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Parent-Youth Associations of Physical Activity and the Influence of Family and Neighbourhood Social Factors

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SUMMARY

Objective: To examine the association between parental involvement in their child's physical activity (PA) and child lifestyle behaviours and weight status**.**

Methods: Data were from the 1999 Quebec Child and Adolescent Health and Social Survey, comprising representative samples of youth aged 9, 13, and 16 years. Parental involvement in PA with their child was assessed and measured as both, one, or neither parent engaging in PA with their child ≥once/week, based on parent reports. A 7-day PA recall was used to categorize youth as inactive, moderately-active, or highly-active. Screen time was classified as ≤14 and >14 hours of TV and video viewing/week. Overweight status was defined according to Cole's sex- and age-specific BMI cut-points.

Results: Participants (n=2511) with both parents engaging in PA with them ≥once/week (vs. neither parent) were more likely to be highly-active at ages 13 (OR 3.89, 95% CI: 1.85-8.18) and 16 (OR 3.45, 95% CI: 1.32-9.01), and to report ≤14 hours/week of screen time at age 13 (OR 2.36, 95% CI: 1.30-4.25). No associations were observed for weight status. We examined effect modification in post-hoc analyses; the association between parental involvement and youth PA was present in two-parent households only, while the association between parental involvement and screen time was only present in neighbourhoods perceived to be safe by parents.

Conclusion: Health promotion strategies targeting parental involvement in youth PA may reduce the future burden of chronic disease, given the favorable association of parental involvement with several youth lifestyle behaviours.

Key words: physical activity, screen time, overweight, neighbourhood safety, family structure

RESUMÉ

Objectif: Examiner le lien entre la participation des parents aux activités physiques (AP) de leur enfant et les habitudes de vie et le statut pondéral de ces derniers.

Méthode: Les données proviennent de l'Enquête Sociale et Santé des Enfants et des Adolescent Québécois (1999), comprenant des échantillons représentatifs de jeunes de 9, 13 et 16 ans (n=2511). L'implication des parents est définie par aucun, 1 seul, ou 2 parents faisant de l'AP avec leur enfant ≥1/semaine. Un rappel 7 jours a servi à classer les jeunes selon leur niveau d'AP, soit faible, modéré ou élevé. Le temps d'écran a été défini par: ≤14 vs. >14 heures/semaine. Le statut pondéral a été défini selon les critères de Cole.

Résultats: Lorsque les deux parents participent aux AP du jeune, le niveau d'AP des adolescents de 13 (OR 3.89, IC 95%: 1.85-8.18) et 16 ans (OR 3.45, IC 95%: 1.32-9.01) est davantage élevé, et le temps d'écran moindre (OR 2.36, IC 95%: 1.30-4.25) chez ceux de 13 ans. Des analyses secondaires montrent que le lien entre l'implication des parents et le niveau d'AP des jeunes est présent chez les familles biparentales seulement; le lien avec le temps d'écran est présent dans les quartiers sécuritaires seulement. Aucune association n'est observée pour le statut pondéral.

Conclusion: Les stratégies de promotion de la santé ciblant la participation des parents aux AP de leurs enfants pourraient réduire le fardeau des maladies chroniques, étant donné l'association favorable entre leur implication et les habitudes de vie des jeunes.

Mots clés: activité physique, télévision, statut pondérale, sécurité de voisinage, structure familiale

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List of Abbreviations

BMI	Body mass index
CAD	Coronary artery disease
CI	Confidence interval
CVD	Cardiovascular disease
IQR	Inter-quartile range
OB	Obesity
OR	Odds ratio
OW	Overweight
PA	Physical activity
QCAHSS	Quebec Child and Adolescent Health and Social Survey
SD	Standard deviation
SES	Socioeconomic status
TV	Television

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Chapter 1: Introduction

Cardiovascular disease (CVD) is one of the leading causes of death, morbidity, and disability in the world (Motl, Birnbaum, Kubik & Dishman, 2004). In 2004, an estimated 32% of all deaths in Canada were attributed to cardiovascular disease (Statistics Canada, 2006). Examples of non-modifiable risk factors for cardiovascular disease include age, sex, and family history (El Fakiri, Bruijnzeels & Hoes, 2006), while modifiable risk factors include obesity, hypercholesterolaemia, hypertension (El Fakiri et al., 2006) and lifestyle behaviours, such as physical inactivity and smoking (Janz, Dawson & Mahoney, 2000; Bao, Threefoot & Srinivasan, 1995).

Overweight and obesity during childhood are important risk factors for CVD- and type 2 diabetes-related morbidity and mortality during adulthood (Guo et al., 2000). In the 2004 Canadian Community Health Survey, 26% of youth between the ages of 2 and 17 were overweight, and 8% were obese. Public health officials are concerned since estimates observed over the last three decades show alarming increases in overweight and obesity; for example, the prevalence of overweight doubled from 14% to 29%, and the prevalence of obesity tripled from 3% to 9%, among adolescents 12 to 17 years of age (Shields, 2006).

Childhood is also an important period with respect to the development of lifestyle behaviours (Chen, Matthews & Boyce, 2003); these are likely to carry into adulthood, thereby increasing the risk for CVD (Janz et al., 2000; Bao et al., 1995; Guo et al., 2000). Clearly, there is a need to develop effective prevention programs that target children and adolescents. In order to inform the development of such prevention efforts, further research is required to better understand the underlying factors that contribute to the development of lifestyle behaviours associated with childhood overweight and obesity, and subsequent CVD risk in adulthood.

There is a vast body of literature available investigating the correlates of youth physical activity (Sallis, Owen & Fotheringham, 2000a). Positive associations between parents' and children's physical activity levels have been observed in approximately one-third of studies (Sallis, Prochaska & Taylor, 2000b). While it is clear that parents contribute to the development of youth lifestyle behaviours, the mechanisms which affect parental influence on youth lifestyle behaviours remain less understood (Taylor, Baranowski & Sallis, 1994; Prochaska, Rodgers & Sallis, 2002). Few studies have investigated the influence of parental involvement in youth physical activity and how it relates to a range of lifestyle behaviours in their child. The aim of this thesis is to explore associations between parental involvement in youth physical activity and youth lifestyle behaviours. This aim will be addressed using three representative samples of Quebec youth aged 9, 13 and 16. Further, the role of family and neighbourhood contexts will be explored, in order to develop a better understanding of circumstances in youth's immediate and broader environment relevant to behavioural risk factors. Knowledge derived from this thesis could help inform the development of health promotion interventions aimed at improving youth lifestyle behaviours, ultimately decreasing risk for adulthood chronic disease.

Chapter 2: Literature Review

2.1 Definitions of Physical Activity-Related Concepts

The terms *physical activity* and *exercise* have been used interchangeably in the past. For the purposes of clarity and consistency, these terms will be defined uniquely. Physical activity is defined as any form of movement by the skeletal muscles resulting in energy expenditure, usually described in kilojoules or kilocalories (Caspersen, Powell & Christenson, 1985; Weinsier, Hunter, Heini, Goran & Sell, 1998). Physical activity includes a broad range of light, moderate, or vigorous intensity activities, including occupational, sports, conditioning, household chores, and more (Caspersen et al., 1985). Energy expenditure refers to the amount of energy used during physical activity or bodily movement produced by the skeletal muscles (Leibel, Rosenbaum & Hirsch, 1995; Caspersen et al., 1985). Energy expenditure depends on several factors including, the degree of movement by muscle mass, and the intensity, duration, and frequency of muscle contractions (Caspersen et al., 1985).

Physical activity is often categorized into 'structured and unstructured' activities. Structured physical activities include conditioning exercises, recreational sports, competitive sports, or organized sport programs and tournaments, and typically occur in 'permanent' physical activity settings (gymnasiums, sports fields, swimming pools, etc) (Caspersen et al., 1985). Unstructured physical activity typically involves utilitarian, leisure, and recreational activities which usually take place in non-physical activity settings, for example daily walking, household chores such as repairs, gardening, and cleaning (Caspersen et al., 1985; Duncan, Spence & Mummery, 2005).

2.2 Measurement of Physical Activity

Physical activity is a complex behaviour measured using a variety of different methods. Devices used to provide direct, objective measures of physical activity include pedometers and accelerometers (Schmidt, Cleland, Thomson, Dwyer & Venn, 2008). An advantage of using pedometers to measure physical activity is their

ability to account for low-intensity physical activities such as walking and incidental activity, which may be difficult to quantify using traditional surveying methods (Shephard, 2003). Accelerometers allow researchers to assess the intensity of physical activity, however due to cost limitations; their use is uncommon in large population studies (Schmidt et al., 2008).

Self-report measures of physical activity typically include diaries, logs and recall questionnaires (Caspersen et al., 1985), and are traditionally used in population-based epidemiological studies due to their cost-effective nature and ability to describe the frequency, intensity, duration, and type of physical activity (Sallis & Saelens, 2000). A disadvantage of self-report measures is their susceptibility to risk of recall and reporting biases (Sallis & Saelens, 2000; Adams et al., 2005). Further, self-report measures often do not take into account unstructured physical activities (Sallis & Saelens, 2000). Although self-report methods rely on individual responses, they are considered useful when assessing physical activity patterns in national surveys, providing a foundation for physical activity-related research (Sirard & Pate, 2001). Some of the more common self-report methods used to measure physical activity include Sallis and colleagues' 7-day recall, the Godin-Shephard survey, and Weston and colleagues' Previous Day Physical Activity Recall (PDPAR). Wallace and McKenzie (1985) found 75% agreement with Sallis and colleagues' 7-day recall and objective direct observational methods. The Godin-Shephard Survey had a strong 2-week test re-test reliability (r= 0.81) (Sallis, Buono, Roby, Micale & Nelson, 1993a). Weston and colleagues (1997) found the PDPAR to have positive associations with pedometers (r=0.77) and accelerometers (r= 0.88) in a sample of 8th and 11th grade youth.

2.3 Importance of Physical Activity

In 1995, an estimated 10.3% of all deaths among Canadian adults over the age 20 were due to causes attributed to physical inactivity, including coronary artery disease (CAD), stroke, colon cancer, breast cancer, and type 2 diabetes, with 35.8% of CAD-associated deaths attributed to physical inactivity (Katzmarzyk, Gledhill &

Shephard, 2000). Apart from its association with chronic disease and premature death, physical inactivity in Canada has created a profound burden on the Canadian economic system. In 1999, $2.1 billion (2.5%) of direct health care expenditures were attributed to physical inactivity (Katzmarzyk et al., 2000). It has been estimated that reducing physical inactivity 10% annually would consequently result in savings of nearly $150 million in direct health care costs (Katzmarzyk et al., 2000). Reducing physical inactivity is believed to have great potential in reducing the risk for chronic diseases and is a public health priority (Katzmarzyk et al., 2000).

2.4 Physical Activity Prevalence

According to the 2010 *Report Card on Physical Activity for Children and Youth*, which uses data from the Canadian Fitness and Lifestyle Research Institute's Canadian Physical Activity Levels Among study, only 12% of youth between the ages of 6 and 14 meet the recommended 90 minutes of moderate-to-vigorous PA per day (Active Healthy Kids Canada, 2010). Various recent surveys in youth have estimated the prevalence of physical activity, and are summarized in the 2009 *Report Card on Physical Activity for Children and Youth*. For instance, findings from the 2007 Canadian Community Health Survey indicate that 51% of youth between the ages of 12 and 17 are active based on calculations of daily energy expenditure; equivalent to 60 minutes of walking every day. Declines in sport participation were found, between 1992 and 2005 in the General Social Survey, from 77% to 59%, respectively (Active Healthy Kids Canada, 2009). The situation in adults is even worse, as an estimated 62% of Canadians are considered to be physically inactive (Katzmarzyk et al., 2000); while only 34% of Canadians aged 25 to 55 meet the requirements of the *Canada's Physical Activity Guide to Healthy Active Living*, which recommends 20 to 30 minutes of vigorous physical activity 4 to 7 days a week.

2.5 Determinants of Physical Activity

This section reviews determinants and influences of physical activity in children and adolescents, including patterns and preferences; genetic heritability; psychosocial factors; family influences; socio-demographic circumstances; and

neighbourhood features. Although parental involvement is the main focus of this thesis, these other major determinants will be briefly addressed in the following sections.

2.5.1 Gender as a determinant of physical activity patterns and preferences

Gender differences in physical activity patterns are apparent in early childhood (Purslow, Hill, Saxton, Corder & Wardle, 2008). According to findings from a recent national survey, gender gaps in physical activity levels were found among boys and girls aged 12-19, with 54.6% of boys and 39.5% of girls being classified as active (Statistics Canada, 2003). Similarly, in a population-based sample of students grades 1-12, researchers found that boys consistently engaged in greater moderate- and vigorous-physical activity compared to girls; furthermore, physical activity levels decreased with the grade-level of students (Trost et al., 2001).

Research suggests that beliefs and attitudes about physical activity differs by gender, and are also reflective of differences in physical activity preferences, socialization processes, and attitudes. Boys show greater preference for moderate and vigorous activities, and are therefore more likely to engage in organized and team sports (Purslow et al., 2008; Vilhjalmsson & Kristjansdottir, 2003). In contrast, girls tend to show greater preference for non-competitive, cooperative activities and sports (Rohm-Young et al., 2006). Boys tend to place greater value on personal recognition, achievement, and competition, while girls tend to view themselves as less athletic and competitive (Vilhjalmsson & Kristjansdottir, 2003; Grieser et al., 2006).

It has been suggested that organized activities during physical education (PE) classes are likely to be more geared toward boys due to their competitive and strenuous nature, suggesting a gender bias in enrolment, and in the organization and of physical activity programs. Often such activities are associated with more masculine identities (Vilhjalmsson & Kristjansdottir, 2003). In a study by Grieser and colleagues (2006), the majority of girls associated physically activity with staying in shape, and having a strong, healthy, attractive body. Other benefits girls associate

with physical activity include socializing opportunities and a sense of being part of a team. There are several negative aspects commonly associated with physical activity among girls as well, with the most common being fear of injury. Others include physical discomfort, due to sweating, fatigue, and shortness of breath (Grieser et al., 2006). Compared to boys, girls tend to report more negative PE experiences, including feelings of incompetence, embarrassment, being negatively evaluated, not having enough choice in selecting activities, and generally having fewer opportunities for physical activity participation (Coakley & White, 1992). Girls are therefore more likely than boys to withdraw from organized sport programs (Vilhjalmsson & Kristjansdottir, 2003).

2.5.2 Genetic contributions

Levels of physical activity can vary substantially between children. Although psychosocial and environmental covariates play a role in explaining these differences, some researchers have used a genetic epidemiological framework to examine this variation (Maia, Thomis & Beunen, 2002). The underlying assumption in this framework suggests that not everyone is equally predisposed to engage in physical activity, due to differences in muscle fiber types and metabolic characteristics, which in turn affect oxidative capacity and exercise tolerance (Maia et al., 2002; Weinsier et al., 1998). This hypothesis was tested using family data, where researchers investigated commonalities between family members. Such parent-child or sibling correlations are suggestive of cultural and genetic contributions. However, twin studies provide support for genetic heritability (Maia et al., 2002; Pérusse et al., 1988).

Pérusse and colleagues (1988) were among the first to investigate this theory, and found that there were family resemblances across two indicators of physical activity, namely, the level of habitual physical activity, and leisure-time energy expenditure. Particularly among siblings, related (full siblings, monozygotic and dizygotic twins) and unrelated (blended-families), there is a significant degree of family resemblance. However, questions have been raised as to whether these

correlations are reflective of shared environmental factors. Maia and colleagues (2002) explored the effect of genetic contribution among family members, including dizygotic and monozygotic twins, by studying correlations between sports participation, as well as leisure-time physical activity participation. The correlation coefficients between monozygotic pairs were nearly double in comparison to dizygotic pairs, suggesting that genetic factors accounted at least in part for variation in sports participation and leisure-time physical activity (Maia et al., 2002).

2.5.3 Psychosocial determinants of physical activity

Traditionally, most research has focused on individual determinants of health behaviours. Certain personality characteristics have been linked to higher physical activity participation, namely, self-confidence, independence, motivation, achievement, and self-efficacy (Reynolds et al., 1990; Ferguson, Yesalis, Promrehn & Kirkpatrick, 1989). However, understanding the mechanisms involved in the adoption of physical activity is complex. Feelings of self-efficacy and health beliefs are important psychosocial factors to consider when studying physical activity behaviour. Self-efficacy is described as one's belief that one is able to achieve a desired behaviour, in this case, physical activity, while overcoming obstacles and previous negative experiences (Bandura, 1977). Self-efficacy beliefs are therefore an important correlate of physical activity, even when confronted by barriers to physical activity; increasing one's motivation to live a physically active lifestyle (Strauss, Rodzilsky, Burack & Colin, 2001). Although not as strong a correlate as self-efficacy, the adoption of physical activity behaviours is also partially influenced by health beliefs, individuals are more likely to be physically active if they believe it is beneficial to their health (Sallis et al., 1986; O'Connell, Price, Roberts, Jurs & McKinley, 1985).

2.5.4 Parental influence and physical activity

Parents can influence youth levels of physical activity at multiple levels; through these include parental support and encouragement, modeling of health behaviours, through logistical support of physical activity (e.g. by providing

transportation, enrolling youth in recreational sports and related activities), and by engaging in physical activity with youth (Sallis et al., 2000b; Wagner, Klein-Platat, Arveiler, Haan & Simon, 2004).

The Social Cognitive Theory of Behaviour emphasizes the importance of reinforcement and model learning from parents and significant others (Anderrsen & Wold, 1992). Peers and family members are important influences; when children and adolescents have someone who thinks they should be active and encourages physical activity, or has someone to be active with, they are more likely to engage in physical activity themselves (Strauss et al., 2001). Parents' attitudes and beliefs concerning physical activity are important factors in shaping children and adolescents' self-efficacy beliefs (Trost et al., 2003). It has been hypothesized that parents who do not emphasize the benefits of physical activity, nor demonstrate positive outlooks on physical activity, may be unsuccessful in educating children and adolescents about the importance of maintaining a healthy lifestyle. This may increase the risk of physical inactivity and obesity. Families with poor psychosocial adjustment are likely to experience greater difficulty in maintaining a healthy lifestyle (Myers, Raynor & Epstein, 1998). Parents who manifest greater symptoms of psychosocial stress are more likely to withdraw from parent-child interactions (Myers et al., 1998).

In their study, Wagner and colleagues found that when both parents are involved in physical activity, a child is more likely to engage in physical activity outside of school. However, in situations where only one parent is involved in physical activity, the parent-child association for physical activity is more evident among active mothers and daughters, while there is a weaker effect between active fathers and sons. Wagner and colleagues (2004) explain the correlation between mothers and daughters physical activity as a result of different socialization processes, as girls appear to be more responsive to social influences compared to boys. Fogelholm and colleagues (1999) found that the relationship between parent and youth physical inactivity was even greater than parent-youth correlates of physical activity. Nelson and Gordon-Larsen (2006) found that youth who actively

engage in school-based physical activity and use recreational centres are provided with positive behavioural and social experiences, such as being surrounded by favourable role-models, better opportunities for social development, teamwork, and problem-solving.

2.5.5 Socioeconomic influences of physical activity

Traditional indicators of socioeconomic status include education, income, and occupation, and tend to be reflective of social status (Adler & Ostrove, 2006). These indicators of socioeconomic status are generally considered to be interrelated (Adler & Ostrove, 2006). An additional measure, such as the number of parents living in the household is commonly used as an indicator of family social structure, which also may be related to lifestyle behaviours and associated outcomes (Wagner et al., 2004).

In a representative study of Canadian youth from the Health Behavior in School-Aged Children (HBSC) study, Janssen and colleagues (2006) found that low material wealth was associated with greater physical inactivity. Similarly, Wagner and colleagues (2004) found that participation in physical activity was associated with higher parental education, in a population-based sample of 12-year old French students. Overall, living in favourable socio-economic environments, has been found to be correlated with greater interpersonal relationships and family cohesiveness, resulting in children being more likely to be involved in recreational activities and sports (Camargo, Weiss, Zhang, Willett & Speizer, 1999; Ebbeling, Pawlak & Ludwig, 2002).

2.5.6 Neighbourhood and built environmental influences of physical activity

Studies focusing on the impact of the neighbourhood physical activity patterns have examined determinants in children and adolescents' residential and community surroundings. Attention has been paid to school and community sports, perceived environment, recreational spaces, and exercise opportunities (Gordon-Larsen, McMurray & Popkin; 2000). In a nationally representative study by Parks and colleagues (2003), there was evidence for differences in physical activity levels

according to area-level income, with low-income residents being less likely to meet the recommendations for regular physical activity. Residents from low-income communities were more likely to perceive personal barriers, specifically reports of poor health, fear of injury, and social support (Parks, Housemann & Brownson, 2003). Although income, education, and occupation are considered to be indicators of socioeconomic status at the individual-level, studies have shown that living in areas with greater social inequalities has important implications for health outcomes, specifically morbidity and mortality (Adler & Ostrove, 2006).

High-minority, low-education neighbourhoods may be more disadvantaged due to limited access to physical activity resources, in that neighbourhoods with these sociodemographic characteristics tend to have fewer public facilities, youth organizations, parks, YMCAs, and schools (Gordon-Larsen, Nelson, Page & Popkin, 2006). Neighbourhood characteristics positively correlated with greater physical activity levels include access to indoor and outdoor gyms, presence of sidewalks, parks, more traffic, attractive scenery, and greater population density (Brownson, Baker, Housemann, Brennan & Bacak, 2001; Nelson, Gordon-Larsen, Song & Popkin, 2006). These elements are more likely to be found in urban areas, which typically are more heterogenous and have greater land-use mix (Mobley et al., 2006). On the other hand, rural areas tend to be more homogeneous and generally longer commutes are required due to greater distances between destinations, resulting in increased time spent in cars, and less use of active transport (Mobley et al., 2006). These findings are further supported by Parks and colleagues (2003), who found residents of rural communities to be the least active. Research by Handy (2004), suggests that the relationship between neighbourhood characteristics and physical activity differs between children and adults. Cul-de-sac neighbourhoods, commonly found in suburban neighbourhoods, tend to favour physical activity among youth, in part due to do greater aesthetics, proximity to playgrounds, thus promoting outdoor play. Among adults however, neighbourhood features which promote travel behaviour such as walking and biking, tend to favour physical activity. Such features

include shorter distances, greater connectivity, and presence of sidewalks (Handy, 2004).

Some studies have investigated the relationship between parental perception of neighbourhood safety and physical activity in youth. Perception of neighbourhood features and characteristics is believed to play an influential role in children and adolescent engagement in unstructured physical activity, which includes walking, bicycling, etc (Weir, Etelson & Brand, 2006). In inner-city communities, crime rates and traffic safety are of considerably higher concern compared to rural and suburban communities, possibly causing parental concern and anxiety in regard to children's safety, limiting outdoor sport and recreational activities (Weir et al., 2006). Furthermore, parents may even discourage activities such as walking to school, showing preference for vehicles as a primary mode of transportation. Consequently, children may be more likely to develop increased reliance on motor transport, affecting lifestyle habits in adulthood (Timperio, Crawford, Telford & Salmon, 2004). Other studies have suggested that parental perceptions of unsafe neighbourhoods increases the number of hours spent watching television, perhaps encouraging sedentary behaviours (Burdette & Whitaker, 2005).

2.6 Sedentary Behaviour

Sedentary behaviours are activities of low-intensity, and generally include pursuits such as television viewing, reading, computer use, or talking on the phone (Ainsworth et al., 1993). Typically, assessment of sedentary pursuits relies on child or parent reported tools, such as questionnaires (Must & Tybor, 2005; Bradley, McMurray, Harrell & Deng, 2000).

2.7 Prevalence of Sedentary Behaviour

The 2010 *Report on Physical Activity for Children and Youth* includes recent estimates of screen time (i.e.: television viewing, playing computer/video games), a commonly-used indicator of sedentary behaviour among Canadian children and youth. According to the Report, data from the 2005-2006 Health Behaviour in

School-aged Children (HBSC) survey suggests that Canadian youth are engaging in nearly 6 hours of screen time per weekday, and more than 7 hours on weekend days; only 10% of Canadian children adhered to guidelines recommending less than 2 hours of screen time daily.

2.8 Correlates and Consequences of Sedentary Behaviour

It is widely believed that televising viewing and other screen use is at least partly responsible for trends of increasing obesity (Gortmaker et al., 1996). According to findings from the National Longitudinal Survey of Youth and Children (1994), which includes a nationally representative sample of Canadian children between 7 to 11 years of age, television viewing and video game use for more than 2 hours per day was associated with increased prevalence of overweight (17%-44%), while more than 3 hours is a risk factors for obesity (10%-61%) (Tremblay & Willms, 2003).

Television viewing is considered to adversely affect weight status in part by displacing physical activity and by exposing viewers to stimuli that trigger greater food consumption (Tremblay & Willms, 2003). Food advertisements on television often call attention to products high in trans and saturated fats, and with a higher glycemic index (Ebbeling et al., 2002). Because the media plays a role in shaping attitudes, excessive exposure to television advertisements may result in children having a greater preference for unhealthy products seen on television. Children have been shown to develop false beliefs about the relationship between unhealthy products and their nutritional value with weight (Vandewater, Shim & Caplovitz, 2004).

Excessive television viewing, computer, and internet use may also lead to sleep disturbances (Taheri, 2006). Most television viewing by children is carried out close to bedtime (Owens et al., 1999). Sleep is known to be important for physiological and psychological health; however sleep loss has potential consequences on the body's metabolic hormonal functioning, and is associated with

lower leptin and greater ghrelin levels, hormones affecting appetite and energy expenditure (Taheri, Lin, Austin, Young, & Mignot, 2004; Taheri, 2006). Common changes include increased appetite and desire for energy-dense foods (Taheri et al., 2004).

Longitudinal tracking of physical activity and sedentary behaviour shows that as sedentary behaviours begin to emerge, physical activity decreases; this suggests that physical activities are being displaced by more sedentary alternatives such as television viewing (Brodersen, Steptoe, Williamson & Wardle, 2005). Similarly, although these lifestyle behaviours are likely different constructs, they can share similar social and environmental influences (Schmitz et al., 2002).

2.8.1 Gender and age determinants of sedentary behaviour

According to the Canadian Community Health Survey (2004) the proportions of youth between the ages of 12 and 17 years engaging in sedentary pursuits for an estimated 30 or more hours per week are 30% and 18% in boys and girls, respectively. Sedentary pursuits were defined based on screen time, i.e. time spent television viewing, playing video games, and using computers (Statistics Canada, 2004). Some researchers believe that gender differences are largely explained by the greater preference for video games and computer use in boys (Marshall, Gorely & Biddle, 2006).

In a nationally representative study of American children, there was a positive correlation between age and time spent in sedentary pursuits. Children between the ages of 2 and 7 years were found to spend an average of 2.5 hours per day watching television and videos, while children between the ages of 8 to 18 spend an average of 4.5 hours of television per day (Robinson, 2001). In a longitudinal study by Bradley and colleagues (2000), increases in sedentary behaviour were reported over a 6-year period among boys and girls aged 8-11 years at baseline. Preferences for types of sedentary pursuits differed, with boys reporting greater interest in television viewing, at times choosing television viewing over sporting activities. For girls, television

viewing decreased slightly over time; instead, girls were more engaged in sedentary activities such as talking on the phone (Bradley, McMurray, Harrell & Deng, 2000). According to findings from the Muscatine study by Janz and colleagues (2000), boys who were classified in the highest tertile of screen time, were nearly twice as likely to be classified as sedentary at 5-year follow-up, suggesting that sedentary behaviours are more stable in boys, compared to girls (Janz et al., 2000).

2.8.2 Parental influence and sedentary behaviour

Although there is a large body of literature on the individual, psychosocial, and behavioural determinants of sedentary behaviour, the focus of this thesis is parental influences of physical activity, sedentary behaviour, and weight status. Lifestyle behaviours are important targets during adolescence to improve long-term health outcomes (Mark & Janssen, 2008).

The influence of parents on sedentary behaviour has become a key area of interest. Research has shown that parental involvement in sports is associated with favourable health and well-being in their children, such as excess television viewing, poor school performance, and self-esteem (Nelson & Gordon-Larsen, 2006). Parent overweight correlates with infrequent participation in physical activity, promoting sedentary behaviour, and greater risk for overweight among youth (Wagner et al., 2004). Similarly, there have been strong associations between parent and children's sedentary behaviours; when both parents spent more than two hours per day watching television; children are more likely to be sedentary (Wagner et al., 2004).

Having televisions in their bedroom increases the number of hours per week spent watching television in children and adolescents (Gentile & Walsh, 2002; Tremblay & Willms, 2003). In such situations, imposing and maintaining rules may be difficult, as most children and adolescents watch television without a parent present resulting in poor monitoring of sedentary activity (Gentile & Walsh, 2002). Further, the relationship between family interactions and television use has been considered bidirectional; in that television use influences and is influenced by family

interactions, for example, less verbal communication between family members when watching television (National Institute of Mental Health, 1982).

2.8.3 Socioeconomic factors and sedentary behaviour

Family rules concerning the television viewing may be related to family structure (i.e.: single-parent vs. dual-parent families; number of siblings) along with several other variables such as parents' employment status, the child's age and gender, and the number of TV's in the home (Gentile & Walsh, 2002; Dorr & Rabin, 1995; Lin & Atkin, 1989). These effects are generally stronger among younger primary-school children. Furthermore, when both parents have less than a high school education, sedentary behaviours tend to be greater in youth, while parental completion of a college diploma is associated with youth spending less time in sedentary activity (Schmitz et al., 2002). In terms of family structure, time spent in front of screens is greater among children from single-parent families compared with children living in dual-parent families (Hesketh, Crawford & Salmon, 2006; Brodersen et al., 2005).

2.8.4 Neighbourhood and built environmental influences of sedentary behaviour

Many studies have focused on the relationships between neighbourhood perceptions and physical activity, especially active transportation; however, fewer studies have investigated the influence of neighbourhoods on sedentary behaviour. Researchers have hypothesized that poor opportunities for active travel, unattractive neighbourhood scenery, and poor perceived safety in the neighbourhood may encourage sedentary behaviour (Mota et al., 2007; Evenson, Scott, Cohen & Voorhees, 2007). According to a study involving 20 US cities, mothers' adverse perceptions of neighbourhood safety was associated with a greater number of hours spent in television viewing. TV viewing time increased by an estimated two hours per week among children in neighbourhoods perceived as unsafe (Burdette & Whitaker, 2005).

Individual and environmental influences of lifestyle behaviours are quite complex; there are likely interactions between various influences that change as children age. For example, individual factors such as peers and family social support tend to equally affect boys and girls (Anderssen & Wold, 1992; Duncan, Duncan & Strycker, 2005); however this dynamic is believed to change with age. Environmental factors, including neighbourhood characteristics such as resources and opportunities for physical activity appear to affect girls (Hume, Salmon & Ball, 2005); while physical characteristics of the school environment seem to influence boys to a greater extent (Sallis et al., 2001; McKenzie, Marshall, Sallis & Conway, 2000).

2.9 Summary

Because lifestyle behaviours are established during childhood (Raitakari et al., 1994), effective prevention practices that target healthy behaviours in children and adolescents are necessary. To inform the development of such prevention efforts, further research is needed to develop a better understanding of family and neighbourhood circumstances that affect youth lifestyle behaviours and health outcomes.

2.10 Objectives

Despite a large body of literature investigating the correlates of youth lifestyle behaviours, the extent to which parental support can influence youth lifestyle behaviours and the contexts that support such relationships, is poorly understood (Taylor et al., 1994; Prochaska et al., 2002). The main purpose of this thesis is to investigate the association between parental involvement in their child's physical activity and the following behavioural and outcomes in youth, notably levels of physical activity, sedentary behaviour, and weight status. As a secondary objective, the extent to which family structure and neighbourhood safety influence these main associations will be examined. These objectives were addressed with the expectation of providing further insight about possible targets for intervention in the youth's immediate and broader environments that can favourably influence health behaviours and related outcomes.

Chapter 3: Conceptual Model

Determinants of lifestyle behaviours are multifactorial, with wide ranging influences including physiological, psychological, cognitive, demographic, cultural, social, and environmental (Humpel, Owen & Leslie, 2002; Silver-Wallace, Buckworth, Kirby & Sherman, 2000). However, social and environmental factors are population-wide influences, and are generally favoured for the development of population-based health promotion programs (Humpel et al., 2002; Silver-Wallace et al., 2000). The purpose of this section is to introduce ecological models of health, which propose that health behaviours are determined by the interaction between individual factors and the environmental contexts in which health behaviours occur.

3.1 Social Cognitive Theory

The premise of Bandura's Social Cognitive Theory (SCT), is that social and environmental factors serve as important influences on behaviour as they provide feedback for behaviours, opportunities, and consequences of our actions, shaping individual behavioural constructs such as self-motivation, self-efficacy, expectations of health outcomes, and personal skills (Bandura, 2001; Booth, Owen, Bauman, Clavisi & Leslie, 2000). The extent to which these social and environmental factors exert influence varies according to different contextual or situational factors, such as social support, family and peer influences, and access to resources (Humpel et al., 2002; Booth et al., 2000).

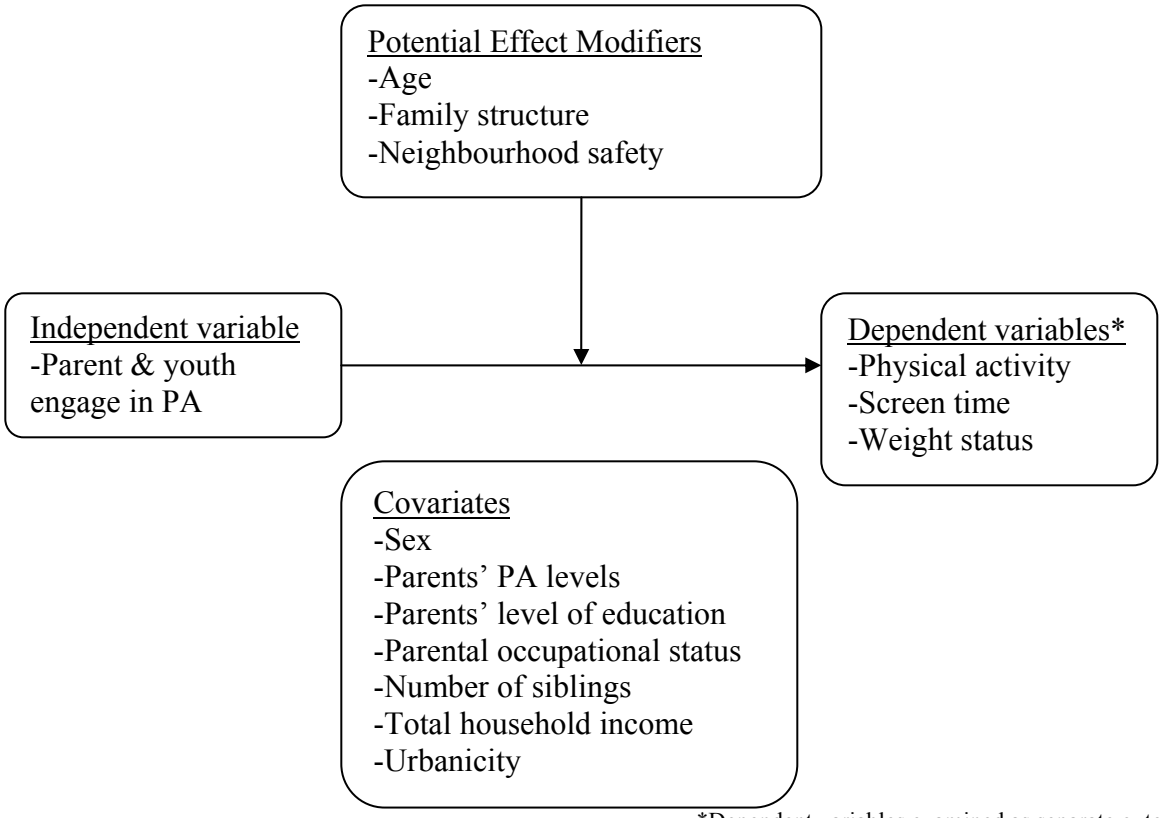
The fundamentals of SCT include humans' ability to learn through observation and modeling; as well as to self-regulate, to anticipate expected outcomes of behaviour (Bandura, 2001). Outcome expectations are constructed based on observed relations between socio-environmental cues and the results that given actions produce, affecting the sense of self-efficacy (Bandura, 2001). A greater sense of self-efficacy leads individuals to perceive their environment favourably, even when presented with challenges and limitations, allowing them to better adapt to their environment. As a result, individuals are able to self-direct themselves to realistically

adopt goals and set courses of action, producing favourable outcomes (Bandura, 2001).

In Social Cognitive Theory, there is great emphasis placed on developing social, intellectual, and behavioural competencies, which primarily occur through modeling (Bandura, 1988). Observation models may be parents, peers, teachers, and the media. Through the modeling process, observers learn rules and strategies about dealing with different situations. Modeling is most likely to be successful when individuals perceive a sense of similarity to role models, emphasizing the quality and importance of relationships with those in the immediate social environment (Bandura, 1988). When models are effective, individuals are more likely to adopt the model's strategies and skills. Environmental conditions are important in that they provide opportunity for individuals to apply and learn skills, and to develop greater self-competence (Bandura, 1988).

Using the principles of Social Cognitive Theory (SCT), Sallis and Hovell (1990) created a social cognitive model of physical activity behaviour. This model uses an ecological approach to explain health behaviour, focusing on the role of the environment and its bidirectional relationship with different behavioural constructs, which are shaped by social and organizational influences surrounding them (Humpel et al., 2002; Bandura, 1988). Ecological models assume that socio-environmental variables do not independently explain lifestyle behaviours (Sallis, Bauman & Pratt, 1998). Instead, it is the interaction of multiple behaviour determinants including, intrapersonal (biological, psychological), interpersonal (family, peers), and institutional and community (access to facilities, social networks). Using an ecological model allows researchers to explore these influences, and the underlying reasons why physical activity is encouraged and promoted in some environments, and less favoured in others (Sallis et al., 1998).

3.2 Conceptual Framework



*Dependent variables examined as separate outcomes

This model seeks to explore the effects of parental involvement in their child's PA on youth lifestyle behaviours and outcomes. The frequency in which parents engage in physical activity with their child is reflective of certain family dynamics, such as healthier parent-child relationships, family support, and cohesiveness (Camargo et al., 1999; Ebbeling et al., 2002). Moreover, the extent to which the main exposure, parental involvement in youth physical activity, is associated with the dependent variables, i.e. youth lifestyle behaviours, may vary according to other factors; this thesis explores 3 such factors, notably child's age, family structure, and neighbourhood safety.

Chapter 4: Methodology

4.1 Study Design

The present study is a secondary analysis of data from the 1999 Quebec Children and Adolescent Health and Social Survey (QCAHSS). The study was a cross-sectional, multi-stage, stratified, cluster sampling survey of Quebec youth, and was initiated by the Institut de la statistique du Québec, in collaboration with experts from the field of health and social services, regional public health departments, and university researchers (Aubin et al., 2003; Paradis et al., 2003). The main goal of the QCAHSS was to develop a better understanding of the health and social well-being among youth; the survey also assessed the presence of cardiovascular risk factors, related lifestyle behaviours, and their underlying determinants, including various genetic and environmental factors (Paradis et al., 2003).

4.2 Sample

The QCAHSS study comprises provincially representative samples of children and adolescents aged 9, 13, and 16 years. These ages were purposefully selected to allow comparisons between groups of pre-pubescent, pubescent, and post-pubescent youth, respectively (Aubin et al., 2002). Exclusion criteria included students enrolled in native schools, federal government schools, schools located in remote locations (for example- Natashquan, Beaucanton, l'Ile d'Anticosti), and schools where more than 50% of the student population suffer from a form of handicap or disability. Due to logistical complications, the Nord-du-Quebec region was also excluded. The sample therefore was representative of 97% of children and adolescents aged 9, 13, and 16, living in Quebec (Aubin et al., 2002; Paradis et al., 2003).

The recruitment process began once records of all Quebec schools were obtained from the Ministry of Education, which included student information from the 1998-1999 academic year. The schools were divided into two categories; the first including all schools located in outlying administrative regions of Quebec (Bas-Saint-Laurent, Côte-Nord, Abitibi-Témiscamingue, and Gaspésie- Îles-de-la-Madeleine), and the second including all schools belonging to all other administrative regions

(Paradis et al., 2003; Aubin et al., 2002). Due to barriers related to logistics and to cost, only two of the outlying administrative regions, were chosen at random for data collection (Paradis et al., 2003). Schools were again subdivided according to language of instruction, then by private or public system, and finally by geographic zone (Aubin et al., 2002).

In all, an estimated 1500 subjects were selected for each age group, with an expected response proportion of 80% in each age group. For each age group, 60 schools were randomly chosen. Children and adolescents aged 9, 13, and 16, were then identified in each school, and stratified by gender; approximately 25 children or adolescents per age group were randomly selected per school (Paradis et al., 2003). Although 13-year olds were mostly chosen from high schools, some attended elementary schools and were therefore selected from the same elementary schools as 9-year olds (Paradis et al., 2003). At the time of the survey, approximately 5% of 16-year olds in Quebec were high school drop-outs. Therefore, a random sample of 16-year olds not currently attending school was selected in order to represent those not attending high school. However, they participated in the questionnaire portion of the survey only (Paradis et al., 2003).

Schools were approached using a system which was developed in collaboration with the Ministry of Education. Regional school directors, school boards, and private schools received pamphlets containing information about the study (Aubin et al., 2002). Schools were contacted by mail in fall 1998, and phone calls were made to principals to discuss participation and to schedule data collection appointments (Aubin et al., 2002).

4.3 Data Collection Instruments and Measures

The QCAHSS questionnaires were developed by the Direction de Santé Publique, experts in the field of health and social services, and university researchers. The child and adolescent questionnaires were derived in part from the Enquête longitudinale sur les enfants (1995) (Deschesnes, 1992; Deschesnes & Schaefer,

1997; Cloutier, Champoux & Jacques, 1994; Loiselle, 1999) (Aubin et al., 2002). Questions in the QCAHSS included demographic characteristics, personal well-being in school, social support, family relationships, self-image, lifestyle behaviours, cultural factors and practices, changes associated with puberty, health problems, risk behaviours associated with sexuality and motor vehicles, and finally, the use of medication, health and social services (Aubin et al., 2002).

The parent questionnaire was derived from the Enquête sociale de santé (1998) (Daveluy, Pica, Audet, Courtemanche & Lapointe, 2000) and the Enquête longitudinale sur les enfants (1995) (Human Resources Development and Statistics Canada, 1995). This questionnaire assessed individual and social factors including health status and lifestyle behaviours, neighbourhood perceptions, socio-economic characteristics, as well as items pertaining to the child participating in the study on child health, the family and school environment, and academic progress (Aubin et al., 2002).

Data collection occurred from January to May 1999. A week prior to the school visits, the researchers, and data collectors sent all the materials, including questionnaires intended for the children or adolescents and the parents. The school administration was then responsible for sending parents their package. Trained data collectors visited the selected schools twice, for duration of three hours at each visit. An additional visit was scheduled only in the event of a student being absent (Paradis et al., 2003; Aubin et al., 2002). In 1996, selected survey instruments were tested during a pilot study, among 329 students from three elementary schools and three high schools in the Montreal region; in the spring of 1998, all survey procedures and test instruments were tested among 196 students in six Quebec schools, and among 50 adolescents who were not attending school (Paradis et al., 2003).

Children and adolescents brought home a package containing a letter concerning survey participation, consent forms for parents and children, a parental questionnaire, and a preaddressed, postage-paid envelope to return the parent

questionnaire and consent form. The parent who best knew the child or adolescent was asked to complete the questionnaire (Paradis et al., 2003). The responding parent was asked to answer questions on behalf of their current spouse or partner, concerning their smoking habits, alcohol consumption, and certain lifestyle behaviours (Paradis et al., 2003). Further, questions about each biological parent were asked, in terms of their history of hypertension, blood cholesterol, diabetes, heart attack, angina, stroke, cerebral or peripheral vascular disease, asthma, hay fever; and the use of prescription medication, particularly for the heart, hypertension, or elevated blood cholesterol (Paradis et al., 2003).

On a day of data collection in a given school, participants were gathered in a classroom assigned for the purposes of completing the questionnaires, and in order to take the necessary physiological and anthropometric measures. Anthropometric measures included height and weight; subjects were asked to remove their shoes and stand against the wall; height was obtained using regular tape measure, and was measured to the closest millimetre (0.1 cm) as participants inhaled (Paradis et al., 2003). While wearing light clothing, weight was measured to the closest 0.2 kg. All measures were taken twice, and were used to calculate body mass index (kg/m^2). In the event that measures of height or weight differed by 0.5 cm or 0.2 kg, respectively, the measure was taken again, and the average of the two most approximate measures was used (Paradis et al., 2003).

The children and adolescents then proceeded to the questionnaire portion of the data collection. These were completed in the presence of a research assistant who gave instructions and remained available to address any concerns or questions that may arise (Aubin et al., 2002). Two questionnaires were created; one for 9-year olds, and the other for 13- and 16-year olds. The former had simplified wording, and fewer questions and response categories for several questions (Paradis et al., 2003). Nine-year olds completed their questionnaires in the presence of two interviewers. Using a manual, one interviewer stood in front of the classroom and read and provided instructions for each question. The second interviewer was present to answer

questions that would arise, also ensuring that students instructions were being properly followed (Paradis et al., 2003). Questionnaires required approximately 45 to 60 minutes to complete, and were available in English and in French (Aubin et al., 2002).

4.4 Study Variables

4.4.1 Dependent variables

The dependent variables for this study are three specific youth lifestyle behaviours and outcomes, namely level of physical activity, screen time, and weight status.

Youth Physical Activity. Children and adolescents were asked to report their frequency of physical activity. Using a seven-day recall based on the Weekly Activity Checklist (Sallis et al., 1993), participants were asked- "In the past week (Monday to Sunday), indicate the days where you did the following activities, for at least 15 minutes straight". The checklist included a list of 18 physical activities. Participants checked, for each day of the preceding week, each activity that they had engaged in for at least 15 minutes (Paradis et al., 2003). In order to reflect the physical activity preferences and interests of the represented age groups, the physical activity checklist differed for 9-year old children and 13- and 16-year old adolescents (Paradis et al., 2003); and included activities most frequently practiced in winter and early spring (O'Loughlin, Paradis, Kischuk, Barnett & Renaud, 1999). Thus, the measure of physical activity includes all forms of physical activity whether it is organized or unorganized sport, competitive or non-competitive, school-based or community based, individual or group-based. For each of the 18 activities listed, the number of days in the 7-day period checked by participants was summed to create a physical activity score. The total number of activities endorsed over the 7-day period was used to create age-specific categories of PA frequency (inactive/ moderately-active/ highly-active), based on approximate tertile cut-offs. For children aged 9, these categories corresponded to 0-5, 6-10, and ≥11 sessions/week, respectively. For

adolescents aged 13 and 16, these corresponded to 0-5, 6-12, and ≥13 sessions/week, respectively.

Screen time. In their questionnaires, children and adolescents were asked to record the average number of hours spent in television (TV) and video viewing, during weekdays and weekends. The total number of hours spent on weekdays and weekends were combined (number of hours/weekday *5 + number of hours/weekend *2) in order to have an estimate of the total number of hours screen time per week. This variable was dichotomized (≤14 hours/ > 14 hours), identifying participants who exceed recommended limit of two hours of screen time per day (American Academy of Pediatrics, 1999).

Weight status. Height and weight were measured according to standardized protocols (Paradis 2003). BMI was computed as weight in kilograms divided by height in meters squared. Overweight and obesity status were identified using age- and sex-specific body mass index (BMI) cut-points. As described by Cole and colleagues (2000), these internationally accepted cut-points are useful in identifying youth at risk for obesity-related morbidity (Cole, Bellizzi, Flegal & Dietz, 2000).

4.4.2 Independent variable

Parental physical activity (PA) involvement. Parental PA involvement comprised our main hypothesized exposure variable. Derived from the National Children and Youth Fitness Study (Ross & Pate, 1987), parents were asked about the frequency in which they engaged in PA with their child - “In the past 3 months, how many times have you engaged in physical activity with the child?” Responses included: not once, approximately once a month, approximately 2 or 3 times a month, approximately once a week, approximately twice a week, approximately 3 times a week, 4 times a week or more, and don’t know’. The responding parent was asked to answer the same question on behalf of their partner or spouse as well.

Each variable was recoded as 'engages in PA with child or adolescent ≥ once a week' or 'engages in PA with child or adolescent < once a week', and then combined into a single variable 'parental PA involvement'. If both parents engaged in PA with their child or adolescent ≥ once a week, subjects were considered as having both parents involved in youth PA. If only one parent engaged in PA with their child or adolescent ≥ once a week, while the other engaged in PA with child or adolescent < once a week, subjects were considered to have only one parent involved youth in PA. Finally, if both parents were categorized as engaging in PA with child or adolescent < once a week, subjects were categorized as having neither parent involved in PA with the child or adolescent.

4.4.3 Other variables

Individual factors.

These include *age* (by design, limited to 9, 13 and 16 years) and *sex*.

Family and socioeconomic factors.

The responding parent was asked to answer a series of questions concerning their lifestyle behaviours, family composition, and socioeconomic factors, and that of their spouse or partner, whether biological or not, currently living in the same household as the participant.

Parent physical activity (PA) level. The responding parent reported his or her level of physical activity, as well as that of their spouse or partner. These questions were based on items developed by Gionet and Godin (1989). The responding parent was asked: "In the past 3 months, how many times have you engaged in physical activity, for at least 20 to 30 minutes per session, during your free time?" Responses included: not once, approximately once a month, approximately 2 or 3 times a month, approximately once a week, approximately twice a week, approximately 3 times a week, 4 times a week or more, and don't know'. Each parent was classified as engaging either in 'low' physical activity (< 3 times/week), or in 'high' physical activity (≥ 3 times/week). Mothers' and fathers' PA levels were then recoded into a

single variable ‘Parental PA levels’, which was dichotomized as ‘at least one parent engages in PA ≥ 3 times/week’, and ‘neither parent engages in regular PA’.

Family structure. Family structure was determined according to the number of parents living in the child’s principal household. Parents were asked if the child or adolescent lived with either both biological or adoptive parents (yes/ no); children and adolescents were categorized as living in a two parent household (yes/ no). Almost all children and adolescents not living with either biological or adoptive parents, were living in single parent households (Aubin et al., 2002).

Siblings. Parents were asked to record the total number of siblings living in the household; responses were grouped into three categories: none, one sibling, and two or more siblings.

Parents’ level of education. Parents were asked to indicate their highest level of education as well as that of their spouse or partner. Categories included: no formal schooling or only nursery, primary school, high school incomplete, high school graduate, vocational or trade school, college, or university. In this study, level of education attained by each parent was dichotomized into two categories (≤ high school diploma vs. CEGEP/technical/University), to identify parents who pursued further studies at the post-secondary level. Mothers’ and fathers’ educational attainment were recoded into one variable ‘Parents’ educational levels’, and categorized as ‘at least one parent has CEGEP/technical/University education’ and ‘neither parent has CEGEP/technical/University education’.

Parental occupational status. Parents were asked to indicate their occupational status and that of their spouse or partner. Response categories included: Full-time job (≥ 30 hours/week), part-time job (< 30 hours/week), going to school, homemaker, not working for health reasons, on maternity/paternity leave, unemployed, on welfare (social assistance), on strike or locked out, and other. Both parents’ occupational statuses were dichotomized, with all those in full-time jobs

categorized under ‘full-time employment’, and all others categorized as ‘other’. Parental occupation status was recoded into a single variable with three categories: ‘both parents work full-time’, ‘at least one parent works full-time’, and ‘neither parent works full-time’.

Total household income. In their questionnaire, parents were asked to report their total household income for 1998, before taxes and deductions. For the purposes of this study, “household” refers to everyone living in the same residence as the child or adolescent. Income was dichotomized (< 50,000/ ≥ 50,000) based on the approximate median cut-off within the QCAHSS data set.

Neighbourhood and environmental factors.

Urbanicity. Areas were categorized as ‘urban’ if they were inhabited by 1000 people, with a population density of 400 people per square kilometre; otherwise, they were categorized as ‘rural’ (Statistics Canada, 1996).

Neighbourhood safety. Neighbourhood safety was determined according to parent perceptions of neighbourhood characteristics. The responding parent was asked to rate how safe their neighbourhood was as a place to raise children. Response choices include excellent, somewhat good, average, somewhat bad, very bad, and don’t know. Neighbourhood perceptions were then dichotomized, with those who responded ‘excellent’ classified in the ‘safe’ category, while those who responded otherwise categorized as ‘not safe’.

4.5 Statistical Analyses

All analyses were conducted using SPSS software, version 17.0. In addition to descriptions of sample characteristics, bivariate analyses were conducted in age-specific logistic regressions, between parental involvement in youth PA and each of the youth lifestyle behaviours. Given the exploratory nature of the study, covariates which were associated with the outcomes with a significance-level of 0.20 or less were retained for multivariate analyses. Effect modification of the relationships

between parental involvement in youth PA and youth lifestyle behaviours, by family structure and by neighbourhood safety was tested and examined by comparing stratum specific models. Binomial regression analyses were used for variables with dichotomized outcomes; while polytomous regression analyses were used for outcomes with multiple categories, such as with physical activity. Because we had no data regarding the duration or intensity of physical activity, inactivity was used as a reference category in order to investigate dose response effects. Therefore participants who engaged in moderate or high activity were compared to those who were inactive.

4.6 Missing Values

Only participants with data available for both parents were included in our analyses. Participants whose parents did not participate in the study, or whose responding parent did not answer questions on behalf of their spouse or partner, specifically for questions pertaining to their physical activity involvement, individual physical activity levels, occupational status, and level of education, were excluded from analyses. Multivariate models only included participants with complete data; incomplete data were assumed to be missing at random.

Chapter 5: Scientific Article

Parental Involvement in Youth Physical Activity: Impact on Youth Lifestyle Outcomes

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5.1 Abstract

Objective: To examine the association between parental involvement in their child's physical activity (PA) and child lifestyle behaviours and weight status**.**

Methods: Data were from the 1999 Quebec Child and Adolescent Health and Social Survey, comprising representative samples of youth aged 9, 13, and 16 years. Parental involvement in PA with their child was assessed and measured as both, one, or neither parent engaging in PA with their child ≥once/week, based on parent reports. A 7-day PA recall was used to categorize youth as inactive, moderately-active, or highly-active. Screen time was classified as ≤14 and >14 hours of TV and video viewing/week. Overweight status was defined according to Cole's sex- and age-specific BMI cut-points.

Results: Participants (n=2511) with both parents engaging in PA with them ≥once/week (vs. neither parent) were more likely to be highly-active at ages 13 (OR 3.89, 95% CI: 1.85-8.18) and 16 (OR 3.45, 95% CI: 1.32-9.01), and to report ≤14 hours/week of screen time at age 13 (OR 2.36, 95% CI: 1.30-4.25). No associations were observed for weight status. We examined effect modification in post-hoc analyses; the association between parental involvement and youth PA was present in two-parent households only, while the association between parental involvement and screen time was only present in neighbourhoods perceived to be safe by parents.

Conclusion: Health promotion strategies targeting parental involvement in youth PA may reduce the future burden of chronic disease, given the favorable association of parental involvement with several youth lifestyle behaviours.

Key words: physical activity, screen time, overweight, neighbourhood safety, family structure

5.2 Introduction

Over the past three decades, the prevalence of overweight among Canadian youth between the ages of 12 and 17 has doubled from 14% to 29%, while the prevalence of obesity tripled from 3% to 9% (Shields, 2006). Overweight and obesity during childhood are important risk factors for CVD- and type 2 diabetes-related morbidity and mortality during adulthood (Guo et al., 2000). Furthermore, childhood is an important period where lifestyle behaviours develop (Chen, Matthews & Boyce, 2003); and may carry into adulthood, therefore increasing the risk for CVD (Janz, Dawson & Mahoney, 2000; Bao, Threefoot, Srinivasan & Berenson, 1995; Guo et al., 2000).

According to the 2010 *Report Card on Physical Activity for Children and Youth* (Active Healthy Kids Canada, 2010), which uses data from the Canadian Fitness and Lifestyle Research Institute's Canadian Physical Activity Levels Among Youth study, only 12% of youth between the ages of 6 and 14 meet the recommended 90 minutes of moderate-to-vigorous PA per day (Active Healthy Kids Canada, 2010). Gradual increases in daily PA have been found to be associated with lower risk for metabolic syndrome (Ekelund et al., 2009), while excess screen time is associated with increased risk (Mark & Janssen, 2008). Screen time (i.e.: television viewing, playing computer/video games), is a commonly-used indicator of sedentary behavior. The Report Card also summarizes findings from the Health Behaviour in School-aged Children (HBSC) survey (2005-2006), and revealed that only 10% of Canadian children meet the recommended guidelines for less than 2 hours of daily screen time, with many engaging in nearly 6 hours of screen time per weekday, and more than 7 hours on weekend days.

Despite a large body of literature investigating the correlates of youth lifestyle behaviours, the pathways by which parents can influence these outcomes, and the contexts that support these relationships, remain less understood (Taylor, Baranowski & Sallis, 1994; Prochaska, Rodgers & Sallis, 2002). Positive associations between parents' and children's PA levels have been reported in approximately one-third of

studies (Sallis, Prochaska & Taylor, 2000) that addressed this question. Although Wagner and colleagues (2004) observed that having both parents regularly involved in sport activities was associated with greater youth participation in PA outside of school, few studies have investigated the impact of parental involvement in their child or adolescent's PA; and whether this form of parental support varies according to socioeconomic and environmental circumstances (Wagner, Klein-Platat, Arveiler, Haan & Simon, 2004). Compared to two-parent families, single-parent families are typically at a socioeconomic disadvantage, which may manifest as reduced access to PA resources (Hohepa, Scragg, Schofield, Kolt & Schaaf, 2007; Gordon-Larsen, Nelson, Page & Popkin, 2006). At the neighborhood level, low income areas are more likely to be perceived as unsafe by parents (Burdette & Whitaker, 2005), which may result in children spending less time outdoors and being less physically active (Gordon-Larsen, McMurray & Popkin, 2000).

Clearly, there is an urgent need to develop effective prevention practices that target reduced overweight in children and adolescents. In order to inform the development of such prevention efforts, further research is required to better understand the underlying factors that are related to lifestyle behaviors in childhood. The aim of this study therefore is to investigate the associations between parental involvement in youth PA and youth lifestyle behaviours and weight status, in a representative sample of Quebec youth; in secondary analyses, we also examine the potential modifying roles of family structure (single- vs. two-parent families) and parental perceptions of neighborhood safety (safe vs. unsafe).

5.3 Methods

The present study is a secondary analysis of archival data from the Quebec Children and Adolescent Health and Social Survey (QCAHSS), which took place between January and May 1999. The main goal of the QCAHSS was to profile the overall health and social well-being of Quebec youth, and to describe the prevalence and distribution of cardiovascular risk factors and associated lifestyle behaviors. The QCAHSS used a cluster sampling design to draw three provincially representative,

independent samples of youth aged 9, 13, and 16 years. Data were collected during 3 hour school-visits. While the 13- and 16-year olds completed their questionnaires independently, the 9-year olds were supervised by interviewers to enhance comprehension and to verify that instructions were being followed (Paradis et al., 2003). Parents' questionnaires were sent home to be completed by the parent who best knew the child. More detail on the survey design and methods is available in Paradis et al (2003).

The outcome variables of the current analysis include youth PA frequency, screen time, and weight status. Frequency of youth PA was measured using a 7-day recall of PA sessions, which was adapted from the Weekly Activity Checklist (Sallis, Buono, Roby, Micale & Nelson, 1993; Paradis et al., 2003). The list of physical activities was adapted to reflect PA preferences of Quebec youth. Participants were asked to check off which of 18 different physical activities they had engaged in for a period of 15 minutes or more, for each day of the previous week (Monday to Sunday). The total number of activities endorsed over the 7-day period was used to create age-specific categories of PA frequency (inactive/ moderately-active/ highly-active), based on approximate tertile cut-offs. Although it is a limitation that no estimate of intensity is available, this categorization allows us to explore the presence of possible dose-response associations. It should also be acknowledged that, because of the likelihood of misclassification of PA frequency, associations may only be apparent by comparing the lowest and highest tertiles. For children aged 9, these categories corresponded to 0-5, 6-10, and ≥11 sessions/week, respectively. For adolescents aged 13 and 16, these corresponded to 0-5, 6-12, and ≥13 sessions/week, respectively.

Weekly television/video screen time was used as an indicator of sedentary behavior; participants were asked 'How many hours a day do you usually watch television or videos?' The number of hours for weekdays and weekends were reported separately, and then summed to obtain the total number of hours per week spent in television and video viewing. Screen time was then categorized as low (0-14

hours/week) or high (>14 hours/week), in order to identify participants who exceeded the recommended two-hour daily limit of screen time (American Academy of Pediatrics, 1999).

Height and weight were measured according to standardized protocols (Paradis 2003). BMI was computed as weight in kilograms divided by height in meters squared. Overweight and obesity status were identified using age- and sex-specific body mass index (BMI) cut-points. As described by Cole and colleagues (2000), these internationally accepted cut-points are useful in identifying youth at risk for obesity-related morbidity (Cole, Bellizzi, Flegal & Dietz, 2000).

Parental involvement in youth PA was defined by the frequency in which parents reported engaging in PA with their child. Parents completing the questionnaire were asked, "In the past 3 months, how many times have you engaged in a PA with the child (or adolescent)?" The parent was also asked the same question, concerning their spouse or partner living in the same household. Response choices included 'not once, approximately once a month, approximately 2 or 3 times a month, approximately once a week, approximately twice a week, approximately 3 times a week, 4 times or more a week'. For analytical purposes, parental involvement in youth PA was categorized as both parents, one parent, and neither parent engaging in PA with their child at least once per week.

To assess parents' own PA levels, the participating parent was asked 'In the past 3 months, how many times have you engaged in a PA for at least 20 to 30 minutes per session, during your free time?' Response choices were 'Not once, approximately once a month, approximately 2 or 3 times a month, approximately once a week, approximately twice a week, approximately 3 times a week, 4 times or more a week'. They were asked to report the PA levels of their spouse or partner as well. Parents' responses were then combined into two categories, 'at least one parent engages in PA ≥3 times per week/ neither parent engages in PA ≥3 times per week', identifying households where at least one parent engaged in PA on a regular basis.

Family structure (single-parent/ dual-parent) was determined according to parents' answer to the following question 'Does the child (or adolescent) currently live with both his/her biological or adoptive parents?' (yes/no). In addition, parents were asked how many brothers, sisters, step-brothers, and step-sisters currently live in the same household as the selected participant; these were categorized as only-child/ one sibling/ ≥2 siblings.

Total annual household income for 1998 was based on the total income (before taxes and deductions) of all household members who shared expenses and who were living with the selected participant at the time of the survey. The range of responses included 'less than $10,000, $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 $59,999, $60,000 to $79,999, and $80,000 or over'. Total household income was dichotomized as < $50,000/ ≥ $50,000 per year, with the cut-point corresponding to the approximate median value.

The responding parent was asked to report their highest level of education attained as well as that of their spouse. Response options included 'no formal schooling, primary school, high school (incomplete), high school (graduated), vocational or trade school, college (CEGEP), and University'. Parents' level of education was then combined into the following categories: 'at least one parent has college/technical/university education/ neither parent has college/technical/university education'.

Parents' occupational status was determined according to the responding parent and their spouse or partner's occupational status at the time of the survey. The range of responses were 'full-time job, part-time job, going to school, homemaker, not working for health reasons, maternity or paternity leave, unemployed, on welfare, on strike or locked out, or other'. Parent occupational status was then combined into

the following categories: ‘both parents work full-time/only one parent works full-time/ neither parent works full-time’.

Environmental factors assessed in the study included neighbourhood safety and urbanicity. Neighbourhood safety was determined according to parental perceptions of how safe the neighbourhood was to raise children. Response choices included ‘excellent, somewhat good, average, somewhat bad, and very bad’. Participants who answered ‘excellent’ were considered to live in ‘safe’ neighbourhoods; otherwise, participants were considered as living in ‘unsafe’ neighbourhoods. Urbanicity was defined as living in a rural or urban area. Urban areas were inhabited by at least 1000 people, with a population density of at least 400 people/km^2.

After the initial descriptive results, the main associations of interest were examined in age-specific logistic regression models and adjusted for a range of potential confounders. Variables with a significance level of 0.20 or less in univariate analyses were retained for multivariate analyses. We tested whether or not the relationships between parental involvement in youth PA and youth lifestyle behaviours and weight status were modified by each of family structure and neighbourhood safety. All analyses were performed separately for children (age 9) and adolescents (ages 13 and 16).

Our main focus was to assess associations between parental and youth outcomes in a developmental context. Although previous studies have stratified by both age and sex, we chose to focus on the age-related differences in PA, which has been done in other nationwide studies (Telama & Yang, 1999). The decline in PA trends has been attributed to motivational, social, and recreational factors that tend to change with age (Telama & Yang, 1999); however the developmental stage at which such changes occur, and the factors which influence change remain unclear (Anderssen et al., 1996). Although we stratify by sex for descriptive purposes, we did not study sex-specific models. While sex-differences were found in our sample, we

do not expect that the importance of parental involvement differs by sex once age is taken into consideration. Studying sex-specific parent-youth PA associations (i.e.: mother-daughter, father-son) may be warranted, but was beyond the scope of this study. Moreover, loss of statistical power due to over-stratification of data was a potential concern; thus we opted to include sex in all models rather than stratify by all age-sex categories. Finally, sex was not a significant effect modifier when examining the relationship between parental involvement and youth outcomes in any of the final models.

5.4 Results

5.4.1 Sample retained for analysis

The analytic sample comprised participants for whom data were available for both parents (n=2511), corresponding to 68.5% of the initial sample of n=3665. Excluded participants were more likely to be male and to be older, to be from single-parent families, to have fewer siblings, to be from lower income households, and to live in urban neighbourhoods perceived as unsafe to raise children. In terms of lifestyle behaviors and health status, excluded participants were more likely to be highly-active, but were also more likely to be overweight. No significant differences were found between included and excluded participants in terms of screen time, parents' PA levels, parents' level of education, or parents' occupational status (Table A.1). We then looked at differences between single-parent families for whom data for both parents were not available and those who were retained for analyses. We found that compared to youth from single-parent families without data available for both parents, youth from single-parent families retained in our analyses were less likely to be highly-active, less likely to be overweight, more likely to have two or more siblings, more likely to have a greater household income, and more likely to perceive their neighbourhood as safe.

5.4.2 Sample characteristics

The sample comprised 48% girls, and 52% boys. The median number of PA sessions for youth aged 9, 13, and 16 years was 7, 7, and 6 PAs/week, respectively.

Mean screen time was 18 hours/week for 9 year olds, 24 hours/week for 13 year olds, and 22 hours/week for 16 year olds (Table 1). The prevalence of excess weight (overweight and obesity) was 22% (Table 2). The frequency of having both parents, one parent, and neither parent involved in youth PA was 12%, 14%, and 73%, respectively (Table 2).

5.4.3 Descriptive analyses

Table 1 also shows the distribution of parental involvement in youth PA, stratified by age and by sex. These analyses show that parental involvement in youth PA significantly decreased as age increased. At age 13 years, two-parent and one-parent involvement was greater for boys than for girls, however, at age 16 years, girls were more likely to have two-parent involvement compared to their male counterparts.

The distributions of youth PA, screen time, and weight status, according to age and sex, are also presented in Table 1. The median number of PA sessions decreased significantly between ages 13 and 16. Boys were significantly more likely than girls to engage in more PA at ages 13 and 16. Mean screen time was highest among 13-year old boys and lowest among 9-year olds girls (Table 1). The proportion of participants classified as overweight varied little by age, ranging from 21% to 24% across all age-sex groups.

Table 2 shows the distribution of youth, family, socioeconomic, and neighbourhood characteristics in the QCAHSS. In unadjusted analyses, factors associated with parental involvement in youth PA included youth age and sex, youth PA, parents' PA levels, family structure, number of siblings living in the household, neighbourhood safety, and urbanicity.

5.4.4 Multivariate analyses

Youth physical activity

The odds of youth being moderately-active and highly-active (vs. inactive) were estimated in separate age-specific multivariate logistic models. Results are shown in Table 3. After controlling for sex, parents' PA levels, family structure, number of siblings, neighbourhood safety, urbanicity, income, parent education, and parental occupational status, we found that at age 13, having both parents involved in youth PA was associated with youth being moderately-active (OR: 2.52, 95% CI: 1.24 – 5.11) or highly-active (OR: 3.89, 95% CI: 1.85 – 8.18). Having only one parent involved was also associated with a greater likelihood of being moderately-active (OR: 1.72, 95% CI: 1.01-2.94) or highly-active (OR: 2.11, 95% CI: 1.17 – 3.80), among 13 year olds. For 16 year olds, having both parents involved was associated with being highly-active (OR: 3.45, 95% CI: 1.32 – 9.01).

Screen time

Parental involvement in youth PA was only associated with screen time in 13-year olds. After controlling for sex, family structure, siblings, parents PA levels, parents level of education, parental occupational status, urbanicity, total household income, and neighbourhood safety, 13-year olds were more likely to engage in lower screen time when both parents were (OR: 2.36, 95% CI: 1.30 – 4.25) or one parent was (OR: 1.71, 95% CI: 1.03 – 2.84) involved in youth PA (Table 4).

5.4.5 Effect modification

Bivariate associations prompted us to conduct exploratory analyses; specifically, these were to examine if the relationships between parental involvement and youth outcomes were modified by family structure or neighbourhood safety. As with all multiple testing situations, results should be considered exploratory and be interpreted with caution.

Youth physical activity and family structure

Family structure modified the association between parental involvement in youth PA and youth PA, with significant associations observed only in two-parent families. When only one parent was involved in youth PA, children (age 9) from two-parent families were more likely to be moderately-active (OR: 1.65, 95%CI: 1.04 – 2.63); and adolescents (ages 13 & 16) were more likely to be highly-active (OR: 1.72, 95%CI: 1.06-2.80). When both parents were involved in youth PA, adolescents (ages 13 & 16) were more likely to be both moderately-active (vs. inactive) (OR: 1.84, 95%CI: 1.04 – 3.25) or highly-active (vs. inactive) (OR: 3.42, 95%CI: 1.85 – 6.31) (Table A.5).

Youth physical activity and neighborhood safety

Neighbourhood safety modified the association between parental involvement and youth PA, but among 13- and 16-year old adolescents only. Adolescents (ages 13 and 16) living in neighbourhoods perceived to be safe were more likely to be moderately-active when both parents were (OR: 2.21, 95% CI: 1.13 – 4.32) or only one parent was involved in youth PA (OR: 1.84, 95% CI: 1.06 – 3.20). Adolescents (ages 13 and 16) were more likely to be highly-active (vs. inactive) when both parents were involved in youth PA, whether they lived in neighbourhoods perceived by parents as safe (OR: 3.08, 95% CI: 1.50 – 6.35) or unsafe (OR: 5.58, 95% CI: 2.08 – 14.98) (Table A.6).

Screen time and family structure

Family structure also modified the association between parental involvement in youth PA and youth screen time. Adolescents (13- & 16-year olds) from two-parent households were more likely to engage in lower screen time when both parents were involved in PA (OR: 1.74, 95% CI: 1.07 – 2.83). No such associations were observed in single parent households (Table A.7).

Screen time and neighborhood safety

The association between parental involvement in youth PA and low screen time was significant in 'safe' neighbourhoods only (see table 9), among both children (age 9) and adolescents (ages 13 and 16). Nine-year olds residing in safe neighbourhoods were more likely to engage in lower screen time when one parent was involved in their child's PA (OR: 1.76, 95%CI: 1.00 – 3.09). Similarly, adolescents (13- and 16-year olds) were more likely to engage in lower screen time when both parents were involved in youth PA (OR: 1.97; 95%CI: 1.12 – 3.47) (Table A.8).

5.5 Discussion

This study examined the influence of parental involvement in youth PA on youth lifestyle behaviors and health outcomes, notably, PA, screen time, and weight status, in a nationally representative sample of Quebec youth. We found that participants were more likely to be moderately- or highly-physically active when both parents engaged in PA with them at least once per week, even after controlling for parents own usual level of PA as well as other social and environmental influences. Similarly, having both parents engage in PA with their child at least once per week was associated with lower screen time.

We found that the degree of parental involvement in youth PA declined with age, which is supported by research on youth development. Research suggests that the transition between childhood and adolescence is marked by changes in social influences and expansion of social networks (Eccles, 1999). Although parents continue to serve as role-models, adolescents begin to seek independence from parents, while the influence of peers tends to increase (Ardelt & Day, 2002). Therefore, we can only speculate that the decline in parental involvement in youth PA is partially attributed to influences outside the family environment during adolescence.

In our study, adolescents (ages 13 and 16) were more likely to be moderately- or highly-active when both parents were involved in PA, but in two-parent households only. In comparison to two-parent families, single-parent households are at a disadvantage, economically and socially (Hohepa et al., 2007). Hendry and colleagues (1993) suggest that older children in particular from low-income single-parent families are burdened with more domestic duties and having more demanding responsibilities, possibly due to parents' longer work hours. It is possible that demands placed on single-parents and their children result in less time to contribute to family-time, which would include recreational and sport activities, and lower likelihood of children being enrolled in sports programs and teams outside of school, potentially explaining the lack of association between parental involvement in youth PA and youth lifestyle behaviors.

In two-parent families, adolescents engaged in lower screen time when both parents were involved in PA. One possible reason is that greater parental involvement in youth PA is associated with more strict regulations concerning the amount of screen time, as Gentile and Walsh (2002) have established that media consumption tends to be higher in single-parent, low SES families. Involved parents that tend to regularly monitor media use are more likely to be aware of unhealthy media effects, and in turn are more likely to have children involved in alternative activities, therefore reducing opportunities for sedentary activities (Gentile & Walsh, 2002). It is possible that lower screen time in two-parent households when both parents are involved in PA is indicative of overall greater monitoring of children's behavior, leading to a greater likelihood of inculcating healthy lifestyle behaviours in their children (Shropshire & Carroll, 1997). It may also be possible that greater parental involvement is associated with lower screen time in two-parent households because the latter regularly engage in more activities overall, thus displacing more sedentary activities as an alternative. Although sedentary behavior and physical activity likely should be examined as two distinct behaviours, the displacement of physical activity is considered a highly plausible mediating factor in the relationship between sedentary behaviour and overweight status (Marshall et al., 2004).

Molnar and colleagues (2004) suggest that lack of neighbourhood safety and social disorder in particular, are important barriers to participation in recreational programmes. We therefore examined neighbourhood safety as a potential effect modifier between parental involvement in youth PA and youth lifestyle behaviours. We found that the relationship between parental involvement in youth PA and low screen time was only evident in neighbourhoods perceived to be safe, suggesting that when parents are less preoccupied with concerns about crime and safety; they may be more willing to make use of outdoor recreational resources (Molnar, Gortmaker, Bull & Bulka, 2004).

Our measure of neighbourhood safety is general; therefore we are limited in our ability to identify specific reasons for perceived lack of neighbourhood safety. Nevertheless, certain socio-demographic groups may be more likely to perceive their neighbourhoods as unsafe. For example, research indicates that disadvantaged neighbourhoods (i.e.: with lower social capital) have higher reports of crime (Kawachi, Kennedy & Wilkinson, 1999; Brownson, Baker, Housemann, Brennan & Bacak, 2001; Wilson, Kirkland, Ainsworth & Addy, 2004). In terms of the built environment, certain features such as accessibility between destinations and street connectivity promote social interaction, and therefore possible perceptions of safety (Foster & Giles-Corti, 2008). In addition, the neighbourhood socioeconomic environment is believed to be reflective of factors not included in our study, such as neighbourhood attractiveness and proximity to facilities, along with neighbourhood safety (van Lenthe, Brug & Mackenbach, 2005). Parents living in unsafe neighbourhoods may be more preoccupied about crime, disorder, and financial worries, and thus may be less willing or able to use nearby resources and PA opportunities. As a result, youth living in unsafe neighborhoods likely have fewer options for active pursuits and more time to devote to sedentary behaviors, especially if they spend large amounts of time alone or unsupervised.

In this study, no associations were found between parental involvement in youth physical and participants' weight status (Table 5), despite initially

hypothesizing that greater involvement in children's PA would be associated with a healthier BMI. It is possible that no such associations between parental involvement in youth PA and weight status were found because of the cross-sectional nature of this study. Longitudinal studies are necessary, in order to assess the potential mediating effects and etiological influence of youth PA and sedentary behaviour on overweight and obesity, and to inform intervention needs. If healthy lifestyle practices (i.e.: regular PA and low screen time) are maintained during adolescence and adulthood, the long-term risk for overweight and obesity may be reduced.

5.5.1 Strengths and limitations of the study

This study has several strengths. Data from the QCAHSS comprise representative samples of pre-adolescent, adolescent, and post-adolescent youth; and the study had an overall high response rate. Moreover, youth height and weight were measured by trained personnel, providing more reliable measures of BMI compared to self-reported measures. As with most self-report methods, the use of a PA recall questionnaire may have increased the likelihood that subjects over-reported PA levels. Likewise, there is a possibility that subjects underreported the number of hours spent in sedentary activities. Nevertheless, self-report methods are simple, cost-effective, and commonly used in large population-based studies. (Sirard & Pate, 2001). Although self-report methods rely on individual responses, they are considered useful when assessing PA patterns in national surveys, providing a foundation for PA-related research (Sirard & Pate, 2001). Sallis and colleagues' 7-day recall is one of the most commonly used self-report methods used for the assessment of PA, and has been found to have 75% agreement with objective direct observational methods (Wallace and McKenzie, 1985), and a test-retest reliability of r=0.77 (Sallis et al., 1993). Finally, due to the cross-sectional nature of the design, we refrain from making causal inferences.

5.5.2 Implications and future directions

Longitudinal studies are needed to examine the long-term patterns of PA and sedentary behavior, and to assess how parental influence evolves during youth

development. Our findings point to the important role of parents engaging in PA with their child/adolescent, and its benefits for shaping healthy active lifestyles. In this population of Quebec youth, parental involvement in youth PA appeared to benefit 13- and 16-year olds more than 9-year olds, suggesting that maintaining parental involvement in youth PA is important during the adolescent transition. However, our results demonstrated that parental involvement in youth PA declines significantly with youth age. Future studies aiming to study the presence of social influences and lifestyle behaviors should incorporate different types of role-models (i.e. parents, siblings, peers, teachers, etc.); in order to better understand how others in the social environment affect PA and other lifestyle habits.

Our findings highlight the importance of family and environmental circumstances, in that parental PA involvement and associated healthy youth lifestyle behaviors were only apparent in two-parent households and in 'safer' neighbourhoods. Factors influencing youth lifestyle behaviors in single-parent households and reasons for poor perceptions of neighbourhood safety require further study. Health promotion strategies should target parental involvement in youth PA, and aim to improve neighbourhood safety in order to encourage families to engage in PA and to limit the amount of time spent in sedentary behaviors.

Table 1 - Distributions of youth PA, screen time, weight status, and parental involvement in youth PA in the QCHASS (n=2511), stratified according to age and sex.

		Age 9				Age 13				Age 16				
		All	**Boys**	**Girls**		**All**	**Boys**	**Girls**		**All**	**Boys**	**Girls**		
	n	**897**	**441**	**456**	**p§**	**848**	**408**	**440**	**p§**	**766**	**362**	**404**	**p§**	**p§§**
							%							
Youth PA† (sessions/week)														
median (IQR)	**2496**	**7 (4-11)**	7 (4-12)	7 (4-10)	0.083	**7 (4-12)**	8 (5-14)	6 (3-11)	**<0.001**	**6 (3-11)**	8 (4-12)	5 (3-9)	**<0.001**	**<0.001**
Screen time (hours/week)														
mean ± SD	**2312**	**18.3±14.2**	19.2±14.6	17.5±13.9	0.09	**23.9±13.6**	24.9±14.5	23.1±12.7	0.073	**21.9±13.7**	22.6±14.0	21.3±13.3	0.193	**<0.001**
Weight status (%)														
Overweight	**552**	**21.4**	20.5	22.3	0.474	**21.2**	21.8	20.5	0.255	**23.8**	24.4	23.3	0.551	0.735
Non-overweight	**1950**	**78.6**	79.5	77.7		**78.8**	78.2	79.5		**76.2**	75.6	76.7		
Parental PA involvement ≥ once/week (%)														
Both parents	**310**	**22.5**	24	21.1	0.561	**8.4**	9.3	7.5	**0.001**	**4.8**	3.3	6.2	**0.042**	
Only one parent	**359**	**19.3**	19	19.5		**13.1**	17.2	9.3		**9.8**	11.9	7.9		**<0.001**
Neither parent	**1842**	**58.2**	56.9	59.4		**78.5**	73.5	83.2		**85.4**	84.8	85.9		

§ *P-value* for comparison between sexes.

§§ *P-value* for comparison between age groups.

Percentages (%) computed excluding missing data.

†Youth PA based on PA frequency as inactive/ moderately-active/ highly-active; for youth age 9 categories corresponded to 0-5/ 6-10/ ≥ 11 PA sessions/week; for youth ages 13 and 16, categories corresponded to 0-5/ 6-12/ ≥ 13 sessions/week, respectively.

Table 2 - Distribution of family, social, and neighborhood characteristics in the QCHASS, according to parental involvement in youth PA at least once/week (n=2511).

		All	Both parents	One parent	Neither parent	p-value
	n	**2511**	**310**	**359**	**1842**	**(x^2)**
Youth characteristics and lifestyle behaviors						
Age (years)						
9	**897**	35.7	65.2	48.2	28.3	**< 0.001**
13	**848**	33.8	22.9	30.9	36.2	
16	**766**	30.5	11.9	20.9	35.5	
Sex						
Male	**1211**	48.2	50.3	54.9	46.6	**0.012**
Female	**1300**	51.8	49.7	45.1	53.4	
†Youth PA (sessions/week)						
Highly-active	**566**	22.7	33	24.9	20.5	**< 0.001**
Moderately-active	**905**	36.3	34.3	41.2	35.6	
Inactive	**1025**	41.1	32.7	33.9	43.9	
Screen time (hours/week)						
High	**1484**	64.2	53.5	55.8	67.6	**< 0.001**
Low	**828**	35.8	46.5	44.2	32.4	
Weight status						
Overweight	**552**	22.1	20.1	21.6	22.5	0.635
Non-overweight	**1950**	77.9	79.9	78.4	77.5	
Parent, family, and socioeconomic characteristics						
Parents' PA levels (≥ 3x/week)						
At least one parent	**823**	33.5	54.5	51.4	26.5	**< 0.001**
Neither parent	**1635**	66.5	45.5	48.6	73.5	
Parental education levels (college/technical/university)						
At least one parent	**1691**	69.1	70.5	72.5	68.2	0.248
Neither parent	**755**	30.9	29.5	27.5	31.8	
Parental full-time occupational status						
Both parents	**1060**	42.8	40.7	42.8	43.2	0.644
Only one parent	**1201**	48.5	48.5	48.2	48.6	
Neither parent	**213**	8.6	10.7	9	8.2	
Family structure						
Two-parent household	**2090**	83.6	87.4	85	82.7	**0.087**
Single-parent household	**411**	16.4	12.6	15	17.3	

Siblings						
0	**305**	12.2	12	9.8	12.7	0.171
1	**1260**	50.4	47.1	49.2	51.3	
≥ 2	**933**	37.3	40.9	41.1	36	
Total household income						
≥ 50,000	**1291**	54.4	52.9	52.4	55.1	0.561
< 50,000	**1081**	45.6	47.1	47.6	44.9	
Neighbourhood and environmental characteristics						
Neighbourhood safety						
Safe	**1274**	51.1	58.0	51.8	49.8	**0.027**
Not safe	**1220**	48.9	42.0	48.2	50.2	
Urbanicity						
Non-urban	**992**	39.5	49.7	46	36.5	**< 0.001**
Urban	**1519**	60.5	50.3	54	63.5	

†Youth PA based on PA frequency as inactive/ moderately-active/ highly-active; for youth age 9 categories corresponded to 0-5/ 6-10/ ≥ 11 PA sessions/week; for youth ages 13 and 16, categories corresponded to 0-5/ 6-12/ ≥ 13 sessions/week, respectively.

Percentages (%) computed excluding missing data.

Table 3- Crude and adjusted odds ratios (OR) for moderate and high youth PA (versus inactive), according to parental involvement in youth PA (n=2511) at least once/week, stratified by age (QCAHSS, 1999).

			Moderately-active		Highly-active	
Age	**Parental involvement**	**n**	**Crude OR (95% CI)**	**Adjusted OR (95% CI)**	**Crude OR (95% CI)**	**Adjusted OR (95% CI)**
9	Both parents	202	1.14 (0.77-1.68)	0.99 (0.65-1.52)	1.43 (0.96-2.13)	1.45 (0.94-2.23)
	Only one parent	173	1.45 (0.97-2.15)	1.42 (0.93-2.16)	1.09 (0.70-1.71)	1.13 (0.70-1.80)
	Neither parent	522	1	1	1	1
13†	Both parents	71	2.17 (1.15-4.09)*	2.52 (1.24-5.11)**	3.29 (1.70-6.36)***	3.89 (1.85-8,18)***
	Only one parent	111	1.88 (1.15-3.06)**	1.72 (1,01-2.94)*	2.24 (1.31-3.84)**	2.11 (1.17-3,80)**
	Neither parent	666	1	1	1	1
16††	Both parents	37	1.15 (0.52-2.57)	1.41 (0.58-3.41)	2.69 (1.19-6.08)*	3.45 (1.32-9.01)**
	Only one parent	75	1.25 (0.73-2.13)	1.26 (0.69-2.28)	1.46 (0.75-2.82)	1.17 (0.54-2.53)
	Neither parent	654	1	1	1	1

† Moderate youth PA adjusted for sex, parents PA levels, family structure, siblings, neighbourhood safety, urbanicity, income, parent education. High youth PA adjusted for sex, parents PA levels, family structure, siblings, neighbourhood safety, urbanicity, income, parent education, parental occupational status.

††High youth PA adjusted for sex, parents PA levels, family structure, siblings, neighbourhood safety, urbanicity, income, parental occupational status.

Parental involvement in based on parents engaging in PA with youth ≥ once/week.

Youth PA based on PA frequency as inactive/ moderately-active/ highly-active; for youth age 9 categories corresponded to 0-5/ 6-10/ ≥ 11 PA sessions/week; for youth ages 13 and 16, categories corresponded to 0-5/ 6-12/ ≥ 13 sessions/week, respectively.

***p ≤ 0.001, **p < 0.01, *p < 0.05

Table 4- Crude and adjusted odds ratios (OR) for screen time (≤ 14 hours/week) according to parental involvement in youth PA, stratified by age (n=2511)

			Screen time (≤ 14 hours/week)	
			Crude OR	Adjusted OR
Age	**Parental involvement**	**n**	**(95% CI)**	**(95% CI)**
9	Both parents	202	1.10 (0.77-1.55)	1.14 (0.78-1.66)
	Only one parent	173	1.45 (1.01-2.09)*	1.40 (1.03-2.84)
	Neither parent	522	1	1
13†	Both parents	71	2.61 (1.55-4.39)***	2.36 (1.30-4.25)**
	Only one parent	111	1.58 (1.00-2.52)*	1.71 (1.03-2.84)*
	Neither parent	666	1	1
16	Both parents	37	1.28 (0.63-2.59)	1.14 (0.52-2.50)
	Only one parent	75	1.22 (0.74-2.01)	1.15 (0.66-2.01)
	Neither parent	654	1	1

†Model adjusted for sex, family structure, siblings, parents PA levels, parents level of education, parental occupational status, urbanicity, total household income, neighbourhood safety.

Parental involvement in based on parents engaging in PA with youth ≥ once/week.

***p ≤ 0.001, **p < 0.01, *p < 0.05

Table 5- Crude and adjusted odds ratios (OR) for non-overweight status according to parental involvement in youth PA, stratified by age (n=2511)

			Non-overweight	
			Crude OR	Adjusted OR†
Age	**Parental involvement**	**n**	**(95% CI)**	**(95% CI)**
9	Both parents	202	1.43 (0.94-2.17)	1.39 (0.88-2.19)
	Only one parent	173	1.19 (0.78-1.81)	1.14 (0.72-1.81)
	Neither parent	522	1	1
13	Both parents	71	1.13 (0.61-2.08)	1.10 (0.57-2.09)
	Only one parent	111	1.17 (0.70-1.95)	1.09 (0.64-1.86)
	Neither parent	666	1	1
16	Both parents	37	0.54 (0.27-1.09)	0.49 (0.23-1.06)
	Only one parent	75	0.76 (0.44-1.29)	0.67 (0.37-1.19)
	Neither parent	654	1	1

†Model adjusted for sex, family structure, siblings, parents' PA levels, neighbourhood safety, and urbanicity.

Parental involvement based on parents engaging in PA with youth ≥ once/week.

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Chapter 6: Discussion

6.1 Summary and Interpretation of Main Findings

Childhood is a period where unhealthy lifestyle behaviours can be established, and carried into adulthood, potentially increasing CVD risk (Chen et al., 2003; Janz et al., 2000; Bao et al., 1995; Guo et al., 2000). There is a need therefore to develop effective health promotion and disease prevention programs that target children and adolescents. In order to inform the development of such interventions, it is important to better understand the underlying factors in youth's immediate and broader environments that are associated with their lifestyle behaviours. This thesis focuses on the potential influence of home environmental factors, notably parental involvement, on youth lifestyle behaviours and weight status, since it may be amenable to intervention, thus providing a suitable target for public health programs. For the purposes of this study, parental involvement was conceptualized as parental role-modeling, and as an indicator of parental support. The main objective of this study was to investigate the association between parental involvement in youth physical activity and youth behavioural outcomes, including physical activity, sedentary behaviour, and weight status.

Overall, findings support a favourable association between parental involvement in youth PA and youth behavioural outcomes, in particular youth physical activity and screen time. Analyses were stratified by age, in order to compare the associations between parental involvement and youth outcomes among pre-pubescent, pubescent, and post-pubescent children. The degree of parental involvement in youth physical activity declined with child's age; this finding is supported by other research on youth development. It is well known that the transition between childhood and adolescence is marked by changes in social influences and networks (Eccles, 1999). While parents remain important role-models to adolescents, the influence of peers tends to increase (Ardelt & Day, 2002). Because this study did not include measures of relationships with peers, one can only speculate that the decline in parental involvement in youth PA is partially attributed

to influences outside the family environment during adolescence. Although the likelihood of parental involvement typically attenuated as children aged, parental involvement appeared to benefit adolescents to a greater extent, compared to nine-year olds. These findings suggest that maintaining parental involvement in youth PA is particularly important during the adolescent transition, as seen among 13- and 16-year olds in this sample.

The decline in youth physical activity and increased screen time across age groups may be explained by several factors. Although parents continue to serve as role-models, adolescents begin to seek independence from parents, while the influences of peers tend to increase (Ardelt & Day, 2002). Peer experiences begin to influence behavioural norms and expectations, affecting adolescent behaviours and attitudes (Paxton, Rodzilsky, Burack & Colin, 1999; Ricciardelli & McCabe, 2004). Smith (1999) examined the relationship between elements in the peer context and physical activity participation in a sample of 12-15 year old pre-adolescent and adolescent youth. Findings suggested that important contributors of motivation and physical activity behaviours include perceptions of peer relationships, physical self-worth, and affective responses toward physical activity. Further, favourable perceptions of friendship in the physical activity context were associated with positive affect, and attraction to sports and exercise (Smith, 1999).

In secondary analyses, we examined family and neighbourhood contexts that could influence the associations between parental involvement in youth PA and youth behavioural outcomes and weight status. In this study, adolescents (ages 13 and 16 years) were more likely to be moderately- or highly-active when both parents were involved in their PA, but in two-parent households only. Single-parent families are likely at a disadvantage, both economically and socially (Hohepa et al., 2007). This many further reflect on the family environment and parent-youth dynamics (Shropshire & Carroll, 1997). According to Hendry and colleagues (1993), older children from low-income, single-parent families, are likely to be more overwhelmed by domestic duties and demanding responsibilities set upon them by parents, who are

likely to have longer working hours, or more than one job. We further their explanation, by adding that demands placed on single-parents and their older children may result in less time contributed towards family life, specifically, enjoying recreational and sport activities together, as well as a lower likelihood of being enrolled in sport programs outside the educational setting. Parents from single-parent households may be limited in their ability to support and provide resources in order to effectively model healthy physical activity behaviours, possibly due to the additional stressors as a result of being a single-parent. These factors may partially explain why youth physical activity tends to be greater and sedentary behaviours are lower in two-parent households, as found in other studies (Hesketh et al., 2006), even after controlling for socioeconomic and neighbourhood factors.

While adolescents engaged in lower screen time when both parents were involved in PA with them our post-hoc analyses suggested that this was apparent in two-parent families only. It is possible that greater parental involvement in youth PA is associated with more strict regulations concerning the amount of screen time. Involved parents who tend to regularly monitor media use are more likely to be aware of unhealthy media effects, and in turn are more likely to have children involved in alternative activities (Gentile & Walsh, 2002). It is possible that lower screen time in two-parent households when both parents are involved in PA is attributed to better monitoring of children's behaviour, highlighting the important role of parents to socialize and attract their children to PA (Shropshire & Carroll, 1997). It may also be possible that greater parental involvement is associated with lower screen time in two-parent households because the latter regularly engage in more activities overall, thus displacing more sedentary activities as an alternative. Although sedentary behavior and physical activity likely should be examined as two distinct behaviours, the displacement of physical activity is considered a highly plausible mediating factor in the relationship between sedentary behaviour and overweight status (Marshall et al., 2004).

Molnar and colleagues (2004) suggest that lack of neighbourhood safety and social disorder in particular, are important barriers to participation in recreational programmes. Thus, neighbourhood safety was also tested as a potential effect modifier between parental involvement in youth PA and youth outcomes. Living in a safe neighbourhood was only favourable for the relationship between parental involvement in youth PA and youth screen time. One possible reason that no significant results for PA were found may be because concern about crime and disorder leads to parents replacing outdoor PA with indoor PA (Foster & Gilles-Corti, 2008), and therefore not necessarily reducing overall PA levels.

To our knowledge, no other studies have explored how perceptions of neighbourhood safety affect parental involvement in youth physical activity. However, some studies have highlighted the importance of perceived neighbourhood safety on sedentary behaviour. Burdette and Whitaker (2005) found mothers who perceive their neighbourhoods as unsafe were less likely to encourage outdoor play, and were also more likely to have children that spend greater amounts of time indoors, resulting in excess screen time. These findings suggest that neighbourhood safety is a key target in parents' ability to promote physical activity and reduce screen time.

The measure of neighbourhood safety in this thesis is broad, and does not identify specific underlying reasons for perceived lack of neighbourhood safety. Certain socio-demographic groups may be more susceptible to a perceived lack of safety. For example, research indicates that disadvantaged neighbourhoods (i.e.: lower social capital) have higher reports of crime and perceive less safety (Kawachi, Kennedy & Wilkinson, 1999; Brownson et al., 2001; Wilson, Kirkland, Ainsworth & Addy, 2004). In terms of the built environment, certain features such as accessibility between destinations and street connectivity promote social interaction (Foster & Giles-Corti, 2008). In addition, the neighbourhood socioeconomic environment is believed to be reflective of factors not included in this study, such as neighbourhood attractiveness and proximity to facilities, along with neighbourhood safety (van

Lenthe, Brug & Mackenbach, 2005). Given these findings, results suggest that safer neighbourhood present parents with more opportunities and resources, at the social- and environmental-level, creating a family-oriented neighbourhood environment conducive to practicing PA together. Parents living in unsafe neighbourhoods are more likely to be concerned with crime, disorder, and both financial and neighbourhood resources; and/or have reduced access to resources and opportunities to promote healthy, active lifestyles. Taken together, these factors potentially provide youth with an outlet for increasing screen time, especially if they spend large amounts of time alone or unsupervised.

In this study, no associations were found between parental involvement in youth physical and participants' weight status, despite having initially hypothesized that greater involvement in children's PA would be associated with a healthier weight status. Although not significant in the current analysis, results from previous studies have supported this hypothesis. It is possible that no such associations between parental involvement in youth PA and weight status were found because of the cross-sectional nature of this study. Other aspects of parental involvement may need to be important in regards to youth overweight status, for example meal preparation and teaching youth about healthy diet behaviors, and should be considered in future studies.

6.2 Limitations and Strengths of the Study

This study has several strengths. Data from the QCAHSS comprise representative samples of pre-adolescent, adolescent, and post-adolescent youth; and the study had an overall high response rate. Moreover, youth height and weight were measured by trained personnel. As with most self-report methods, the use of a PA recall questionnaire may have increased the likelihood that subjects over-reported PA levels. Likewise, there is a possibility that subjects underreported the number of hours spent in sedentary activities. Nevertheless, self-report methods are simple, cost-effective, and commonly used in large population-based studies (Sirard & Pate, 2001). Although self-report methods rely on individual responses, they are considered

useful when assessing physical activity patterns in national surveys, providing a foundation for physical activity-related research (Sirard & Pate, 2001). Sallis and colleagues' 7-day recall is one of the most commonly used self-report methods used for the assessment of PA, and has been found to have 75% agreement with objective direct observational methods (Wallace and McKenzie, 1985), and a test-retest reliability of r=0.77 (Sallis et al., 1993).

However, the use of a physical activity recall questionnaire increases the chance of reporting biases, in that subjects may exaggerate physical activity levels, unlike with more objective physiological measures of physical activity, such as accelerometers and pedometers. Likewise, there is a possibility that subjects may underreport the number of hours spent in sedentary activities. The seasonal period in which the data was collected influences physical activity, as levels would expectedly be lower during winter due to weather constraints and limits, compared to the spring or summer. Because questions pertaining to physical activity focus on the amount of structured and unstructured physical activity in the last three months, there is risk of recall bias as well. Given that there are parents in the sample with incomplete high school education, poor education attainment may affect understanding of questions compared to parents with post-secondary training. Likewise, reading abilities vary considerably within age groups, particularly among the 9 year olds. Although questions were modified in the 9 year old children's questionnaire, there is still risk of miscomprehension of questions. Finally, due to the cross-sectional nature of the design, we refrain from making causal inferences.

Chapter 7: Conclusion

7.1 Future Directions

Findings emphasize the important role of parents engaging in PA with their child/adolescent, and its benefits for shaping healthy active lifestyles. In this population of Quebec youth, parental involvement in youth PA appeared to benefit 13- and 16-year olds more than 9-year olds, suggesting that maintaining parental involvement in youth PA is important during the adolescent transition. Results demonstrated that parental involvement in youth PA declines according to youth age. Longitudinal studies would be beneficial to better understand the evolution and patterns parental involvement in youth physical activity. Future investigations on the role of social influences and lifestyle behaviours could incorporate different types of role-models (i.e. parents, siblings, peers, teachers, etc.); in order to better understand how others in youth's social immediate social circle can influence (both positively and negatively) lifestyle behaviours and weight status.

This study uses subjective assessments of neighbourhood safety; future studies should incorporate both perceived measures and actual data related to neighbourhood safety. Complementary qualitative assessments would be useful to develop a better understanding of the impact of unfavourable perceptions of neighbourhood safety, as these are important environmental barriers for physical activity. Although parental involvement was not associated cross-sectionally with youth weight status in the current analysis, it stands to reason that these behaviours would mediate effects on weight status in the longer term, and thus remain important health promotion targets to establish healthy lifestyle and habits and to reduce the long-term risk for overweight and obesity.

7.2 Implications for Public Health and Policy

Health promotion strategies need to develop family-focused interventions in order to target parental involvement in youth physical activity, as our findings point to favourable influences that may reduce the future burden of cardiovascular disease.

The complexity of family relationships is an issue to be addressed when exploring parental involvement and youth physical activity behaviours, as the benefits of parental involvement were apparent in two-parent families only. Factors influencing youth lifestyle behaviours in single-parent households therefore require further investigation.

Improving neighbourhood safety is important for improving health at the population level. Results suggest that families from neighbourhoods perceived as safe by parents appear to make better use of physical activity opportunities and resources, thus supporting their efforts to model and reinforce healthful behaviours. In addition, parents living in 'safer' neighbourhoods may be more inclined to spend more time with their children outside the home environment, thus reducing the amount of screen time. These factors should be considered when developing policies and programs that promote healthy lifestyle behaviours among youth.

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Appendix A
Complimentary Analyses

Table A.1 - Distribution of sample characteristics of included and excluded participants in the QCHASS

	ALL (n=3665)	Included (n=2511)	Excluded (n=1154)	p§
		%		
Youth characteristics and lifestyle behaviours				
Age (years)				
9	34.6	35.7	32.1	<0.001
13	32.4	33.8	29.3	
16	33.1	30.5	38.6	
Sex				
Male	49.2	48.2	51.5	0.068
Female	50.8	51.7	48.5	
Youth PA (sessions/week)				
Highly-active	24.3	22.7	28.0	0.003
Moderately-active	35.5	36.3	33.9	
Inactive	40.2	41.1	38.1	
Screen time (hours/week)				
High	64.7	64.2	66.0	0.308
Low	35.3	35.8	34.0	
Weight status				
Overweight	22.9	22.1	24.8	0.073
Non-overweight	77.1	77.9	75.2	
Parent, family, and socioeconomic characteristics				
Parents' PA levels (≥ 3x/week)				
At least one parent	33.5	33.5	37.5	0.810
Neither parent	66.5	66.5	62.5	
Parents' education levels (college/technical/University)				
At least one parent	69.1	69.1	68.6	0.920
Neither parent	30.9	30.9	31.4	
Parents' full-time occupational status				
Both parents work	42.7	42.8	37.5	0.260
Only one parent	48.5	48.5	48.6	
Neither parent	8.8	8.6	13.9	
Family structure				
Two-parent	71.3	83.6	13.4	<0.001
Single-parent	28.7	16.4	86.6	

Siblings				
0	15.3	12.2	29.8	<0.001
1	49.0	50.4	42.2	
≥ 2	35.7	37.3	27.9	
Total household income				
≥ 50,000	47.6	54.4	15.4	<0.001
< 50,000	52.4	45.6	84.6	
Neighbourhood and environmental characteristics				
Neighbourhood safety				
Safe	48.7	51.1	37.6	<0.001
Not safe	51.3	48.9	62.4	
Urbanicity				
Non-urban	36.4	39.5	29.3	<0.001
Urban	63.6	60.5	70.7	

Note: Analyses were performed excluding missing data (n=1353 were excluded).

§ Chi-square (x^2) test comparing included and excluded participants

Table A.2- Family, socioeconomic, and neighbourhood bivariate associations with moderate and high youth physical activity

	Age 9 (n=897)				Age 13 (n=848)				Age 16 (n=766)			
	Moderately-active		Highly-active		Moderately-active		Highly-active		Moderately-active		Highly-active	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Main independent variable												
Parental involvement in youth PA												
Both parents	1.14	0.80-1.68	1.43	0.96-2.13†	2.17	1.15-4.09*	3.29	1.70-6.36***	1.15	0.52-2.57	2.69	1.19-6.08*
One parent	1.45	0.97-2.15†	1.09	0.70-1.71	1.88	1.15 - 3.06**	2.24	1.31-3.84**	1.25	0.73-2.13	1.46	0.75-2.82
Neither parent	1.00		1.00		1.00		1.00		1.00		1.00	
Youth characteristics												
Sex												
Male	1.08	0.80-1.47	1.61	1.15-2.24**	1.43	1.05-1,95*	2.41	1.68-3.47***	1.84	1,34-2,53***	3.30	2.16-5.02***
Female	1.00		1.00		1.00		1.00		1.00		1.00	
Parent, family, and socioeconomic characteristics												
Parents' PA levels (≥ 3x/week)												
At least one parent	1.37	0.97-1.91†	1.26	0.88 - 1.81	1.06	0.77-1.47	1.06	0.72-1.55	1.08	0.77-1.50	1.20	0.79-1.83
Neither parent	1.00		1.00		1.00		1.00		1.00		1.00	
Parental education levels (college /technical /university)												
At least one parent has	0.94	0.67-1.32	0.90	0.63-1.30	1.62	1.15-2.28**	1.38	0.94-2.03†	1.27	0.90-1.79††	0.98	0.64-1.50
Neither parent	1.00		1.00		1.00		1.00		1.00		1.00	
Parental full-time occupational status												
Both parents	1.48	0.82 - 2.70††	1.42	0.76-2.67	1.20	0.69-2,09	1.39	0.69-2.80	1.32	0.72-2.43	0.79	0.39-1.61
At least one parent	1.47	0.82-2.64††	1.30	0.70-2.41	0.97	0.56-1.67	1.67	0.84-3.32††	0.77	0.42-1.42	0.63	0.31-1.28††
Neither parent	1.00		1.00		1.00		1.00		1.00		1.00	

Family structure												
Two-parent household	1.02	0.68-1.53	1.42	0.89-2.26††	1.21	0.80-1.83	1.09	0.68-1.73	1.02	0.67-1.56	1.29	0.72-2.32
Single-parent household	1.00		1.00		1.00		1.00		1.00		1.00	
Siblings												
0	0.72	0.42-1.23	0.77	0.44-1.34	0.79	0.45-1.38	0.81	0.43-1.53	0.78	0.49-1.26	0.60	0.32-1.13††
1	1.08	0.78-1.50	0.94	0.66-1.34	0.97	0.69-1.35	0.92	0.63-1.34	0.99	0.70-1.41	0.82	0.53-1.28
≥ 2	1.00		1.00		1.00		1.00		1.00		1.00	
Total household income												
≥ 50,000	0.95	0.70-1.30	0.88	0.63-1.24	1.53	1.11-2.11**	1.50	1.04-2.17*	1.37	0.98-1.91†	1.17	0.77-1.78
< 50,000	1.00		1.00		1.00		1.00		1.00		1.00	
<u>Neighbourhood and environmental characteristics</u>												
Neighbourhood safety												
Safe	0.93	0.68-1.26	0.77	0.55-1.07††	0.87	0.64-1.19	1.30	0.91-1.87††	1.07	0.78-1.46	1.01	0.67-1.52
Not safe	1.00		1.00		1.00		1.00		1.00		1.00	
Urbanicity												
Non-urban	1.24	0.91-1.69††	1.01	0.73-1.41	0.84	0.61-1.16	0.96	0.67-1.39	0.90	0.65-1.26	0.86	0.56-1.33
Urban	1.00		1.00		1.00		1.00		1.00		1.00	

***p<0.001, **p<0.01, *p<0.05, †p<0.10, ††p<0.20

Table A.3- Family, socioeconomic, and neighbourhood bivariate associations with low screen time (≤14 hours/ week)

	Age 9		Age 13		Age 16	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Main independent variable						
Parental PA involvement						
Both parents	1.10	0.78-1.55	2.61	1.55-4.39***	1.28	0.63-2.59
One parent	1.45	1.01-2.09*	1.58	1.00-2.52*	1.22	0.74-2.01
Neither parent	1.00		1.00		1.00	
Youth characteristics						
Sex						
Male	0.76	0.58-1.00*	0.97	0.70-1.35	0.82	0.60-1.12
Female	1.00		1.00		1.00	
Parent, family, and socioeconomic characteristics						
Parents' PA levels (≥ 3x/week)						
At least one parent	1.01	0.75-1.37	1.13	0.80 – 1.60	1.26	0.91-1.73††
Neither parent	1.00		1.00		1.00	
Parental education levels (college/ technical/ university)						
At least one parent	1.43	1.05-1.95*	1.43	0.98-2.08†	1.70	1.19-2.41**
Neither parent	1.00		1.00		1.00	
Parental full-time occupational status						
Both parents	1.06	0.61-1.85	2.29	1.13-4.67*	1.59	0.86-2.94††
At least one parent	1.36	0.80-2.34	1.80	0.88-3.67††	1.09	0.59-2.03
Neither parent	1.00		1.00		1.00	
Family structure						
two-parent	1.15	0.78-1.70	1.23	0.78-1.94	1.09	0.71-1.68
single-parent	1.00		1.00		1.00	
Siblings						
0	0.61	0.38-0.99*	1.12	0.64-1.98	0.53	0.33-0.86**
1	0.97	0.72-1.31	0.99	0.70-1.41	0.70	0.50-0.99*
≥ 2	1.00		1.00		1.00	
Total household income						
≥ 50,000	1.02	0.77-1.35	1.63	1.15 - 2.30**	1.50	1.07-2.09*
< 50,000	1.00		1.00		1.00	

Neighbourhood and environmental characteristics						
Neighbourhood safety						
Safe	1.04	0.79-1.38	1.55	1.11 - 2.17**	0.99	0.73-1.36
Not safe	1.00		1.00		1.00	
Urbanicity						
Non-urban	0.85	0.64-1.12	0.72	0.51 - 1.02†	0.76	0.54-1.07††
Urban	1.00		1.00		1.00	

***p<0.001, **p<0.01, *p<0.05, †p<0.10, ††p<0.20

Table A.4- Family, socioeconomic, and neighbourhood bivariate associations with youth non-overweight status

	Age 9		Age 13		Age 16	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Main independent variable						
Parent PA involvement						
Both parents	1.43	0.94-2.17†	1.13	0.61-2.08	0.54	0.27-1.09†
One parent	1.19	0.78-1.81	1.17	0.70-1.95	0.76	0.44-1.29
Neither parent	1.00		1.00		1.00	
Youth characteristics						
Sex						
Male	1.12	0.81-1.54	0.93	0.67-1.29	0.94	0.67-1.31
Female	1.00		1.00		1.00	
Parent, family, and socioeconomic characteristics						
Parents' PA levels (≥ 3x/week)						
At least one parent	1.17	0.82-1.67	1.21	0.84-1.73	0.88	0.62-1.24
Neither parent	1.00		1.00		1.00	
Parental education levels (college/technical/university)						
At least one parent	1.19	0.84-1.69	1.10	0.77-1.57	0.82	0.57-1.19
Neither parent	1.00		1.00		1.00	
Parental full-time occupational status						
Both parents	1.29	0.73-2.28	0.77	0.42-1.41	1.21	0.70-2.22
At least one parent	1.53	0.87-2.70††	1.28	0.70-2.35	1.20	0.65-2.21
Neither parent	1.00		1.00		1.00	
Family structure						
Two-parent	0.75	0.47-1.19	0.93	0.60-1.45	0.67	0.41-1.11††
Single-parent	1.00		1.00		1.00	
Siblings						
0	0.64	0.38-1.06†	0.80	0.45-1.43	0.70	0.43-1.15††
1	0.98	0.69-1.39	0.97	0.68-1.38	0.81	0.56-1.19
≥ 2	1.00		1.00		1.00	
Total household income						
≥ 50,000	1.25	0.90-1.73††	0.92	0.65-1.30	1.28	0.91-1.82††
< 50,000	1.00		1.00		1.00	

Neighbourhood and environmental characteristics						
Neighbourhood safety						
Safe	0.89	0.65-1.23	1.07	0.77-1.49	1.10	0.79-1.54
Not safe	1.00		1.00		1.00	
Urbanicity						
Non-urban	0.99	0.72-1.36	0.77	0.55-1.08††	1.01	0.71-1.44
Urban	1.00		1.00		1.00	

***p<0.001, **p<0.01, *p<0.05, †p<0.10, ††p<0.20

Table A.5- Odds of moderate and high youth PA in the QCAHSS, according to parental involvement in youth PA, stratified by age and family structure

			Moderately-active		Highly-active	
			Two-parent	Single-parent	Two-parent	Single-parent
		n	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Children†	Both parents	202	0.83 (0.52-1.32)	2.24 (0.71-7.09)	1.43 (0.90-2.26)	1.58 (0.43-5.74)
(age 9)	One parent	173	1.65 (1.04-2.63)*	0.65 (0.21-2.00)	1.28 (0.76-2.15)	0.58 (0.17-1.99)
	Neither parent	522	1	1	1	1
Adolescents††	Both parents	108	1.84 (1.04-3.25)*	1.81 (0.28-11.76)	3.42 (1.85-6.31)***	5.40 (0.81-35.88)
(ages 13 & 16)	One parent	186	1.49 (0.98-2.27)	1.17 (0.34-4.05)	1.72 (1.06-2.80)*	1.88 (0.48-7.29)
	Neither parent	1320	1	1	1	1

†Moderate PA adjusted for sex, siblings, parents' PA levels, neighbourhood safety, urbanicity, and parental occupational status; high PA adjusted for sex, siblings, parents' PA levels, neighbourhood safety, and urbanicity

††Moderate PA adjusted for sex, siblings, parents' PA levels, neighbourhood safety, urbanicity, parental occupational status, parental education, and household income.

***p<0,001, **p<0,01, *p<0,05

Table A.6- Odds of moderate and high youth PA in the QCAHSS, according to parental involvement in youth PA, stratified by age and neighbourhood safety

			Moderately-active		Highly-active	
			Safe	Unsafe	Safe	Unsafe
		n	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Children†	Both parents	202	0.67 (0.37-1.23)	1.49 (0.80-2.77)	1.64 (0.89-3.02)	1.38 (0.74-2.59)
(age 9)	One parent	173	1.32 (0.73-2.39)	1.63 (0.89-3.01)	1.15 (0.57-2.33)	1.07 (0.56-2.04)
	Neither parent	522	1	1	1	1
Adolescents††	Both parents	108	2.21 (1.13-4.32)*	1.45 (0.57-3.71)	3.08 (1.50-6.35)**	5.58 (2.08-14.98)**
(ages 13 & 16)	One parent	186	1.84 (1.06-3.20)*	1.11 (0.62-1.98)	1.86 (0.99-3.50)	1.67 (0.85-3.28)
	Neither parent	1320	1	1	1	1

†Moderate PA adjusted for sex, family structure, siblings, parents' PA levels, urbanicity, and parental occupational status; high PA adjusted for sex, family structure, siblings, parents' PA levels, and urbanicity

††Moderate PA adjusted for sex, family structure, siblings, parents' PA levels, urbanicity, parental occupational status, parental education, and household income.

***p<0,001, **p<0,01, *p<0,05

Table A.7- Odds of low screen time (≤14 hours/week) in the QCAHSS, according to parental involvement in youth PA, stratified by age and family structure

			Two-parent	Single-parent
	Parental involvement	**n**	**OR (95% CI)**	**OR (95% CI)**
Children†	Both parents	202	1.08 (0.72-1.62)	2.39 (0.77-7.37)
(age 9)	One parent	173	1.28 (0.84-1.95)	4.03 (1.21-13.50)
	Neither parent	522	1	1
Adolescents††	Both parents	108	1.74 (1.07-2.83)*	1.59 (0.29-8.77)
(ages 13 & 16)	One parent	186	1.29 (0.87-1.92)	2.27 (0.75-6.90)
	Neither parent	1320	1	1

†Model adjusted for sex, siblings, parents' PA level, neighbourhhod safety, urbanicity, and parental education

††Model adjusted for sex, siblings, parents' PA level, neighbourhhod safety, urbanicity, parental education, household income

*p<0,05

Table A.8- Odds of low screen time (≤14 hours/week) in the QCAHSS, according to parental involvement in youth PA, stratified by age and neighbourhood safety

			Safe	Unsafe
	Parental involvement	**n**	**OR (95% CI)**	**OR (95% CI)**
Children†	Both parents	202	1.40 (0.79-2.29)	0.97 (0.57-1.67)
(age 9)	One parent	173	1.76 (1.00-3.09)*	1.20 (0.70-2.06)
	Neither parent	522	1	1
Adolescents††	Both parents	108	1.97 (1.12-3.47)*	1.21 (0.51-2.91)
(ages 13 & 16)	One parent	186	1.45 (0.88-2.39)	1.27 (0.72-2.23)
	Neither parent	1320	1	1

†Model adjusted for sex, family structure, siblings, parents' PA level, urbanicity, and parental education

††Model adjusted for sex, family structure, siblings, parents' PA level, urbanicity, parental education, household income

*p<0,05