnel-Vallée, PhD (McGill University)

**M.Sc Community Health** (2012-2014)

Université de Montréal

Faculty of Medicine – Department of Social and Preventive Medicine

Advisor: Katherine L. Frohlich, PhD

**B.Sc Sociology** (2009-2011)

Université de Montréal

Faculty of Arts and Sciences – Department of Sociology

### **RESEARCH INTERESTS**

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Young adulthood, health inequalities, smoking, quantitative methods, measurement, social theory

### **SCHOLARSHIPS, GRANTS, AND AWARDS**

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2018 - Postdoctoral Scholarship from the Canadian Institutes for Health Research (**\$100,000**)

2018 - Postdoctoral Scholarship from the “Fonds de recherche du Québec – Santé” (**\$110,000**)

2018 - Travel Award from the Canadian Institutes of Health Research (**\$1,000**)

2018 - Travel Award from the Université de Montréal Faculty of Graduate and Postdoctoral Studies (**\$500**)

2017 - Travel Award from the Université de Montréal Public Health Research Institute (**\$800**)

2017 - Publication Award from the Université de Montréal Public Health Research Institute (**\$400**)

2017 - Travel Award from the Canadian Institutes of Health Research (**\$1,500**)

2017 - Scholarship from the Quebec Inter-University Center for Social Statistics (**\$2,000**)

2016 - “Alma Mater” Award from the Uni. de Montréal Faculty of Graduate and Postdoctoral Studies (**\$6,000**)

2016 - Travel Award from the Quebec Ministry of Education (**\$1,500**)

2016 - Mentorship Award from the Canadian Institutes of Health Research (**\$2,500**)

2015 - Travel Award from the Canadian Institutes of Health Research (**\$2,500**)

2015 - “Armand-Frappier” Award from the Department of Social and Preventive Medicine (**\$1,000**)

2015 - Doctoral Scholarship from the “Fonds de recherche du Québec – Santé” (**\$60,000**)

2014 - Doctoral Scholarship from the Université de Montréal Public Health Research Institute (**\$20,000**)

2014 - Doctoral Scholarship from the Department of Social and Preventive Medicine (**\$10,000**)

2014 - Student Project Grant from the Université de Montréal Graduate Student Investment Fund (\$300)  
2013 - “J.-A.-DeSève” Award from the Uni. de Montréal Faculty of Graduate and Postdoctoral Studies (\$5,000)  
2013 - Excellence Award from the Department of Social and Preventive Medicine (\$2,750)  
2012 - Masters Scholarship from the “Fonds de recherche du Québec – Santé” (\$30,000)  
2010 - Award from the “Société Belge de Bienfaisance” (\$1,000)

## **RESEARCH FUNDING**

---

Connecting educational and health researchers to tackle the co-emergence of health and educational inequities at a crucial junction of the life course. Canadian Institutes of Health Research, Canada. (2017, \$10,000). With Véronique Dupéré (PI), Isabelle Archambault, Eric Dion, Alain Lesage, Katherine Frohlich, Luigi de Benedictis.

Comprehending the MEchanisms behind Tobacco cessation in adolescents in the context of assisted decision-making: the COMET project. Institut National du Cancer, France. (2017-2019, €353,413). With Laetitia Minary (PI), François Alla, Nelly Agrinier, Joëlle Kivits, Amandine Vallata, Jennifer O’Loughlin, Marie-Pierre Sylvestre, Katherine Frohlich, Yan Kestens, Benoit Thierry, Pierre Rondier, Linda Cambon.

Exploring the effects of Quebec’s legislation “An Act to Bolster Tobacco Control” on social inequalities in smoking. Canadian Cancer Society Research Institute. (2017-2019, \$194,479). With Katherine Frohlich (PI), Jennifer O’Loughlin, Rebecca Haines-Saah, Kristin Voigt, Josée Lapalme.

## **REVIEWING ACTIVITIES**

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**Guest Editor:** International Journal of Public Health. Special issue on adolescent transitions (2018).

**Reviewer:** Conferences. Canadian Public Health Association; Canadian Tobacco Control Forum; International Union for Health Promotion and Education. Journals. Canadian Journal of Public Health; Social Science & Medicine; Addiction; Nicotine and Tobacco Research; Journal of Health and Social Behaviour; BMC Public Health; Health Sociology Review; European Journal of Public Health; International Journal of Public Health; Ethnicity & Disease; Health Promotion International; Sociology of Health & Illness. Academic. Armand-Frappier Award for Most Promising Masters Student (Social and Preventive Medicine Dept., Université de Montréal).

## **TEACHING ACTIVITIES**

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2018 – *Masterclasses of the Public Health Research Institute* (Université de Montréal)  
Facilitator

2017 – “*Strategies in Health Promotion and Disease Prevention*”  
Teaching Assistant & Guest Lecturer with Louise Potvin, PhD (Université de Montréal)

2014-2015 (three times) – “*Introduction to Biostatistics*” and “*Basic Concepts in Biostatistics*”  
Teaching Assistant & Guest Lecturer with Michèle Rivard, ScD (Université de Montréal)

2011 – “*Introduction to Sociology in Quebec*”  
Teaching Assistant with Yan Sénéchal, PhD (Université de Montréal)

## **RESEARCH INTERNSHIPS**

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2017 – “*RESIST: Réseau Social et Sevrage Tabagique - Social Network and Smoking Cessation*”  
Under Laetitia Minary, PhD – Université de Lorraine, France

2016 – “*Intersectionality and Cardiovascular Health*”  
Under Gerry Veenstra, PhD - University of British Columbia, Canada

2013 – “*CH-X: Swiss Federal Surveys of Adolescents*”  
Under Thomas Abel, PhD - University of Bern, Switzerland

2011 – “*Interdisciplinary Study of Inequalities in Smoking*”  
Under Katherine L. Frohlich, PhD - Université de Montréal, Canada

## **PEER-REVIEWED PUBLICATIONS**

---

**Gagné, T.**, Omorou, A. Y., Kivitz, J., Alla, F., Minary, L. Profil socioéconomique et tabagisme chez les adolescents en Centre de Formation des Apprentis. Accepted in Revue d'Épidémiologie et Santé Publique.

**Gagné, T.**, Ghenadenik, A. E. (2018). Rethinking the relationship between socio-economic status and health: challenging how socio-economic status is currently used in health inequality research. Scandinavian Journal of Public Health; 46(1): 53-56.

Steinmetz-Wood, M., **Gagné, T.**, Sylvestre, M.-P., Frohlich, K.L. (2018). Do social characteristics influence smoking uptake and cessation during young adulthood? International Journal of Public Health; 63(1): 115-123.

**Gagné, T.**, Veenstra, G. (2017). Inequalities in Hypertension and Diabetes in Canada: Intersections between Racial Identity, Gender, and Income. Ethnicity & Disease; 27(4): 371-378.

**Gagné, T.** (2017). Estimating smoking prevalence in Canada: Implications of survey methodology in the CCHS and CTADS. Canadian Journal of Public Health. 108(3): e1-e4.

**Gagné, T.**, Veenstra, G. (2017). Trends in smoking initiation in Canada: Does non-inclusion of young adults in tobacco control strategies represent a missed opportunity? Canadian Journal of Public Health. 108(1):e14-e20

**Gagné, T.**, Lapalme, J., McQueen, D. V. (2017). What is health promotion? A bibliometric analysis of current research. Health Promotion International. DOI: 10.1093/heapro/dax002

Giancaspro, G., **Gagné, T.**, Tampieri, D., Cortes, M. (2017). Inflow Angle of Small Paraophthalmic Aneurysms Is a Determinant of Adjacent Sphenoid Bone Remodeling. Journal of Computer Assisted Tomography.

Caron-Cantin, M., **Gagné, T.** Tampieri, D., Cortes, M. (2017). Radiologist Contribution to Improved Nasogastric Tube Placement for Hospitalize Neurological Patients. Journal of the American College of Radiology.

**Gagné, T.,** Ghenadenik, A, Shareck, M., Frohlich, K.L. (2016). Expected or completed? Comparing two measures of education and their relationship with social inequalities in health among young adults. Social Indicators Research. DOI: 10.1007/s11205-016-1517-9

**Gagné, T.,** Ghenadenik, A, Abel, T., Frohlich, K.L. (2016). Social inequalities in health information seeking among Montreal young adults. Health Promotion International. pii: daw094

**Gagné, T.,** Frohlich, K., Abel, T. (2015). Cultural capital and smoking among young adults: applying indicators in social inequalities in health behaviours. European Journal Public Health; 25(5): 818-823.

Frohlich, K., Shareck, M., Vallée, J., ..., **Gagné, T.** et al. (2017). Cohort Profile: The Interdisciplinary Study of Inequalities in Smoking (ISIS). International Journal of Epidemiology; 46(2): e4.

**Gagné, T.,** Agouri, R., Cantinotti, M., Boubaker, A. & Frohlich, K.L. (2014). How important are paper copies of questionnaires? Testing invitation modes when studying social inequalities in smoking among young adults. International Journal of Public Health; 59(1): 207-210.

#### **PEER-REVIEWED PUBLICATIONS UNDER REVIEW**

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**Gagné, T.,** Steinmetz-Wood, M., Lee, J., Frohlich, KL. A field coming of age? A methodological systematic review of studies on social inequalities in smoking among young adults. Revise and re-submit in Tobacco Control.

**Gagné, T.,** Quesnel-Vallée, A., Frohlich, KL. Considering the Age-Graded Nature of Associations Between Socioeconomic Characteristics and Smoking During the Transition Towards Adulthood. Under review in Preventive Medicine.

#### **LETTERS & COMMENTARIES**

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**Gagné, T.,** Lapalme, J., Leroux, J. (2017). Implications of the professionalization of health promotion in Canada: a response to Graham's Letter to the Editor. Health Promotion & Chronic Disease Prevention in Canada. 37(5): 172-173.

**Gagné, T.,** Lapalme, J. (2017). 1986: Ottawa and onwards. The Lancet Public Health. 2(2): e1.

**Gagné, T.,** Lapalme, J. (2016). On the importance of promoting graduate funding opportunities: A response to CIHR President Alain Beaudet's open letter. Canadian Journal Public Health. 107(2); e218.

**Gagné, T.,** Lapalme, J. (2015). Trashing bibliometry? In defence of a unique approach for disciplinary development. International Journal of Public Health. 60(8): 879-880.

#### **INVITED PRESENTATIONS & TALKS**

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**Gagné, T. &** Lapalme, J. (2018). Exploring the effects of Quebec's legislation "An Act to Bolster Tobacco Control" on social inequalities in smoking. Centre de Recherche du Centre Hospitalier de l'Université de Montréal (CRCHUM), Montreal, Canada.

**Gagné, T.** (2017). *Mieux comprendre les caractéristiques du tabagisme chez les jeunes adultes pour orienter nos actions*. Presentation in the plenary "Regards sur la santé et le bien-être des jeunes québécois âgés entre 15 et 29 ans". Journées Annuelles de Santé Publiques (JASP), Québec, Canada.



Gahagan, J., Knight, R., Machado, S., Irwin, B., Brushett, S., **Gagné, T.**, Stocker, M., Jackson, L., Pederson, A. (2017). Emerging Leaders in Health Promotion in Canada: Future Directions and Contributions in Addressing the Needs of Marginalized Populations. Canadian Public Health Association (CPHA) Annual Conference, Halifax, Canada.

## **PRESENTATIONS & TALKS**

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Tong, Y., Demko, N., **Gagné, T.**, Cortes, M. (2018). Evaluation of Pain Reproduction and other Predictive Factors of Selective Lumbar Nerve Block Efficacy for the Diagnosis and Palliative Treatment of Chronic Low Back Pain: A Retrospective Cohort Study. American Academy of Neurology. Los Angeles, United States.

**Gagné, T.**, Veenstra, G. (2018). Inequalities in Hypertension and Diabetes in Canada: Intersections between Racial Identity, Gender, and Income. European Society for Health and Medical Sociology (ESHMS), Lisbon, Portugal.

**Gagné, T.**, Quesnel-Vallée, A, Frohlich, K. (2018). Uncovering socioeconomic circumstances in the study of social inequalities in health during young adulthood: insights from Bourdieusian and lifecourse theories. European Society for Health and Medical Sociology (ESHMS), Lisbon, Portugal.

**Gagné, T.**, Frohlich, K., Quesnel-Vallée, A. (2018). Challenging the study of health inequalities during young adulthood: smoking in the Canadian National Population Health Survey as a case example. Society for Longitudinal and Lifecourse Studies (SLLS), Milan, Italy.

**Gagné, T.** (2018). Young Adults in Transition: Results from the ISIS Study. Symposium of the Interdisciplinary Study of Inequalities in Smoking, Université de Montréal Public Health Research Institute, Montreal, Canada.

**Gagné, T.**, Quesnel-Vallée, A., Frohlich, K. L. (2017). Towards Understanding Young Adults' Socioeconomic Circumstances In Health Inequality Research: Smoking as a Case Example. American Sociological Association (ASA), Montreal, Canada.

Fortin, R., Martin, T., **Gagné, T.** (2017). Health Promotion Canada: Introducing a consortium to empower health promoters in Canada. Canadian Public Health Association (CPHA), Halifax, Canada.

**Gagné, T.**, Veenstra, G. (2017). Do young adults represent a missed opportunity? Trends in smoking initiation in Canada. Canadian Public Health Association (CPHA), Halifax, Canada. **Nominated for Best Student Presentation Award.**

**Gagné, T.**, Ghenadenik, A., Shareck, M., Frohlich, K.L. (2017). Expected or completed? Comparing two measures of education and their relationship with social inequalities in health among young adults. “Association Francophone pour le Savoir” (ACFAS), Montréal, Canada

**Gagné, T.** (2017). “Les jeunes adultes, une opportunité manquée? Tendances en matière d’initiation tabagique au Canada”. Scientific Seminars of the Université de Montréal Public Health Research Institute, Montreal, Canada

**Gagné, T.**, Lapalme, J., McQueen, D. V. (2016). What is health promotion? A bibliometric analysis of current research. International Union for Health Promotion and Education (IUHPE), Curitiba, Brazil.

**Gagné, T.,** Ghenadenik, A., Abel, T., Frohlich, K. (2016). Health information seeking behaviour among young Canadian adults: examining profiles and their social patterning. International Union for Health Promotion and Education (IUHPE), Curitiba, Brazil.

**Gagné, T.,** Frohlich, K., Abel, T. (2014). Cultural capital and smoking among young adults: exploring indicators in social inequalities in health behaviours. European Society for Health and Medical Sociology (ESHMS), Helsinki, Finland.

**Gagné, T.,** Frohlich, K. (2014). “Exploration d’indicateurs du capital culturel dans l’étude des inégalités sociales liées au tabagisme chez les jeunes adultes”. Canadian Society for Health Sociology, Montréal, Canada.

**Gagné, T.,** Agouri, R., Cantinotti, M., Boubaker, A., Frohlich, K.L. (2013). Testing invitation methods in a study of social inequalities in smoking with young adults: Web versus paper questionnaire administration. Canadian Public Health Association (CPHA), Ottawa, Canada.

**Gagné, T.** (2011). “Le Canada, peu curieux de son orientation sexuelle? Théories et limites dans l’étude de l’orientation sexuelle comme déterminant social de santé”. “Association francophone pour le savoir” (ACFAS), Sherbrooke, Canada.