Université de Montréal

Effects of a Real-Life Workplace Program Promoting Healthy Lifestyle Habits

Predictors of intentions and improvements

Par

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Résumé

L'adoption de saines habitudes de vie (HdeVs) préviendrait les maladies chroniques responsables d'environ 71% des décès mondialement. Cependant, la majorité de la population mondiale adulte, incluant les Canadiens, n'adhère pas aux recommandations en matière de saines HdeVs. L'Organisation mondiale de la santé a notamment recommandé de promouvoir davantage la santé au travail. Bien que certaines études rapportent des bienfaits en réponse à des programmes de promotion des saines HdeVs au travail (PPSTs), des revues systématiques et des méta-analyses questionnent leur efficacité. De plus, peu d'études ont tenté d'identifier les employés bénéficiant le plus des PPSTs. Cette thèse a donc quatre objectifs, présentés dans quatre articles, soit : Article 1) Décrire l'évaluation du PPST « Activez votre santé » offert à des employés québécois; Article 2) Évaluer les effets d'un nombre croissant d'interventions (*Témoin*, *Légère*, *Moyenne*, et *Élevée*) dans un PPST sur les variables liées à la santé et aux HdeVs; Article 3) Identifier les facteurs prédisant l'intention d'améliorer différentes HdeVs et vérifier l'association entre l'intention initiale et l'amélioration de l'HdeV; et Article 4) Identifier, parmi les employés montrant initialement une santé sous-optimale, les caractéristiques qui prédisent l'amélioration de comportements et la réduction de facteurs de risque. Les variables suivantes ont été recueillies par questionnaire avant et après le PPST : santé (incluant la santé mentale), plusieurs perceptions (incluant le niveau de stress), et six HdeVs ainsi que l'intention de les améliorer. Article 1 décrit la conception de l'étude, les interventions, la collecte de données et l'échantillon. Article 2 soutient que le PPST a permis de maintenir ou d'améliorer les résultats, peu importe le nombre d'interventions du PPST. Article 3 identifie les facteurs communs prédisant l'intention d'améliorer plus d'une HdeV, par exemple le sexe, l'IMC et la non-adhésion aux recommandations. L'intention initiale d'amélioration était généralement associée à l'amélioration du comportement, particulièrement dans le groupe *Élevée*. Article 4 identifie quelques prédicteurs d'amélioration pour chaque comportement et facteur de risque. Toutefois, les prédicteurs différaient pour chacun d'eux. En conclusion, le PPST « Activez votre santé » a permis d'aider certains employés ayant une santé sous-optimale. Un nombre élevé d'interventions semble avoir été plus bénéfique. Pour être plus efficaces, les PPSTs devraient documenter l'intention initiale d'améliorer les différentes HdeVs et cibler les interventions en fonction des intentions et des besoins des employées. **Mots-clés** : Association, Canada, Employés, Santé, Travail, Occupation.

Abstract

Adopting healthy lifestyle habits would prevent chronic diseases which are responsible for approximately 71% of deaths worldwide. However, most of the adult population in the world, including Canadians, do not adhere to the recommendations for healthy lifestyle habits. The World Health Organization has recommended increased promotion of health at work. Studies have reported benefits in response to workplace health promotion programs (WHPPs), but systematic reviews and meta-analyses question their effectiveness. In addition, few studies have attempted to identify which employees benefit most from WHPPs. Therefore, this thesis has four objectives presented in four articles, which are: Article 1) Describe the evaluation of the *Activate Your Health* WHPP offered to Quebec employees; Article 2) Evaluate the effects of an increasing number of interventions (*Control*, *Light*, *Moderate*, and *High*) in a WHPP on health- and lifestyle habit-related outcomes; Article 3) Identify factors predicting intention to improve different lifestyle habits and test the association between initial intention and lifestyle habit improvement; and Article 4) Identify, among employees initially showing suboptimal health, characteristics that predict behavioural and risk factor improvements. The following variables were collected by questionnaire before and after the WHPP: health including mental health, several perceptions including stress levels, and six lifestyle habits as well as intention to improve them. Article 1 describes the study design, interventions, data collection, and sample. Article 2 supports that the WHPP maintained or improved outcomes regardless of the WHPP's number of interventions. Article 3 identifies common factors predicting the intention to improve at least two lifestyle habits: sex, BMI, and nonadherence to recommendations. Initial intention to improve was generally associated with behavioural improvement, especially in *High*. Article 4 identifies some predictors of improvement for each behaviour and risk factor. However, the predictors differed for each improvement. In conclusion, the *Activate Your Health* WHPP was successful in helping some employees with suboptimal health. A higher number of interventions appeared to be more beneficial. To be more effective, WHPPs should document the initial intention to improve various lifestyle habits and target interventions based on the intentions and needs of employees.

Keywords: Association, Canada, Employees, Health, Occupation, Work.

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BMI	Body mass index
CCHS	Canadian Community Health Survey
CHMS	Canadian Health Measure Survey
CI	Confidence interval
CBT	Cognitive-behavioural therapy
ES	Effect size
HRA	Health-risk assessment
INT $	International dollar
OR	Odds ratio
PA	Physical activity
RCT	Randomized controlled trial
RR	Relative risk
ROI	Return on investment
MVPA	Moderate-to-vigorous physical activity
WHPP	Workplace Health Promotion Program

To my parents who sacrificed their lives for us

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Introduction

Chronic diseases, also known as noncommunicable diseases, require long-term care and have become more prevalent throughout the years (World Health Organization & Public Health Agency of Canada, 2005). They account for 71% of all deaths annually (World Health Organization, 2021). More than 15 million adults between 30 and 69 years of age die prematurely every year due to these diseases (World Health Organization, 2021). Having a healthier diet, being physically active regularly and abstaining from smoking can prevent substantial cases of cardiovascular diseases, such as heart disease and stroke, as well as type 2 diabetes (World Health Organization, 2009). A considerable percentage of cancers can also be prevented via these health behaviours (World Health Organization, 2009). As a result, healthy lifestyle habits can also reduce mortality, with greater effects when they are combined (Dam et al., 2008; Kvaavik et al., 2010; Menotti et al., 2014). Thus, according to the World Health Organization, one of the most important ways to tackle this global issue is to control unhealthy lifestyle habits, and its department for the prevention of chronic diseases has decided to concentrate on this direction (World Health Organization, n.d.).

Although adopting and maintaining healthy lifestyle habits can provide many benefits, in 2016, 28% of adults worldwide did not meet the recommendations of 150 minutes of moderate intensity or 75 minutes of vigorous intensity physical activity (PA) per week (Guthold et al., 2018). It was estimated that, in 2015, 20% of individuals aged 15 years and older were tobacco smokers (World Health Organization, 2018b). Also, 43% of the population aged 15 years and older reported drinking alcohol in the past year (World Health Organization, 2018a). Canada is not an exception when it comes to non-compliance to recommendations of healthy lifestyle habits. In fact, based on the 2016-2017 Canadian surveys, 84% of adults between 18 and 79 years old did not reach the national recommendation of 150 minutes of moderate-to-vigorous PA (MVPA) in bouts of 10 minutes (Clarke et al., 2019). Also, 71% of Canadians aged 12 years and older did not eat fruits and vegetables at least 5 times per day (Statistics Canada, 2019).

In a report published in 2007, the World Health Organization recommended that health promotion at work be stimulated even further (World Health Organization, 2007). This setting is ideal for the promotion of healthy lifestyle habits since people spend nearly eight hours of their day at work (US Bureau of Labor Statistics, 2020). Moreover, a large proportion of the population can be reached at once if programs are implemented in large companies (Dishman et al., 1998). Multiple levels of influence, for example organizational and individual levels, can be targeted at the workplace (Engbers et al., 2006; Engbers et al., 2005; Proper et al., 2003a). There are also established communication channels within each organization that can facilitate health promotion efforts (Bull et al., 2008).

Many studies have inquired into the effects of health promotion programs offered at work. These so-called workplace health promotion programs (WHPPs) have shown positive effects on employees' health- and work-related parameters (Cancelliere et al., 2011; Muto & Yamauchi, 2001; Parks & Steelman, 2008; Proper & Van Oostrom, 2019; Tarro et al., 2020). Healthy workers can benefit companies by improving company productivity and success; indirectly they can contribute to improvements in society at large (Burton, 2010). However, no studies have examined the effects on worker's health and lifestyle habits of varying number of interventions within the same program. Moreover, several systematic reviews and meta-analyses have stated that these programs have small or limited effectiveness on health and/or lifestyle habit-related outcomes (Conn et al., 2009; Fisher et al., 1990; Geaney et al., 2013; Lee et al., 2014; Malik et al., 2014; Marshall, 2004; Redeker et al., 2019; Robbins et al., 2019; Wong et al., 2012; Yuvaraj et al., 2019). Additionally, a recent systematic review by Muir et al. (2019) mentioned that most studies investigate the effectiveness of WHPPs and did not further explore for whom those programs were the most or the least beneficial in terms of health behaviour changes. Furthermore, we wanted to explore the association between baseline intention and its behavioural improvement following a multimodal WHPPs targeting multiple lifestyle habits in workers in Quebec because several theories suggest that intention and behaviour are associated (Ajzen, 1985, 1991; Prochaska & Velicer, 1997; Schwarzer, 2008).

Capsana is an organization that has existed in Canada for more than 30 years (Capsana, 2020). It has been promoting health and healthy lifestyle habits and preventing and managing chronic diseases. It created a health promotion program at work called the *Activate Your Health* program that included a research component. The program was composed of an increasing number of intervention packages called "options": *Control*, *Light*, *Moderate*, and *High*. The interventions included PA, eating habits, sleep habits, smoking habits, alcohol consumption and psychological well-being. Various types of interventions were part of the program depending on the option: in person vs. web-based, tailored vs. group, and organizational vs. individual level. There were also two optional interventions that were offered to companies depending on their option choice: an informational/motivational session and a smoking cessation challenge.

In this thesis, the detailed description of the *Activate Your Health* program will be presented. The data collected by Capsana before and after the implementation of this WHPP will be analyzed to evaluate the effect of the program on many health and lifestyle-habit-related outcomes using a quasi-experimental study design. Then, to better understand the behavioural change in the context of the current program, employees' initial intention to improve various lifestyle habits as well their predictors will be analyzed. The association between employees' initial intention and behavioural improvement following the program will also be explored. Finally, the predictors of lifestyle habits and health risk factor improvements among employees who have the potential to improve at the baseline, who are the main targets of such programs, will also be investigated.

This thesis begins with a literature review as the first chapter on 1) healthy lifestyle habits in adults and the consequences of unhealthy habits; 2) health promotion at work; 3) WHPPs; and 4) the effectiveness of these programmes in improving lifestyle habits.

In the second chapter, Article 1 on the study protocol detailing the *Activate Your Health* program is presented. This chapter will provide the information regarding this program that is necessary to better understand and interpret its results. Information regarding the data collection, the data management committee, the study population, the option allocation, the interventions included in each option and the description of each intervention are included.

In the third chapter, Article 2 refers to the impact of the *Activate Your Health* program, which is a partnership study.

The fourth chapter includes Article 3, which explored the predictors of initial intention and the association between intention and behavioural change following the program.

The fifth chapter presents the results of Article 4, which focused on the predictors of improvement in lifestyle habits and other health risk factors in individuals who had the potential to improve at baseline.

In the sixth chapter of this thesis, a general discussion on the main findings of all the studies will be presented.

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Chapter 1 – Literature review

This literature review will first summarize the necessary background on lifestyle habits. It will start by defining them, then surveying the different healthy lifestyle habits and their recommendations, investigate the prevalence of non-adherence to these health behaviours. This will be followed by showing the consequences of unhealthy lifestyle habits. The importance of the workplace as a setting for health promotion will be elaborated and the definition and types of WHPPs will be presented. Finally, the benefits of such programs for employers and employees will be discussed along with the results of systematic reviews and meta-analyses indicating limited evidence/conclusion and small effect sizes (ESs) of such programs on employees' health and lifestyle habits.

1.1 Lifestyle habits

1.1.1 Definition

It is important to state the definition of *behaviour*, *health behaviour*, and *lifestyle habit*. There are many definitions for *behaviour*, and Levitis and colleagues have addressed the lack of consensus on this word (Levitis et al., 2009). They surveyed professionals in behaviour-focused scientific societies with the goal of articulating a definition that is operational, essential, widely applicable and succinct. They stated that this term was "the internally coordinated responses (actions or inactions) of whole living organisms (individuals or groups) to internal and/or external stimuli, excluding responses more easily understood as developmental changes" (Levitis et al., 2009). In this thesis, one of the early definitions of behaviour would be sufficient, even if it may include activities such as breathing and thinking as behaviour: "what animals do" (Davis, 1966, cited in Levitis et al., 2006). A *health behaviour*, or *health-related behaviour*, is an observable action that individuals take, which affects their health positively or negatively (Godin, 2012; Short & Mollborn, 2015). Some examples of behaviours are tobacco use, engaging in PA, using seat belts, ensuring protection from the sun, and flossing teeth.

A *habit* is defined as a behaviour that is repetitive, usually happens without conscious thought and is cued by a specific context (Wood & Neal, 2009, cited in Gardner, 2015). Essentially, a behaviour that has been repeated a number of times no longer requires cognitive effort to perform it, and there is a gradual transfer from intentional to automatic processes that get triggered by situational or contextual cues (Nilsen et al., 2013). For example, brushing teeth before going to bed becomes a habit that is cued by bedtime, and buckling a seatbelt by getting into a vehicle. These behaviours are performed without consciously thinking about them. For instance, a person could learn to go for a jog in such a way that it becomes automatic. As a behaviour becomes a habit, it allows an individual to use mental resources for other activities such as a performing a novel or challenging task or thinking about a topic (Nilsen et al., 2013). When intervention targeting a certain healthy behaviour is offered, for example, being physically active most days of the week, making it a habit may prevent relapsing into old behaviour and allow this new behaviour to be maintained over time even after the study or intervention (Lally et al., 2008; Lally & Gardner, 2013). In the current thesis, habit was not measured.

Lifestyle, a term often used in media, is another word that has many definitions (Jensen, 2007). Jensen (2007) mentioned that this word is used to describe a “manner of living or way of living.” Other authors have used it to refer to the group of health-related factors such as tobacco use, exercise, and fat intake (Jensen, 2007). Conceptually there is a difference between habit and behaviour as described above. For the sake of simplicity and coherence throughout this thesis, which includes published articles, the word *lifestyle habits* will be used interchangeably with *health behaviours*. In the current thesis, the word *lifestyle habit* will refer to one of the following health behaviours: PA, eating habits, sleep habits, smoking, alcohol consumption and stress management. In addition, a lifestyle habit could be considered as a subset of behaviours. In the current thesis, a *healthy lifestyle habit* will be referred to a behaviour that has a positive impact on an individual’s health. The World Health Organization stated a similar definition (“healthy lifestyle”) in one of its early reports: “A way of living that lowers the risk of being seriously ill or dying early” (World Health Organization, 1999, p.1). Their definition included two additional aspects: enjoyment of life and helping one’s family, for example, by acting as a role model or creating a healthy environment (World Health Organization, 1999). Healthy lifestyle habits that will be discussed throughout this thesis are being physically active, eating healthy, having a good quality and duration of sleep, not using tobacco products, consuming moderate amount of alcohol and exhibiting good stress management.

1.1.2 Recommendations of healthy lifestyle habits

There exist recommendations for healthy lifestyle habits. The national Canadian guidelines for healthy lifestyle habits are summarized in Table 1. Recently, Canada released new guidelines incorporating all activities performed in a day, including PA, sedentary behaviour, and sleep habits, because studies have shown that movement behaviours in a day are associated with health benefits (McGregor et al., 2018; McGregor et al., 2019; Ross et al., 2020). Sedentary behaviour will be discussed later (section 6.4). After nearly 11 years, the Canadian Food Guide has also been updated. The last version contained a specific number of servings to consume daily based on age and sex for each of the following food group: fruits and vegetables, grain products, milk and alternatives, and meat and alternatives (Government of Canada, 2007). The latest guidelines (i.e., 2019 Food Guide) illustrate (Table 1) the proportion that each of the following food groups should occupy on a typical plate, regardless of age and sex: fruits and vegetables, protein foods, and whole-grain foods (Health Canada, 2019). The guidelines also emphasize the importance of plant-based foods because their consumption has been associated with decreased risk of cardiovascular diseases, cardiovascular risk factors, colon cancer and type 2 diabetes (Health Canada, 2019). As for tobacco use, the guidelines recommend that Canadians of any age not to smoke and encourages smokers to stop (Gouvernment of Canada, 2015, 2021). Finally, there are guidelines for alcohol consumption called “Canada’s Low-Risk Alcohol Drinking Guidelines” that suggest a number of drinks per day and a maximum number of drinks per week based on sex (Canadian Centre on Substance Use and Addiction, 2018). For each lifestyle habit Canada recommends the course individuals should follow to be healthy.

Table 1 - National healthy lifestyle habit recommendations for Canadian adults.

Lifestyle habits	References Author (year)	Canadian recommendations for adults
Physical activity	Ross et al. (2020)	Minimum of 150 minutes of moderate to vigorous intensity weekly
Sedentary behaviour	Ross et al. (2020)	Eight hours or less of sedentary time per day (≤3h of recreational screen time; often try to break long seated periods)
Eating habits	Health Canada (2019)	Proportions on a healthy plate: • Fruits and vegetables: ½

		• Whole grains: ¼ • Protein food: ¼
Sleeping habits	Ross et al. (2020)	Seven to nine hours of good quality sleep regularly
Smoking	Government of Canada (2015)	Not smoking or quit smoking if current smoker
Alcohol consumption	Canadian Centre on Substance Use and Addiction (2018)	Women: ≤2 drinks per day on most days (maximum of 10 drinks per week) Men: ≤3 drinks per day on most days (maximum of 15 drinks per week)

1.1.3 Non-adoption of healthy lifestyle habits

Although recommendations for various lifestyle habits have been established and have existed for decades, this has not done enough to encourage individuals to adopt healthy lifestyle habits. A considerable proportion of the population does not adhere to recommendations. The term "adherence" has been defined as the extent to which a certain health or medical recommendation/advice given by a health care provider matches the behaviour exhibited by an individual (Haynes et al., 2002; World Health Organization, 2003). For instance, taking at least 80% of a prescribed dose of medication signifies medication adherence (Nieuwlaat et al., 2014). Adherence could be used interchangeably with "concordance" or "compliance," and it is not meant to be judgmental or to place the blame on any actors, i.e., neither the patient nor health professional issuing the medical advice (Haynes et al., 2002).

Some reasons for not adhering to a certain medical regimen are not providing proper instructions, an unhealthy relationship between health professional and patient, and lack of financial resources to afford treatment (Haynes et al., 2002). Leijon and colleagues (2011) studied reasons for not adhering to PA referrals, defined as a written PA prescription. Primary health care providers gave a prescription to 1,358 patients who had a "sedentary lifestyle" or who might otherwise benefit from becoming physically active due to their diagnosis (Leijon et al., 2011). The reasons for non-adherence to referrals varied based on where the activity had to be performed, i.e., at home or at a facility. For example, among patients who were referred to activities based at a facility, economic factors were the most common reason, whereas, among those who were prescribed home-based activities, low motivation was the most frequent reason for non-adherence (Leijon et al., 2011). Moreover, certain characteristics also influenced the reasons for non-adherence. For instance, while older individuals reported sickness and pain as main reasons, younger patients mentioned economic factors and lack of time (Leijon et al., 2011). Other reasons for non-adherence to healthy lifestyle habit recommendations were the complexity of the recommendations and instructions, health literacy/language barriers, depressive symptoms, patients' beliefs, and interpretation of behaviour change, especially behaviours that do not have immediate benefits (Martin et al., 2005; Stonerock & Blumenthal, 2017).

In the current thesis, not complying with national or provincial health recommendations was considered as non-adherence. For example, the Canadian Society for Exercise Physiology recommends adults between 18 and 64 years old to do at least 150 minutes of MVPA per week. An individual who does not achieve this recommendation is considered as non-compliant. Researchers have examined barriers to adoption or improvement of lifestyle habits (Carter-Pokras et al., 2011; Gough & Conner, 2006; Liang & Ploderer, 2016; López-Azpiazu et al., 1999; O'Kane et al., 2008; Seguin et al., 2014; Villanti et al., 2016). For instance, two main barriers for adopting healthy eating habits and undertaking PA were lack of time and willpower in rural men (Gabrielle et al., 2008). Participants from rural regions also mentioned other reasons such as tiredness and social norms for not being physically active (O'Kane et al., 2008; Seguin et al., 2014). Even active transport was associated with a negative stigma. For example, going to work by bicycle could be seen as the loss of a driver's license (Seguin et al., 2014). For smoking cessation, among adults aged 18-24 years who were either former or current smokers, not knowing how to handle stress and craving/withdrawal were the most prevalent barriers for quitting (Villanti et al., 2016). These studies show that there are many reasons why individuals do not adopt healthy lifestyle habits and, depending on the lifestyle habit, these reasons vary.

The following section summarizes the prevalence of non-adoption of healthy lifestyle habits in the world followed by their prevalence in Canada. Both show that a significant proportion of adults in the world and in Canada do not adopt healthy lifestyle habits.

1.1.3.1 Physical activity

Nearly 1.4 billion adults, 28% of the world's adult population, did not meet World Health Organization's recommendations of at least 150 minutes of moderate intensity or 75 minutes of vigorous intensity PA per week in 2016 based on surveys (Guthold et al., 2018). Worldwide, a third of women and a fourth of men are not sufficiently active (Guthold et al., 2018). The prevalence of physical inactivity by sex was higher in high-income countries compared to low-income countries (37% vs. 16%) (Guthold et al., 2018). However, even within the same country the prevalence of physical inactivity could vary significantly and reach 80% in certain subpopulations of adults (World Health Organization, 2019). Thus, while the prevalence of physical inactivity may vary depending on the country, the important point to note is that inactivity is regularly prevalent in a significant proportion of the population.

In Canada, Clarke and colleagues analyzed PA levels of adults aged 18-79 years old between 2007 and 2017 using accelerometer derived data from different cycles of Canadian Health Measure Survey (CHMS) (Clarke et al., 2019). They found that there was no significant trend in MVPA throughout years. While nearly 3% of Canadians did not accumulate any MVPA, 36% did not accumulate any in bouts of 10 minutes (Clarke et al., 2019). Also, 55% of adults did not meet the weekly 150 minutes of MVPA PA guidelines, with men accumulating more than women. However, a higher proportion of individuals (84%) did not meet the weekly 150 minutes of MVPA Canadian PA guidelines in bouts of 10 minutes or more (Clarke et al., 2019). There was no sex difference in this proportion. The proportions of physical inactivity in Canada are higher than the ones reported by the World Health Organization above. It is important to note that the Canadian data were objectively measured, a method known to result in lower numbers of PA than reported data (Colley et al., 2018; Dyrstad et al., 2014). All these numbers show that a large proportion of Canadians do not meet the guidelines for PA.

1.1.3.2 Eating habits

A recent study by Micha and colleagues (2015) analyzed the consumption of food from the major food groups between 1990 and 2010 in 113 counties in individuals aged ≥20 years. The authors reported that mean global daily fruit intake increased and only two countries achieved the recommendation of ≥300 g daily. There was no change in the mean global daily vegetable intake between those two-time points. Also, there was a decrease in global whole-grain intake (Micha et al., 2015). Furthermore, globally, mean intakes of fruits, vegetables, and whole grains were below recommendations (Micha et al., 2015). More recently, the mean vegetable intakes of adults aged 18 years and older in 162 countries were below recommended levels, with 88% of countries displaying intakes below recommendations (Kalmpourtzidou et al., 2020). These data show that non-compliance to eating habits recommendations in the world is a challenge.

Krueger et al. (2017) studied the proportion of Canadians who fulfilled or exceeded the 2007 Canada's Food Guide's recommendation of fruit and vegetable servings per day. To do so they used the data from the Canadian Community Health Survey (CCHS) between 2000/2001 and 2012. The data included those aged <18 years old. The authors found that more than three out of four Canadians did not meet Canada's food guide recommendations. Overall, Canadians of all ages had mean servings of fruits and vegetables less than six per day (Krueger et al., 2017). In addition, among those aged ≥18 years old, women had a higher consumption than men (4.7 vs. 4.1 servings, respectively). More recently, based on the CCHS 2017, 71% of Canadians aged 12 years old and older did not consume fruits and vegetables ≥5 times per day (Statistics Canada, 2019). Compared to 2015's data, this percentage is lower, and a decreasing trend has been observed (Statistics Canada, 2019). In a comparison of the sexes, men were less likely to reach fruit and vegetable consumption at least five times per day compared to women: 78% vs. 65% (Statistics Canada, 2019). Quebec was the province with the highest percentage of citizens (35%) eating fruits and vegetables five or more times per day (Statistics Canada, 2019). Even though it is higher compared to other provinces, there are still many Quebecers who do not achieve these targets. Thus, many Canadians also do not comply with national recommendations for eating habits, with men exhibiting lower consumption than women.

1.1.3.3 Sleep habits

There seems to be a lack of reports by the World Health Organization on sleep duration and sleep habits in the adult population. To put into perspective the Canadian sleep habit data, data from other countries and relevant studies will be presented. Steptoe et al. (2006) analyzed self-reported data of students aged 17 to 30 years old in 24 countries, excluding Canada, in 1999-2001. They reported that 63% of them slept for 7-8 hours and 21% slept <7 hours. Ford et al. (2015) used data from the National Health Interview Survey in 1985, 1990, and 2004-2012, surveying adults aged 18 years and older from the United States. In 2012, on average, adults got 7.2 hours of sleep adjusted for age, which was slightly but significantly lower than in 1985 (7.4 hours). Moreover, the age-adjusted proportion of individuals sleeping ≤6 hours was 29% in 2012. Thus, there are at least 20% of the world's adult population who do not get enough sleep, and this prevalence has increased.

A Canadian study published in 2017 used self-reported data from the CHMS data from 2007 to 2013 (Chaput et al., 2017). The authors observed that Canadians aged between 18 and 64 years old had on average 7.1 hours of sleep per night. Additionally, 35% of adults did not meet the recommended 7-9 hours of sleep per night. Women had longer sleep duration than men (7.2 vs. 7.0 hours per night). Moreover, in this age group, 43% of men and 55% of women reported having trouble going to sleep or staying asleep sometimes, most of the time or all the time (Chaput et al., 2017). More recently, based on CHMS 2014-2015, a quarter of adults between 18 and 79 years old do not respect the current recommendations of 7-9 hours of sleep per night (Public Health Agency of Canada, 2019). Also, one out of two adults had trouble going to sleep or staying asleep (Public Health Agency of Canada, 2019). These results indicate that at least half of adults have trouble going to sleep. More importantly, a significant percentage of Canadians do not comply with the recommendations, and thus do not get enough sleep.

1.1.3.4 Smoking

Based on a World Health Organization report, in 2015, among individuals aged ≥15 years old, 20% were "current smokers" (World Health Organization, 2018b). Since 2000, the prevalence of smoking rates has decreased worldwide. The prevalence of smoking was projected to continue decreasing and reach prevalence of 19% and 17% in 2020 and 2025, respectively. The prevalence of smoking was higher in men than women, and the prevalence was the highest among individuals aged 45-54 years (World Health Organization, 2018b). Across all age groups, the prevalence of smoking has been decreasing (World Health Organization, 2018b). Overall, between 2000 and 2015, the prevalence of tobacco smoking declined in most World Health Organization regions and appeared to be flat in African and East Mediterranean regions (World Health Organization, 2018b). When countries were separated by income groups, in 2015, the prevalence of smokers in high-income groups, upper-middle income groups, lower middle income groups and low income groups were 25%, 23%, 17% and 12%, respectively (World Health Organization, 2018b). Thus, their seems to be a positive association between smoking prevalence and a country's income level (World Health Organization, 2018b). It is projected that this prevalence will decrease in most regions except in men who live in the Eastern Mediterranean Region, in which it was expected to further increase by 2025 if this lifestyle habit is not tightly controlled (World Health Organization, 2018b). Although the prevalence of smokers seems to be decreasing, there is an important proportion of adults who still smoke in the world.

In Canada, based on the CCHS 2015-2018, which inquired about cigarette smoking, the prevalence of daily or occasional smokers was 16% in individuals aged 12 years and older (Statistics Canada, 2019). The prevalence of daily or occasional smokers declined from 2015 to 2018 in both sexes. When stratified by sex, a larger proportion of men were daily or occasional smokers compared to women (19% vs. 13%, respectively). Similar prevalences are reported by the Canadian Tobacco and Nicotine Survey among Canadians aged 15 years and older in 10 provinces (Gouvernment of Canada, 2020). It stated that 12% of Canadians were daily or occasional smokers in 2019 (Gouvernment of Canada, 2020); three times more individuals were daily smokers compared to occasional smokers (9% vs. 3% respectively). There was a higher proportion of men who were occasional smokers in comparison with the prevalence in women (Gouvernment of Canada, 2020). It is important to note that, although the prevalence of smokers is low, it still represents a significant number of Canadians who smoke cigarettes, which is known to have numerous negative repercussions on health (Office of the Surgeon General (US) & Office on Smoking and Health (US), 2004).

1.1.3.5 Alcohol consumption

Worldwide, in 2016, among individuals aged 15 years and older, 2.3 billion (43%) were considered current drinkers and 2.4 billion (45%) had never consumed alcohol (World Health Organization, 2018a). Fifty-seven percent of people abstained from drinking alcohol in the past year (World Health Organization, 2018a). In addition, in comparison with men, women were less often considered current drinkers, and they drank less when they consumed (World Health Organization, 2018a). Compared to the year 2000, the proportion of drinkers has decreased by 5%. Moreover, it decreased in most World Health Organization regions since 2000 except in the Western Pacific and South-East Asia regions, where it has increased and remained stable respectively (World Health Organization, 2018a). A large adult population worldwide are current drinkers even if the proportion of drinkers has decreased.

Based on the Canadian Alcohol and Other Drug Use Monitoring Survey 2013, 16% of individuals aged 15 years and older exceeded the national low-risk alcohol drinking guidelines (Public Health Agency of Canada, 2017). A larger proportion of men exceeded the recommendations compared to women (19% vs. 13%). Across age groups, there were significantly more individuals exceeding the guidelines among Canadians aged between 25 and 34 years old compared to those aged 50 years and older (Public Health Agency of Canada, 2017). In 2017, among Canadians aged 15 years and older, 78% had consumed alcohol in the past year (Health Canada, 2017). Thus the number of Canadians who abstained from drinking in the past year was much lower than the worldwide percentage presented above. Moreover, among those who had consumed alcohol in the past year, 21% and 15% of those were considered to be exceeding the Canadian alcohol consumption guidelines for chronic and acute effects, respectively (Health Canada, 2017). Additionally, men were more likely than women to exceed these guidelines. These results indicate that in Canada, a considerable number of individuals do not adhere to alcohol consumption recommendations.

1.1.3.6 Stress management and chronic stress

There seems to be a lack of data on stress management from the World Health Organization; For Canada some prevalence was found, but data on perceived stress will be used to complement. Based on the most recent available data of the CCHS on the ability to handle stress, 83% of Canadians aged 12 years and above reported that they had a good or excellent ability to handle unexpected and difficult problems (Statistics Canada, 2020c). Additionally, 91% of individuals aged 12 years and above reported that they had a good or excellent ability to handle the day-to-day demands in life (Statistics Canada, 2020c). As for stress levels, based on the CCHS 2016, 22% of individuals aged 12 years and older reported that their life was either "quite a bit" or "extremely" stressful most days in the past year (Branchard et al., 2018). In 2019 and 2020, this percentage decreased slight by 1 and 2%, respectively (Statistics Canada, 2020a). Considering these data, it could be understood that most Canadians have at least good perceived stress management. There is a reasonable proportion of individuals who perceive their life to be quite a bit stressful and this in the past year. In certain sub-group of the population stress seems to be more important. For example, in Canadian workers the prevalence of reported stress is higher. Specifically in workers, based on the most recently available results of the General Social Survey data, in 2010, 46% reported that their lives were "a bit" stressful on most days (Crompton, 2011). Additionally, 27% of workers aged 20 to 64 years old reported that their lives were either "quite a bit" or "extremely" stressful on most days without a significant sex difference. Among these highly stressed individuals, work was the main source of stress for 1 out of 5 employees (Crompton, 2011). Employees with good and fair-to-poor mental health were 1.7 and 3.7 times more likely to report high stress levels, respectively, compared with very good to excellent mental health (Crompton, 2011). These findings are probably greatly increased through the COVID-19 sanitary crisis. This section highlights the importance of stress management in Canadian workers especially regarding occupational stress.

1.1.3.7 Lifestyle habit profile in Canada: A quick look

Using the CHMS 2012-2013 and CCHS 2014, in Canadians aged 20 years and above, key modifiable risk behaviours were studied: physical inactivity, unhealthy eating, heavy drinking, and daily or occasional smoking (Public Health Agency of Canada, 2017). Across all age groups, a majority of individuals (>56%) was identified as being at risk for physical inactivity and unhealthy eating (Public Health Agency of Canada, 2017). The prevalence of physical inactivity was lowest in Canadians aged 20-34 years old (Public Health Agency of Canada, 2017). In the same 20-34 age group prevalence for smoking and heavy drinking was highest (Public Health Agency of Canada, 2017). Figure 1 depicts the proportion of Canadians per number of risk behaviours (0, 1, 2, 3, or 4) was also reported in Canadians aged 20 years and above based on self-reported data (Public Health Agency of Canada, 2017). In 2014, at least 8 out of 10 Canadians lived with at least one of the four key modifiable risk behaviours, and 2% of Canadians had all four risk factors (Public Health Agency of Canada, 2017). These numbers show that most Canadians do not adopt healthy lifestyle habits, again reinforcing Canadian non-compliance with established recommendations.

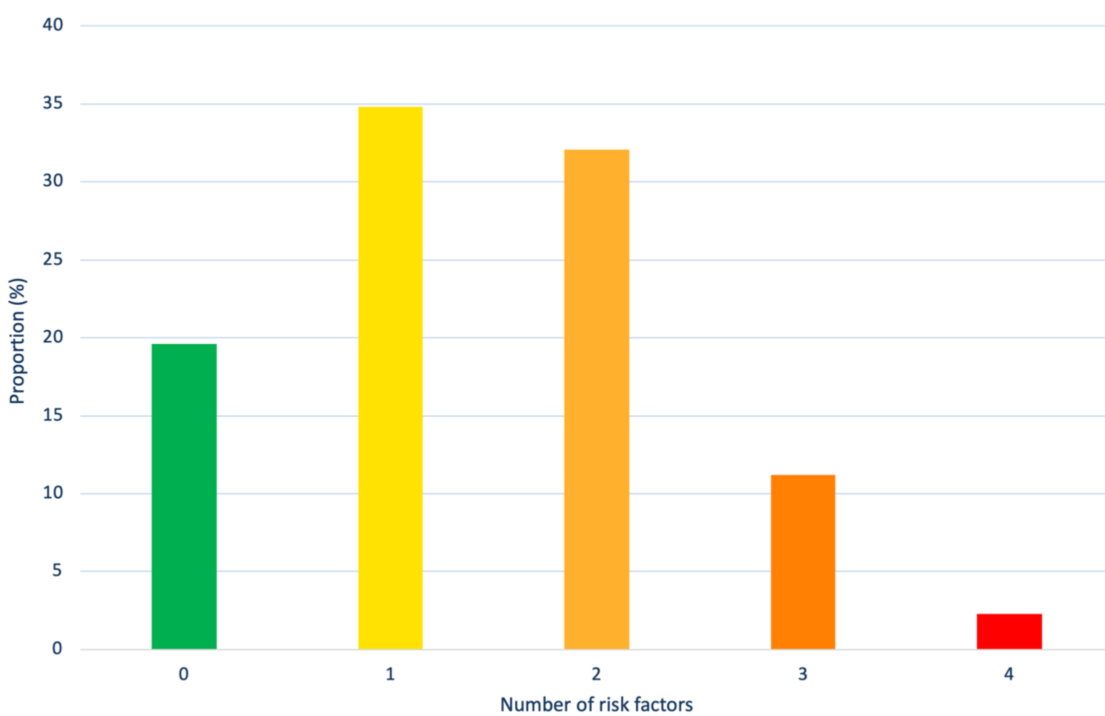

Figure 1. – Proportion of Canadians ≥20 years old per number of risk factors (high alcohol consumption, daily or occasional smoking, physical inactivity, <5 times per day consuming fruits and vegetables).

Source: How Healthy are Canadians? Public Health Agency of Canada, 2017. Adapted and reproduced with permission from the Minister of Health, 2021.

1.1.4 Consequences of unhealthy lifestyle habits

Based on the above section, while a proportion of adults make healthy choices, a significant proportion of adults around the world, including in Canada, do not comply with healthy lifestyle habits and adopt risky ones such as heavy alcohol consumption and daily/occasional smoking. Non-adoption of healthy lifestyle habits can have many negative consequences on an individual's physical and mental health and financial resources. These consequences do not end at an individual level; they also impact the societal level. In the remaining portion of this section, some health (physical and mental) and financial consequences of unhealthy lifestyle habits will be discussed, highlighting the importance of focusing on this issue.

1.1.4.1 Chronic diseases

One of the consequences of unhealthy lifestyle habits are chronic diseases. Figure 2 illustrates the relationship between unhealthy lifestyle habits, intermediate risk factors and main chronic diseases, also called non-communicable diseases (World Health Organization, 2021; World Health Organization & Public Health Agency of Canada, 2005). Unhealthy lifestyle habits increase the risk of intermediate risk factors such as high blood pressure, elevated blood glucose, abnormal blood lipids and overweight/obesity (World Health Organization & Public Health Agency of Canada, 2005). While unhealthy lifestyle habit such as tobacco use and insufficient sleep habits can have negative consequences on glycemia, risk of hypertension or blood lipid profiles (Bornemisza & Suciu, 1980; Chattu et al., 2018; Gutiérrez Moreno et al., 1991), adopting healthy ones can have many positive effects on the above-mentioned intermediate risks as presented below.

For example, studies have observed an inverse relationship between PA and incidence of hypertension, and it has been concluded that PA could prevent hypertension (Diaz & Shimbo, 2013). A meta-analysis of randomized controlled trials (RCTs) identified 25 articles examining the effect of aerobic exercise on high-density lipoprotein cholesterol (Kodama et al., 2007). There was a slight change in high-density lipoprotein of +0.07 mmol/L [95% confidence interval (CI): 0.04 to 0.10] with 120 minutes of exercise weekly (Kodama et al., 2007). A systematic review and meta-analysis by Conn and colleagues (2014) reported that exercise interventions had a moderate effect of insulin sensitivity among the 78 reports that were included, with treatment group benefiting compared to control. The mean ESs were 0.38 (95% CI: 0.25 to 0.51) and 0.43 (95% CI: 0.30 to 0.56) for 2-group post-intervention comparisons and 2-group pre–post comparisons, respectively (Conn et al., 2014). These results show the positive effects of PA on intermediate risk factors, thereby showing the importance of adopting this lifestyle habit.

Eating habits can also decrease these intermediate risk factors. In fact, in their meta-analysis of 67 controlled trials, Brown et al. (1999) estimated that total cholesterol and low-density lipoprotein cholesterol decreased by -0.05 mmol/L • g soluble fiber (95% CI: -0.05 to -0.04) and -0.06 mmol/L • g soluble fiber (95% CI: -0.07 to -0.04) respectively, for an intake of 2-10 grams water-soluble dietary fibre per day. A meta-analysis of 38 controlled trials by Anderson et al. (1995) estimated that, when compared with control diet, soy protein intake was associated with net changes in total cholesterol (-0.60 mmol/L, 95% CI: -0.35 to -0.85), low-density lipoprotein cholesterol (-0.56 mmol/L, 95% CI: -0.30 to -0.82), and triglycerides (-0.15 mmol/L, 95% CI: -0.01 to -0.29). A systematic review and meta-analysis (17 RCTs) reported that the Dietary Approaches to Stop Hypertension diet can decrease systolic and diastolic blood pressure by 6.74 (95% CI: -8.25 to -5.23) and 3.54 (95% CI: -4.29 to -2.79) mmHg, respectively (Saneei et al., 2014). Therefore, adopting this healthy lifestyle habits can have positive effects on the individual's health.

Studies published in the late 1900's have shown that high alcohol consumption is associated with higher blood pressure (Cooke et al., 1982; Jackson et al., 1985; Keil et al., 1989; Zakhari, 1997). Indeed, intake of more than two drinks daily, which was considered heavy consumption, was associated with increased blood pressure. A systematic review and meta-analysis (N = 36 trials) examined the impact of reducing alcohol consumption on blood pressure (Roerecke et al., 2017). Studies had to report a "quantifiable change in average alcohol consumption that lasted at least 7 days and a corresponding change in blood pressure" (Roerecke et al., 2017). Among heavy alcohol consumers, reducing their consumption to near abstinence was associated with improvement in systolic and diastolic blood pressure (Roerecke et al., 2017). The largest decrease in blood pressure was observed in those who had a baseline intake of more than 6 drinks per day (mean difference in systolic blood pressure = -5.50 mmHg, 95% CI: -6.70 to -4.30; mean difference in diastolic pressure = -3.97 mmHg, 95% CI: -4.70 to -3.25) (Roerecke et al., 2017). These findings show the influence of high alcohol consumption on an intermediate risk factor of chronic diseases, which is high blood pressure.

Although not identified as one of the common modifiable risk factors of main chronic diseases (Figure 2), unhealthy sleep habits can also negatively impact these intermediate risk factors (Abdurahman et al., 2020; Guo et al., 2013). One intermediate risk that could be influenced by sleep habits is abnormal lipid profile as observed in the systematic review and meta-analysis of Abdurahman et al. (2020). Among the 13 included cross-sectional studies sleep duration qualified as ≥8 hours was associated with the risk of high total cholesterol in individuals of all ages (Abdurahman et al., 2020). The authors also stated that there was a dose-response relation between the different sleep categorizations in long sleepers and high total triglycerides, low high-density lipoprotein, high total cholesterol (Abdurahman et al., 2020). They concluded that well-designed prospective study on a larger scale is needed to better understand the association (Abdurahman et al., 2020). A recent cross-sectional study in a Chinese population observed that there was a "U-shaped" relationship between sleep duration (<7, 7-<8, 8-<9, and ≥9 hours) and high total cholesterol and high low-density lipoprotein cholesterol in adults (Du et al., 2022). It is important to note that the effects of sleep duration on certain lipid profile outcomes seem to vary from one study to another. This could be due to the different categorization of sleep duration, the definitions of abnormal lipid levels, the covariates, the assessment methods of these variables, and the characteristics of the study population in these adults studies (Abdurahman et al., 2020; Du et al., 2022; Song et al., 2020). There is evidence that sleep duration, especially short duration, elevates blood pressure and increases the risk of hypertension in adults (Dean et al., 2012; Guo et al., 2013; Makarem et al., 2019). Therefore, poor sleep habits can negatively affect intermediate risk factors of chronic diseases.

Stress management is another lifestyle habit that is not present in Figure 2 but could influence intermediate risk factors directly and indirectly. This could be explained by the fact that high stress levels can affect blood pressure and blood glucose levels (Gasperin et al., 2009; Steptoe et al., 2005; Wing et al., 1985). For example, a meta-analysis of six cohort studies with a mean follow-up duration of 11.5 years reported that compared to people who responded weakly to a stressful task, those who had a stronger response were 21% more likely to develop increased blood pressure (OR = 1.21, 95% CI: 1.14 to 1.28) (Gasperin et al., 2009). Steptoe and colleagues (2005) examined the effects of financial strain changes on blood pressure (measured ambulatory blood pressure) over three years. In this longitudinal study an association between systolic blood pressure and changes in financial strain was found after controlling for covariates [i.e., baseline systolic blood pressure and financial strain, gender, socioeconomic position, age, smoking, and body mass index (BMI)]. Compared to those who reported no change or "worse" financial strain (125.5 ± 11.5 mmHg), those who reported an improvement in financial strain had lower systolic pressure at 3-year (121.7 ± 11.2 mm Hg) (Steptoe et al., 2005). Stress management intervention can decrease blood pressure (Solano López, 2018). Moreover, stress can influence other lifestyle habits such as smoking and eating habits (Araiza & Lobel, 2018; Lee et al., 2006; Pool et al., 2015; Steptoe et al., 1998; Stubbs et al., 2017), which can indirectly influence the intermediate risk factors and the development of main chronic diseases. For instance, when stressed, certain individuals were observed to change their food choices (e.g., unhealthier and/or sweeter foods/sugar intake) (Araiza & Lobel, 2018; Epel et al., 2001; Hill et al., 2021; Steptoe et al., 1998; Wardle et al., 2000; Zellner et al., 2006). Thus, coping with high stress levels, i.e., stress management is an essential modifiable contributor for improving intermediate risk factors.

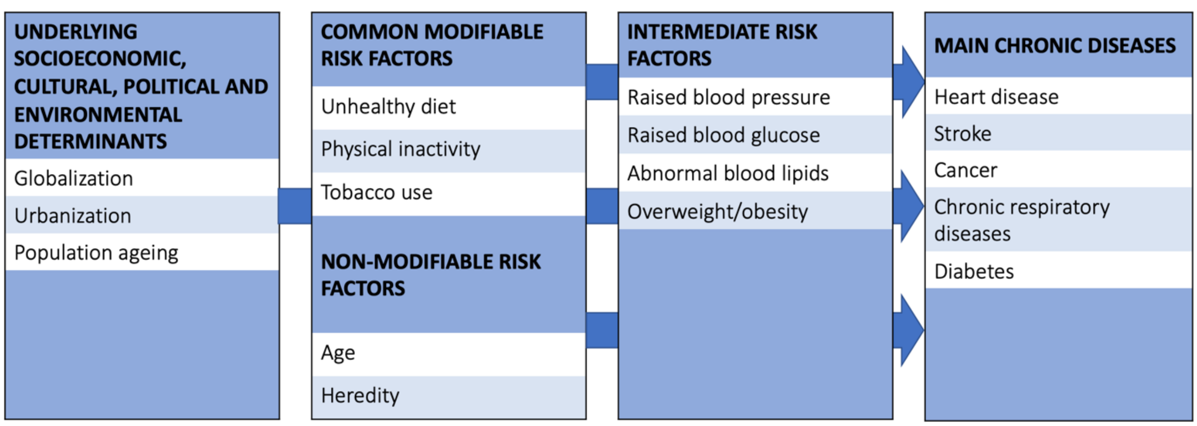

Figure 2. – Association between unhealthy lifestyle habits and major chronic diseases. Reprinted from Preventing Chronic Diseases a Vital Investment, World Health Organization, Page No. 48, Copyright (2021). Accessed on October 24, 2021 from https://apps.who.int/iris/bitstream/handle/10665/43314/9241563001_eng.pdf?sequence=1&isAllowed=y

The negative consequences of unhealthy lifestyle habits on intermediate risk factors can then lead to chronic diseases such as cardiovascular diseases, diabetes and chronic pulmonary diseases (World Health Organization & Public Health Agency of Canada, 2005). Figure 2 summarizes the association between major chronic diseases, intermediate risk factors, and unhealthy lifestyle habits (World Health Organization & Public Health Agency of Canada, 2005). Not adopting these healthy lifestyle habits can lead to the development of chronic diseases. In fact, doing PA, maintaining a healthy diet, and not smoking can decrease roughly 80% of heart disease, stroke, and type 2 diabetes, as well as prevent 40% of cancers (World Health Organization & Public Health Agency of Canada, 2005). Willett et al. (2006) summarized a convincing and probable relationship between lifestyle habits and chronic diseases. For instance, consuming "plenty of fruits and vegetables" can decrease the risk of cardiovascular diseases and cancer (Willett et al., 2006). Following are some findings to show the relationship between unhealthy lifestyle habits and chronic diseases.

PA could decrease the risk of developing cardiovascular diseases, type 2 diabetes and cancer (Willett et al., 2006). For example, compared to placebo, lifestyle habit intervention, which included 150 minutes of moderate-intensity PA, decreased the incidence of diabetes to a greater extent than metformin (58% vs. 31%) among individuals at high risk for diabetes (Knowler et al., 2002). A recent meta-analysis including 33 studies reported that individuals who reached 150 minutes of leisure time MVPA weekly reduced their risk of coronary heart disease by 14% (Sattelmair et al., 2011). Additionally, individuals who reached more than this amount, i.e., 300 minutes of MVPA per week decreased this risk by 20% (Sattelmair et al., 2011). More importantly, regarding coronary heart disease risk, doing less than recommendations was still more beneficial compared to no PA at all (Sattelmair et al., 2011). Interestingly, physical inactivity leads to chronic diseases, but individuals living with these diseases are less likely to become physically active and further decrease their ability to do PA and exercise (Durstine et al., 2013). This creates a downward spiral of deconditioning that can lead to loss of functional capacity, and eventually poor health status and quality of life (Durstine et al., 2013).

As for smoking, it can increase the risk of many chronic diseases. Smoking can increase the risk of cardiovascular diseases and cancers (Office of the Surgeon General (US) & Office on Smoking and Health (US), 2004). A systematic review and meta-analysis (25 prospective cohort studies) on smoking and the risk of type 2 diabetes observed that compared to “never smokers” the risk of diabetes was higher in individuals who smoked heavily [relative risk (RR) = 1.61, 95% CI: 1.43 to 1.80] and those who were light smokers (RR = 1.29, 95% CI: 1.13 to 1.48) (Willi et al., 2007). More importantly, when compared with current smokers, this risk was lower in those who quit (RR = 1.23, 95% CI: 1.14 to 1.33) (Willi et al., 2007). So, smoking cessation has clear benefits. A meta-analysis (N = 85 studies) reported that smoking and the risk of upper aerodigestive tract cancer were associated (RR = 3.47, 95% CI: 3.06 to 3.92), and that the risk remained high for ten years among those who quit (Ansary-Moghaddam et al., 2009). Compared to those who smoked only (RR = 2.56, 95% CI : 2.20 to 2.97), individuals who also drank alcohol had a RR of upper aerodigestive tract cancer of 6.93 (95% CI: 4.99 to 9.62), which is two times higher (Ansary-Moghaddam et al., 2009). This shows the impact of having two unhealthy lifestyle habits on chronic diseases. Regarding alcohol consumption alone, a fairly recent large cohort study followed 334,850 women for 11 years showed that for every increase in intake of alcohol of 10 g per day, the hazard ratio of developing breast cancer increased by 4% (95% CI: 3 to 6%) (Romieu et al., 2015). A report by the National Institute on Alcohol Abuse and Alcoholism on moderate drinking concludes that epidemiological studies seem to identify an association between alcohol consumption and the risk of breast cancer (National Institute on Alcohol Abuse and Alcoholism, 2000). However, moderate consumption had small relative effects, and it was “most clearly evident” that some profiles of women (i.e., family history of this cancer or use of estrogen replacement therapy) were at increased risk of breast cancer (Gunzerath et al., 2004). Shield and colleagues (2013) stated that there are many chronic diseases and conditions that have been causally linked to alcohol consumption only. Examples are alcoholic liver disease, alcoholic cardiomyopathy, and alcoholic gastritis. Some of these conditions (e.g., alcoholic cardiomyopathy) are due to, among other reasons, to long-lasting use of heavy alcohol consumption (National Institute on Alcohol Abuse and Alcoholism, 2000). Therefore, alcohol consumption and/or smoking can lead to chronic diseases.

Although sleep habits are not often included as one of the major lifestyle habits influencing the development of chronic diseases, poor sleep habits can also influence the development of chronic diseases. For example, a systematic review and meta-analysis observed that, among the included five longitudinal studies, short sleep duration qualified as ≤5 hours or ≤6h hours was associated with hypertension (RR = 1.23, 95% CI: 1.06 to 1.42) (Guo et al., 2013). Gangwisch et al. (2007) aimed to study the association between sleep duration and the incidence of diabetes in 8,992 individuals followed for 8 to 10 years. Short sleep duration of ≤5 hours increased the odds of presenting diabetes during the follow-up period (OR = 1.47, 95% CI: 1.03 to 2.09) (Gangwisch et al., 2007). This was obtained after controlling for covariates such as PA, alcohol consumption, age, depression, and ethnicity (Gangwisch et al., 2007). Additionally, when controlled for covariates, those who slept ≥9 hours were also more likely to present diabetes over the same follow-up period (OR = 1.52, 95% CI: 1.06 to 2.18). Furthermore, sleep habits can also have an impact on other lifestyle habits such as PA and eating habits (Beccuti & Pannain, 2011; Noorwali et al., 2018; Schmid et al., 2009). For example, short sleep time and low sleep quality could lead to metabolic and endocrine changes such as increased ghrelin levels and decreased leptin levels (Beccuti & Pannain, 2011). While ghrelin is a hormone that increases food intake, leptin is a hormone that lower it (Park & Ahima, 2015; Sato et al., 2011).

Simply to show the importance of tackling chronic diseases, the remainder of this section will show how chronic diseases account for the number of deaths. Chronic diseases have not stopped increasing throughout the years (World Health Organization & Public Health Agency of Canada, 2005), and World Health Organization (2021) reported that they accounted for nearly 71% of all deaths around the world at that time. The following chronic diseases accounted for these deaths, ranked by the most accountable to the least: cardiovascular diseases (17.9 million/year), cancers (9.3 million/year), respiratory diseases (4.1 million/year), and diabetes (1.5 million/year) (World Health Organization, 2021). These four chronic diseases alone accounted for over 80% of all premature death due to chronic diseases worldwide (World Health Organization, 2021). Therefore, more than half of all death is due to chronic diseases. It is important to note that physical inactivity, unhealthy diets, excessive use of alcohol and tobacco use, which are all modifiable risk factors, increase the risk of death from chronic diseases (World Health Organization, 2021). For example, physical inactivity could be responsible for 1.6 million deaths every year; excessive intake of salt or sodium could be responsible for 4.1 million deaths every year (GBD 2015 Risk Factors Collaborators, 2016, cited in World Health Organization, 2021).

The World Health Organization states that solutions to this issue exist and are cost-effective, and an important way is to decrease the four modifiable risk factors (World Health Organization, 2021; World Health Organization & Public Health Agency of Canada, 2005). The number of deaths due to unhealthy lifestyle habits shows why it is so important to tackle unhealthy lifestyle habits. Canada is not an exception when it comes to the growing cases of chronic diseases, which have been increasing due to a growing population which is also ageing and because of treatment and management innovations, which have extended the life expectancy of individuals living with diseases (Branchard et al., 2018). For example, the age-standardized incidence of heart disease and stroke had been decreasing, but the age-standardized prevalence had been increasing since the early 2000's (Public Health Agency of Canada, 2017). Nearly 8% and 3% of Canadians aged 20 years and above were diagnosed with ischemic heart disease and stroke respectively based on the Canadian Chronic Disease Surveillance System 2011/12 (Public Health Agency of Canada, 2017). Around 1 out of 10 Canadians aged 35 years and older lived with Chronic Obstructive Pulmonary Disease, and the age-standardized prevalence has been increasing (Public Health Agency of Canada, 2017). In Canada, more than 60% of all deaths were caused by chronic diseases and this has not changed between 2011 and 2019 (Statistics Canada, 2020b). These data show the increase in chronic diseases throughout the years and their significant contribution to the number of deaths. Moreover, individuals may live with multiple lifestyle habits as well. For example, based on CCHS 2016's data, 34% and 9% of Canadians aged 20 years and older reported being diagnosed with at least one and two, respectively, of the following major chronic diseases: cancer, diabetes, cardiovascular diseases, chronic respiratory diseases, and mood and/or anxiety disorders (Branchard et al., 2018). These percentages may be even higher when other chronic diseases are taken into accounted.

It is important to note that unhealthy lifestyle habits impact life expectancy. Indeed, a recently published Canadian study developed an algorithm to identify the burden of four unhealthy lifestyle habits on life expectancy using the CCHS 2009-2010 data (Manuel et al., 2016). Compared to Canadians who followed all recommendations for healthy lifestyle habits, the life expectancy of those who had the unhealthiest behaviour was 17.9 (95% CI: 17.7 to 18.1) years less (Manuel et al., 2016). Tackling these unhealthy lifestyle habits is essential simply because of the way they decrease life expectancy.

1.1.4.2 Functional limitations and injuries

Unhealthy lifestyle habits can also lead to functional limitations such as reduced cardiorespiratory fitness and musculoskeletal complaints, and even to injuries. For example, engaging in PA such as brisk walking 3-4 times per week for at least 30 minutes per day can improve cardiorespiratory fitness in individuals with low cardiorespiratory fitness (Ross et al., 2016). A meta-analysis including 24 RCTs consisting of 'brisk walking' programs showed that walking at an average intensity of 70% of predicted heart rate during 38.3 minutes/day on 4.4 days/week for 34.9 weeks improved healthy sedentary participants' cardiorespiratory fitness by 9% from a baseline value of 30.0 ± 5.0 $ml*kg^{-1}*min^{-1}$ (Murphy et al., 2007). Thus, being physically inactive can decrease cardiorespiratory fitness, which can increase functional limitation (Huang et al., 1998; Maslow et al., 2011).

Incorporating PA can also decrease problems related to the musculoskeletal system. Indeed, a Norwegian study by Holth et al. (2008) examined the association between physical inactivity and musculoskeletal complaints using the data of 39,520 individuals collected at two-time points: 1984-86 and 1995-97. Compared to never doing weekly leisure time physical "exercise" at baseline, being physically active decreased the odds (OR = 0.91, 95% CI: 0.85 to 0.97) of reporting chronic musculoskeletal complaints, which are defined as pain and/or stiffness lasting at least three months in the past, 11 years later (Holth et al., 2008). Additionally, individuals who increased their PA levels between the two time points had a lower prevalence both of chronic musculoskeletal complaints that were widespread (OR = 0.72, 95% CI: 0.56 to 0.92; ≥15 days with symptoms from axial region, above and below the waist) and those that were not widespread (OR = 0.77, 95% CI: 0.68 to 0.88; not having the criteria for widespread) (Holth et al., 2008). A conclusion is that not adopting PA can increase these musculoskeletal complaints.

Poor stress management could have a negative impact on the risk of musculoskeletal system-related problems. This could be explained by the fact that high stress levels are associated with an increased risk of presenting musculoskeletal disorders (Cooper & Quick, 2017; Leino, 1989; Warren, 2001). A recent study aimed to cross-sectionally examine the reasons for musculoskeletal system pain in office workers (Celik et al., 2018). Experience of a moderate to extremely stressful workplace was one of the variables related to the work environment that had the most significant effects on this outcome (Celik et al., 2018). In another study, employees were offered one of following three stress management techniques to analyze the effects of this type of program on musculoskeletal symptoms: progressive relaxation, applied relaxation, and Tai-Chi (Wiholm & Arnetz, 2006). Compared to the control group without any techniques, those receiving an intervention had positive effects on lower arm symptoms during the 3-month study period (Wiholm & Arnetz, 2006). Although the sample was relatively small, only certain types of musculoskeletal symptoms improved for a short period of time. This study shows the potential effect of stress management on this outcome. Therefore, coping with stress is essential because poor stress management may increase musculoskeletal system-related problems.

With regard to the risk of injury, poor sleep habits are linked to this risk. For example, a cross-sectional study examined reported sleep habits on occupational injuries in small and mid-size Japanese business employees (n = 2,903) aged 16 to 83 years old (Nakata et al., 2005). Compared to those who did not exhibit these sleep habits, occupational injury prevalence was higher in employees who had poor sleep habits [difficulty initiating asleep (OR = 1.5, 95% CI: 1.2 to 1.8), sleeping poorly (OR = 1.5, 95% CI: 1.1 to 2.0), insufficient sleep (OR = 1.3, 95% CI: 1.1 to 1.7), or insomnia (OR = 1.5, 95% CI: 1.1 to 1.9), adjusted for the following variables: age, gender, marital status, years of education, presence of diseases, smoking, alcohol consumption, caffeine intake, depressive symptoms, and job types (Nakata et al., 2005). Another cross-sectional study in a Taiwanese population (≥15 years or older; n = 36,473) investigated the association between sleep habits and injury (Chen & Wu, 2010). Once all the sleep-related problems were considered and adjusted for covariates [age, sex, marital status, education level, employment type, shift-work status, BMI, self-assessed health, and psychiatric morbidity], excessive daytime sleepiness (OR = 1.50, 95% CI: 1.29 to 1.74) and poor sleep quality assessed by an insomnia questionnaire (OR = 1.69, 95% CI: 1.51 to 1.90) were significant predictors of accidental injuries requiring medical treatment e.g., accidents, falls and burns (Chen & Wu, 2010). Therefore, independent of other factors such as lifestyle habits (e.g., smoking and alcohol consumption), poor sleep habits can negatively impact the risk of occupational injuries.

Alcohol consumption is another unhealthy lifestyle habit that is associated with risk of injury. A systematic review and meta-analysis (28 articles in total) aimed to estimate injury risk due to alcohol consumption (Taylor et al., 2010). Studies had to report alcohol consumption categories (during the three hours prior to the injury in question) or blood alcohol consumption at the time of the reported injury to capture the real world risk (Taylor et al., 2010). The authors observed that injury risk increased with higher consumption of alcohol in a non-linear way. For every 10 g/day increase in alcohol consumption the OR ratio of motor vehicle accidents increased by 1.30 (95 % CI : 1.26 to 1.34) (Taylor et al., 2010). A consumption of 10 g/day of pure alcohol increased the odds for motor vehicle accidents by 1.24 (95% CI: 1.18 to 1.31) and the risk for non-motor vehicle injury by 1.30 (95% CI: 1.26 to 1.34). More importantly, even consuming 24 g/day of pure alcohol, which is considered a moderate level, was associated with increased odds for motor (OR = 2.20, 95% CI: 2.03 to 2.09) and non-motor (OR = 1.79, 95% CI: 1.59 to 2.00) vehicle accidents (Taylor et al., 2010). Drivers who consumed alcohol increased the risk for road injury for themselves and their surrounding (pedestrians, passengers, and other drivers) (World Health Organization, 2018, cited in Chikritzhs & Livingston, 2021; Quinlan et al., 2014). Furthermore, in an old study in rural areas of the United States, one strong predictor of a fatal fire incident was the presence of an alcohol-impaired individual in the house (OR = 7.5, 95% CI: 4.4 to 12.7) (Runyan et al., 1992). These findings show the impact of alcohol consumption on injuries that can sometimes be fatal.

1.1.4.3 Mental health

Unhealthy lifestyle habits are associated with mental health conditions such as anxiety and depression. In Canada, 3.3 million individuals aged 20 years and older used mental health services for mood and anxiety disorders in 2011/2012 (Public Health Agency of Canada, 2017). The prevalence rate was highest in those aged between 35 and 64 years old (Public Health Agency of Canada, 2017). Dozois reported that in a nationally representative sample (n = 1,803) the prevalence of Canadians with high to extremely-high anxiety and high self-reported depression increased four times (5% to 20%) and twice (4% to 10%), respectively, since the outbreak of coronavirus that took place in 2020 (Dozois, 2021). Therefore, mental health is of importance.

PA can have positive effects on depression. In fact, a cross-sectional study by Galper et al. (2006) using cohort data of individuals in the general population aged between 20 and 88 years old, examined the association between PA levels (inactive, insufficiently active, sufficiently active, and highly active) and mental health outcomes (depressive symptomatology and emotional well-being). More weekly PA levels were associated with lower depressive symptoms and higher emotional well-being in men and women, with the relationship peaking at "sufficiently active" category (Galper et al., 2006). Moreover, Schuch et al. (2018) observed that compared to individuals with low levels of PA, those will higher levels were less likely to develop depression (OR = 0.83, 95% CI: 0.79 to 0.88; N = 49 articles). The authors stated that PA has protective effects against the future development of depression (Schuch et al., 2018). A Brazilian study (n = 1,042) reported that adults who did not do any PA were two times more likely to show depression and anxiety in comparison with those who do regular PA (De Mello et al., 2013). A systematic review of prospective studies reported that 25 out of 30 studies showed a negative association between baseline PA and the risk of depression later (Mammen & Faulkner, 2013). Furthermore, the authors stated that most studies were of high quality and provided evidence for the preventive effect of PA on future depression. Interestingly, this positive effect of PA on future depression can be observed regardless of the level of PA (Mammen & Faulkner, 2013). For instance, it can still be observed in people who walk less than 150 minutes per week. A takeaway from these studies is that physical inactivity can have detrimental effects on mental health. Even levels of PA below recommendations appears to be beneficial.

Unhealthy sleep habits have been associated with poor mental health. In fact, based on an early review, sleep disturbances such as insomnia were strongly linked to future onset of depression (Gillin, 1998). A cross-sectional study (n = 20,851) noted that sleep duration was negatively associated (beta = -1.06, 95% CI -0.91 to -1.20) with "not good" mental health days in participants aged on average 47.5 years old (Sullivan & Ordiah, 2018). There was a lower likelihood (OR = 0.77, 95% CI: 0.73 to 0.80) of reporting depression with each additional 1-hour sleep (Sullivan & Ordiah, 2018). Taking these results together, unhealthy sleep habits can also have negative impacts on mental health.

Alcohol consumption and mental health are also related. Excessive alcohol consumption can create stressful situations such as tension at work and/or home, which can lead to poor mental health (Bell & Britton, 2014). A study investigated the association between these two variables using a British cohort study's data collected in 1997-1999, 2002-2004, and 2007-2009 (Bell & Britton, 2014). The authors used dynamic models to study the relationship between alcohol consumption and mental health. Their results indicated that the best fit model was the one in which individuals with better mental health further reduced alcohol consumption adjusted for baseline covariables only (Bell & Britton, 2014). The authors did mention that further studies could examine alcohol intake levels and changes in the relationship between the alcohol consumption-related variables and mental health (Bell & Britton, 2014). More recently, a study including 5,828 individuals reported that alcohol intake promoted depression, and that intensity rather than frequency of alcohol consumption was correlated with depression (Awaworyi Churchill & Farrell, 2017). The authors also mentioned the relationship between alcohol consumption and depression may be different in men and women; in men alcohol consumption could lead to depression, whereas in women, depression might lead to drinking problems (Awaworyi Churchill & Farrell, 2017). There is some evidence that excessive alcohol consumption at least in men can have negative consequences on mental health.

1.1.4.4 Financial burden

In addition to these health-related consequences, unhealthy lifestyle habits can also lead to financial consequences. The economic burden is often given as direct, indirect, and total costs (Dobrescu et al., 2017; Janssen, 2012; Loewen et al., 2019). The direct costs usually consider hospitalization care expenditures, physician care expenditures, and drug costs. Both disability (short- or long-term) and premature death imply loss of ability to work, which can create loss of productivity. This monetary value is referred to as indirect costs. It is important to note that there were discrepancies in the definition of each cost from one study to another.

A study by Ding et al. (2016) estimated the economic burden of physical inactivity in the world for major chronic diseases: coronary heart disease, stroke, type 2 diabetes, breast cancer, and colon cancer. The estimated annual costs of physical inactivity was international dollar (INT $) 53.8 billion and INT $ 13.7 billion in terms of direct health care costs and productivity loss (Ding et al., 2016). Nearly one to three percent of national health care expenditures are attributed to inactivity, estimated from countries with different income levels (Bull et al., 2017). Worldwide, a total of US $ 422.0 billion was spent for health care expenditures of diseases attributable to smoking (Goodchild et al., 2018). Considering productivity loss (deaths and smoking-related illnesses), this cost was estimated to be US $ 1,436.0 billion (Goodchild et al., 2018). In the United States, Carlson et al. (2015) reported that US $ 117.0 billion per year is spent for health care services due to physical inactivity. Additionally, health care expenditures due to cigarette smoking were estimated to be far more than US $ 225.0 billion per year (Xu et al., 2021). In Australia, inadequate sleep was estimated to cost $ 45.2 billion in 2016-2017 including financial ($ 17.9 billion) and nonfinancial (non-monetary value due to loss of quality of life; $ 27.3 billion) costs (Hillman et al., 2018). These data show that unhealthy lifestyle habits can have a large financial impact on countries and in the world.

Unhealthy lifestyle habits can also have a negative impact on the Canadian economy. Table 2 shows the estimated direct and indirect costs associated with some unhealthy lifestyle habits in Canada. A Canadian study estimated that physical inactivity cost the economy CAD 6.8 billion in 2009 (Janssen, 2012). The author also reported that direct, indirect, and total costs due to physical inactivity each represented nearly 4% of overall health care costs. As for the cost due to smoking, in 2012, in Canada, combined with other expenditures such as costs associated with research, prevention and law enforcement, the cost amounted to above CAD 16.2 billion (Dobrescu et al., 2017). Compared to other provinces in Canada, Quebec and Ontario, with their larger populations, were noted to have the highest direct and indirect costs of smoking (Dobrescu et al., 2017). This data shows the negative implications of smoking on the Canadian economy and even on Quebec's economy. Regarding alcohol use in Canada, total costs—which included costs related to criminal justice expenditures and those due to property damage, workplace programs, and research and prevention—were CAD 14.6 billion in 2014 (Canadian Substance Use Costs and Harms Scientific Working Group, 2018). In 2015, diseases related to diet were estimated to cost CAD 26.0 billion per year (Chronic Disease Prevention Alliance of Canada, 2017). Loewen and colleagues (2019) estimated the economic burden of non-adherence to Canada's food recommendations in 2018 using the Global Burden of Disease Study and CCHS (24-hour recalls). Based on data from 19,797 Canadians, individuals who did not satisfy the eight food recommendations [fruit excluding juice, whole grains, vegetables (nonstarchy), fluid milk, nuts and seeds, processed meat, red meat, and sugar-sweetened beverages] incurred total costs of CAD 15.8 billion per year (Loewen et al., 2019). Overconsuming unhealthy foods, for example sugar-sweetened beverages and red meat, was observed to have a larger financial burden than under-consuming healthy foods such as fruit, vegetables, and milk (Loewen et al., 2019). This data shows that only the direct and indirect costs associated with each unhealthy lifestyle habit can easily sum up to more than six billion, which is a huge financial burden on the Canadian economy. It follows that tackling unhealthy lifestyle habits can essentially save a large amount of money.

Table 2 - Overview of estimated costs of some unhealthy lifestyle habits in Canada reported.

Unhealthy lifestyle habits	References Authors (year)	Costs in billion dollars (CAD)	
		Direct costs	Indirect costs
Physical inactivity in 2009	Janssen (2012)	2.4	4.3
Cigarette smoking in 2012	Dobrescu et al. (2017)	6.5	9.5
Alcohol consumption in 2014	Canadian Substance Use Costs and Harms Scientific Working Group (2018)	4.2	5.9

As mentioned earlier, unhealthy lifestyle habits can lead to chronic diseases, and the monetary values of chronic diseases have also been estimated in the world and in Canada. The health-care resources and non-medical goods and services used to treat these conditions were characterized as "enormous" (World Health Organization & Public Health Agency of Canada, 2005). In the European Union, in 2003, cardiovascular diseases were estimated to account for 12% of total European health care expenditures (Leal et al., 2006). While hospitalization represented 57% of the overall direct costs, drugs represented 27% of these costs (Leal et al., 2006). In the United States, between 2014 and 2015, cardiovascular diseases and stroke were estimated to total US $ 351.3 billion (Virani et al., 2020). Moreover, diagnosed diabetes was estimated to cost US $ 327.0 billion (American Diabetes Association, 2018). The authors mentioned that compared to 2012, this total cost represented an increase of 26% due to a higher prevalence and increased costs associated with diabetes per person. These data highlight the huge financial burden of some chronic diseases in just some parts of world. It could be estimated that the worldwide financial burden of these diseases would be even higher. As for Canada, recent data on the estimated costs of chronic diseases were not identified. The available data are old. However, simply to give an overview of the financial burden of chronic diseases in Canada, medical care costs due to chronic diseases were CAD 39.0 billion a year and the indirect costs due to productivity loss was CAD 54.4 billion per year (Mirolla, 2004). The percentage of health care expenditures per year due to the direct cost of chronic diseases was 58% (Public Health Agency of Canada, 2011, cited in Chronic Disease Prevention Alliance of Canada, 2017). Thus, the financial burden associated with chronic diseases is non-negligible reiterating the importance of successfully promoting healthy lifestyle habits.

1.1.5 Conclusions on lifestyle habits

This first section of the literature review defined healthy lifestyle habits as behaviours that have a positive impact on an individual's health (World Health Organization, 1999). It also highlighted the fact that although there are guidelines regarding each lifestyle habit in Canada, a significant proportion of the population do not adopt healthy habits. Subsequently, these unhealthy lifestyle habits can lead to several negative consequences such as development of chronic diseases, functional limitations and injuries, poor mental health and financial burdens. These consequences, not only, negatively impact individuals but also their country and the world. Considering these challenges, the promotion of health and healthy lifestyle habits is key, and the workplace can be an ideal setting for this purpose. The next section will justify why this location is advantageous for health promotion activities.

1.2 Health promotion at work

Bearing in mind the problem of non-compliance to healthy lifestyle habits and their consequences, health promotion is essential. The World Health Organization defined the terms "health promotion" in 1986 in the Ottawa Charter for Health Promotion as a process that enables individuals to better take control over their health and to improve it (World Health Organization, 1986). The importance of the workplace as a health promotion setting was recognized internationally in 1950 (World Health Organization Regional Office for Europe, 2002). In the early 2000s, lack of improvements in healthy workplace approaches was noted (Burton, 2010). In a report called the *Workers' Health: Global Plan of Action*, it was stated "Health promotion and prevention of noncommunicable diseases should be further stimulated in the workplace, in particular by advocating a healthy diet and PA among workers, and promoting mental health at work and family health at work…" (World Health Organization, 2007, p.7). The European Network has defined the terms "Workplace health promotion" as the "combined efforts of employers, employees and society to improve the health and well-being of people at work" (European Network for Workplace Health Promotion, 2007, p.2). A vicious-circle type figure is used in one of the World Health Organization's documents to show the influence of workers' health on society (Burton, 2010). Good health among workers will improve productivity at work, which will indirectly contribute to the success of the company, leading to business competitiveness (Burton, 2010). The latter will consequently improve economic development and prosperity in the country, and thus improve the social well-being and wealth of workers (Burton, 2010). Thus, workplace health promotion is a must for the well-being of workers, companies and society.

Health promotion activities offered at the workplace can significantly contribute to decreasing the risk of chronic diseases at population levels (Wolfenden et al., 2018). There are many reasons for selecting the workplace as an appropriate setting for health promotion activities. Key highlights of some of these are listed below:

- Depending on the company, compared to community settings, for example, a larger proportion of the population can be reached at once. Workers represent 50% of the world's population (World Health Organization, 2007). Based on Statistics Canada from 2016 to 2020, a total of nearly 15-16 million Canadians worked in enterprises of any size (Statistics Canada, 2021b). Therefore, activities offered at the workplace for health promotion can reach a large proportion of the population.
- Working individuals spend at least half of their waking hours per day and even 7-8 hours at work (Dishman et al., 1998; US Bureau of Labor Statistics, 2020). Wolfenden et al. (2018) reported that in countries part of the Organisation for Economic Co-operation and Development, the average weekly hours in paid employment were 36.8 hours in 2014. Therefore, employees could easily participate in health promotion activities compared to if they were offered in community settings where each employee would have to actively make their own arrangements.
- Another attraction of the workplace is the type of worker who could be reached (Hymel et al., 2011; Warner, 1987). It is explained that worksites consist of white-collar workers, who are believed to be receptive to health promotion efforts, and blue-collar workers, who are usually in need of such efforts as they have a high prevalence of unhealthy behaviours (Warner, 1987). Moreover, offering programs at work can improve access to health information, especially among employees who do not have access to health-related information in other settings (Hymel et al., 2011). Therefore, this setting allows health promotion practitioners to reach certain subgroups of interest.
- Within a company, there is already an existing communication channel and potentially beneficial resources, which could be used when implementing health promotion activities (Hymel et al., 2011; Warner, 1987). Some examples are daily gatherings of workers,

company-newsletter type communication systems and “word-of-mouth networks” (Warner, 1987). If offered at the workplace, health promotion could use other established efforts such as occupational health and safety, which was shown to be beneficial in the context of a smoking cessation program at work (Sorensen et al., 2002). Health promotion activities offered at work can make use of existing communication channels and resources.

- Performing health promotion activities at work can remove travel-related inconveniences such as the time, cost and motivation needed to change location because employees are already at that location (Warner, 1987).
- At work employees “are subject to powerful influences encouraging conforming” that includes presence of peer pressure, shared norms and values (Warner, 1987). This could be harnessed towards health promotion activities to change certain unhealthy lifestyle habits such as lack of PA and smoking.
- Positive health behavioural changes achieved at work could have a “spill over” effect as employees may influence their co-workers, clients, and even their own family as well as social circles (Yancey et al., 2007). Thereby, health promotion programs may indirectly have positive effects on a larger number of individuals.
- At work, various levels of influence ranging from individual to company-level and from direct efforts (e.g., health education and healthy food availability) to indirect efforts (e.g., healthy work environment) could be used to promote healthy behaviours since the individual is niched within the company (Brennan, 1982; World Health Organization, 2008). Based on the social-ecological model and social cognitive theory, external factors such as organization/environmental factors can affect an individual’s adoption of healthy behaviours (Bandura & National Inst of Mental Health, 1986; McLeroy et al., 1988; Stokols, 1996). Figure 3 is an adaptation of Meador et al. (2016), which uses the social-ecological model’s level of influence. The authors mentioned that it incorporates examples from the Prevention Partner’s WorkHealthy American and CDC Worksite Health ScoreCard. This figure depicts the different levels of influence that could be shaped when health promotion efforts are offered at work with the goal of improving employees’ health behaviours and health (Meador et al., 2016). Thus, these different levels of influence can be targeted to offer various types of health promotion activities or interventions.

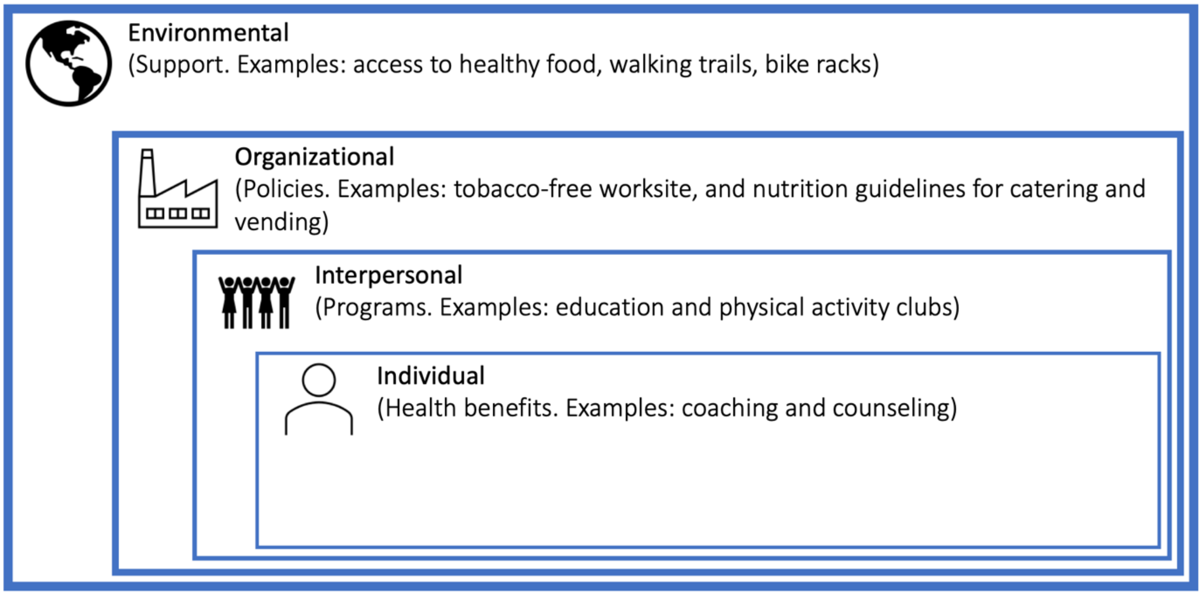

Figure 3. – Different levels of influence at the workplace including examples from the Prevention Partner's WorkHealthy American and CDC Worksite Health ScoreCard.

Adapted from Meador, A., Lang, J. E., Davis, W. D., Jones-Jack, N. H., Mukhtar, Q., Lu, H., Acharya, S. D., & Molloy, M. E. (2016). Comparing 2 National Organization-Level Workplace Health Promotion and Improvement Tools, 2013-2015. *Prev chronic dis, 13*, 160164. https://doi.org/10.5888/pcd13.160164

1.2.1 Conclusion on health promotion at work

This second section of literature review defined workplace health promotion as the combined efforts of three actors—namely employees, employers and society—to improve individuals' health and well-being while at work (European Network for Workplace Health Promotion, 2007). This section also focused on justifying the workplace as an essential setting for health promotion activities. Employees' health is important as this can have an impact on the company and then on society, which then influence workers, forming a loop (Burton, 2010). While this section highlighted the importance of the workplace for health promotion, the next section will discuss programs that promote health at work.

1.3 Workplace health promotion programs

1.3.1 Definition

As there are many reasons for focusing health promotion efforts at work, programs promoting health at work have been implemented. Worksite health promotion programs were defined as "initiatives directed at improving the health and well-being of workers and, in some cases, their dependents" by Goetzel and Ozminkowski (2008). In the current thesis, any interventions, activities or programs offered by the employer with the goal of improving the health of employees would be referred to as "Workplace health promotion programs" (WHPPs). For example, cognitive-behavioural therapy (CBT) interventions offered by the employer will be referred to as a WHPP to avoid using different terminologies used in the literature. The types of programs targeting cancer screening, coronavirus vaccines or infectious disease will not be included in the current thesis.

WHPPs could provide interventions for primary, secondary and/or, sometimes, tertiary prevention (Goetzel et al., 2007). A WHPP targeting primary prevention could be one encouraging PA, healthy eating and stress management either among healthy employees or among those who do not preserve good health and have the potential to become ill with conditions that can be prevented or delayed (Goetzel et al., 2007). Examples of WHPPs targeting secondary prevention are smoking cessation help lines and screening for certain risk factors e.g., hypertension (Goetzel et al., 2007). These programs target high-risk employees i.e., those who do not adhere to healthy lifestyle habits or present abnormal biometric measures such as high blood pressure and/or glycemia (Goetzel et al., 2007). Examples of such programs are smoking cessation programs and instructions on how to manage a certain health condition (Goetzel et al., 2007). Finally, examples of tertiary prevention programs, which target individuals who already have a disease/condition, are encouraging drug compliance or adherence to outpatient treatment guidelines (Goetzel et al., 2007). Thus, WHPPs can have different aims and can target various subgroups of employees. In the next section, different types of WHPPs will be presented.

1.3.2 Interventions in workplace health promotion programs

1.3.2.1 Interventions at different levels of influence

As mentioned early, because WHPPs take place at work, interventions can aim at one of the levels of influence i.e., individual, interpersonal, organization or environmental levels. Some programs usually include only a health-risk assessment (HRA), also known as health-risk appraisal (Soler et al., 2010). In the case of an HRA, it targets the individual level. It is generally agreed that HRAs are composed of the following elements: 1) a health habit and risk factor assessment that could be supplemented by biomedical measures; 2) an estimation of future risks such as mortality and/or other health problems; 3) feedback such as educational material, reports and/or counselling encouraging changes to unhealthy behaviours (Alexander, 2000; DeFriese & Fielding, 1990; Schoenbach et al., 1987). HRAs have many advantages such as a facility to use, relatively low cost, popularity among employees and employers, and their ability to highlight common modifiable risk factors and major health problems among employees (Alexander, 2000). A systematic review of 32 studies stated that HRA with feedback could be a “gateway” intervention to WHPPs that include health education (at least an hour-long or repeated multiple times annually) and possibly many health promotion activities (Soler et al., 2010). Thus, an HRA targets the individual-level, offers an overview of employees’ risk, and could be used as of a broader WHPP.

Interventions can be developed in a way to target interpersonal levels of influence. A 2-week WHPP targeting PA called “Move-A-Thon” encouraged employees to walk in exchange for a donation of money for charity (Reutman & Lewis, 2019). Participants could earn US $ 20.0 for every 3,000 daily steps and an additional US $ 2.0 for each of their “exercise buddies” (for a maximum of five buddies). The eight employees who participated in the challenge had 21 “exercise buddies” for a total donation of US $ 202.0 (Reutman & Lewis, 2019). Interestingly, on average, participants achieved more than 5,000 steps daily throughout the study period and gathered five “exercise buddies” at least on one occasion (Reutman & Lewis, 2019). Although their sample size and program duration were limited, their findings illustrate the effect of an intervention targeting the interpersonal level of influence.

Implementing a policy is an example of intervention that targets the organizational level of influence specifically. A systematic review (24 papers) evaluated the effect of totally smoke-free policies on consumption of cigarettes and reported that implementation of this type of policy at work decreased prevalence of smokers (4%, 95% CI: 3 to 5) and consumption of cigarettes (3.1 cigarettes/day/smoker, 95% CI: 2.4 to 3.8) (Fichtenberg & Glantz, 2002). A more recent study reported that not having established rules limiting smoking at the workplace was associated with presently being a daily smoker (RR = 1.3, 95% CI: 1.2 to 1.4) (Ham et al., 2011). Additionally, not having a WHPP targeting smoking cessation was associated with decreased probability of intending to quit in the next six months (RR = 0.9, 95% CI: 0.8 to 0.9) (Ham et al., 2011). These results show that for certain lifestyle habits targeting the organization level via policies could be advantageous.

Finally, intervention can target the environmental level of influence by introducing environmental changes. Environmental changes can consciously and unconsciously lead to the adoption of healthy lifestyle habits (Engbers et al., 2005). For example, a 6-week quasi-experimental study was composed of a no-program control site and an intervention site, which offered a WHPP improving canteen food quality (labelled healthy foods) (Lassen et al., 2014). Compared to baseline, there were improvements on most nutritional outcomes (-30% total energy/meal, -20% of energy as fat, +47% fruits and vegetables and -40% salt intake) at intervention site at the end of the study, which were significantly different from the control site. Moreover, some of these improvements were maintained at the 6-month post-program evaluation. However, follow-up food intake for the rest of the day was not assessed to verify compensatory adjustments during the remaining part of the day (Lassen et al., 2014). Although this may be a limit of this study, it is an example of an intervention targeting the environmental level and show the potential benefits of this type of intervention on employees' lifestyle habits.

Though interventions can target only one of the different levels of influence, it seems to be beneficial to combine interventions targeting a couple or several levels of influence. In other words, a single program that combines interventions directly targeting employees in addition to organizational and/or environmental factors—which will be referred to as "multimodal" program in the current thesis—seem to be more promising at improving employees' health behaviours (Chu et al., 2016; Engbers et al., 2005; Goldgruber & Ahrens, 2010; Quintiliani et al., 2010). For example, two systematic reviews reported that multimodal WHPPs improved fruit, vegetable, and fat intake as well as PA (Engbers et al., 2005; Kahn-Marshall & Gallant, 2012). More recently, Goldgruber and Ahrens conducted a narrative review of systematic reviews and meta-analyses (17 articles) assessing WHPPs including primary prevention interventions (Goldgruber & Ahrens, 2010). The authors concluded that multimodal WHPPs with behavioural and environmental type interventions yielded the greatest benefits on different outcomes including healthy lifestyle habits (Goldgruber & Ahrens, 2010). Considering these results, multimodal WHPPs seem to be much more beneficial than focusing on one level of influence. However, within the same study, different arms with varying numbers of multimodal interventions have not been studied to determine the number of interventions that is most beneficial for improving employees' health and lifestyle habits.

1.3.2.2 Technology-based interventions

While some interventions are in-person, such as a group exercise class at work or coaching session with a health professional, other interventions use technology, usually, internet/website, termed e-health interventions (Buckingham et al., 2019; Eng, 2002; Jimenez & Bregenzer, 2018). Additionally, mobile phones, smartphone applications and/or wearable technologies (monitors or trackers) can also be used, referred to as mHealth. Some authors include mHealth as a subcategory of e-health (Jimenez & Bregenzer, 2018). These types of interventions have many advantages such as easy accessibility, potential to reach a large proportion of the population relatively inexpensively and the possibility of offering personalized feedback (Buckingham et al., 2019; Sullivan & Lachman, 2017; Ware et al., 2008). A literature review reported that in the 11 RCTs that examined nutrition education delivered through the internet, only one was provided at the workplace (Nakade et al., 2006). In these studies, with intervention periods lasting between four weeks and a year, this internet approach for improving nutrition led to some positive outcomes such as decreased fat intake and improved awareness of healthy eating habits (Nakade et al., 2006). However, the authors mentioned that WHPPs with longer duration and/or follow-up period were needed to conclude about the effectiveness of this delivery method in the context of WHPPs. Buckingham and colleagues (2019) conducted a systematic review that included 25 RCTs and quasi-experimental studies on mHealth WHPP targeting PA and decreasing sedentary behaviour. Among 11 studies that included wearable activity monitors or trackers such as Fitbit as the only intervention tool, 36% reported significant improvement in PA. Among the 14 studies that used either a smartphone app alone or in combination with activity trackers/monitors, 71% reported a significant increase in PA (Buckingham et al., 2019). The authors stated that there is reasonable evidence that in the promotion of PA mHealth WHPPs could be feasible, acceptable, and effective. However, a decline in technology use and engagement were observed in studies that lasted more than 12 weeks. Also, it was suggested that longitudinal studies were necessary to understand the long-term effects of such programs (Buckingham et al., 2019). These studies provide some evidence that WHPPs with interventions using technology can have a positive effect on lifestyle habits of employees. Bearing in mind that technology has become a huge part of our lives, this type interventions may facilitate certain health promotion activities.

1.3.2.3 Intervention targeting one vs. multiple lifestyle habits

As is the case for health promotion programs in any setting, WHPPs can make use of one or many interventions targeting one lifestyle habit, such as only PA or smoking, or target two or more habits at once (simultaneously) or one after another (sequentially) in a given time period (Prochaska & Prochaska, 2009). Schulz et al. (2014) conducted a RCT to examine the effectiveness of a web-based tailored multiple lifestyle habit change intervention targeting PA and smoking as well as fruit, vegetable, and alcohol consumption offered sequentially vs. simultaneously for two years. Risk factor score was the addition of lifestyle habits that did not adhere to guidelines (scores could range from 0 to 5 unhealthy lifestyle habits). At 12 months, the sequential version significantly reduced risk factor score compared to the control condition, which completed and received feedback from a health risk appraisal (ES = 0.28). At 24 months, the simultaneous version significantly reduced risk factor score compared to the control condition (ES = 0.18). However, when both intervention groups (sequential vs simultaneous) were compared at both time points none of them were significantly different from each other at reducing the risk factor score. Reviews also suggest that both approaches are equally effective for most health behaviours (James et al., 2016; Maisano et al., 2020). There is evidence that multiple health behaviour interventions may be superior to single habit ones for weight loss (Maisano et al., 2020). In this section, the pros and cons of targeting multiple lifestyle habits will be discussed with a focus on, but not limited to, WHPPs.

Pros of multiple lifestyle habits programs

Firstly, targeting many lifestyle habits may increase the chances of improving at least one lifestyle habit that is close to the employee’s objectives. Outside the context of WHPPs, Johnson and colleagues (2008) randomized participants with overweight or obesity into a control and a home-based multiple lifestyle habit program. Their program focused on three lifestyle habits during nine months: PA, eating habits, and managing emotional distress. The program targeting multiple lifestyle habits was noted to be more effective in changing many lifestyle habits among a large number of individuals compared to a single lifestyle habit program (Johnson et al., 2008). A review of systematic review and meta-analysis identified 22 articles on single vs. multiple health behaviour change (PA and diet) interventions in adults (Sweet & Fortier, 2010). Although single behaviour interventions were reported to be more effective at changing these behaviours compared to multiple behaviour ones, the latter were reported to be more effective at changing at least one behaviour (Sweet & Fortier, 2010). Furthermore, a 2.5-year study (n = 2,761) using randomized matched-pair design offered a worksite program targeting smoking cessation, nutrition, and PA (Emmons et al., 1999). The authors reported that the program was efficient at changing at least two of these behaviours and suggested investigating more programs targeting multiple behaviours (Emmons et al., 1999). Thus, these multiple lifestyle habit programs could potentially allow employees to improve more than one lifestyle habit and increase their reach.

Secondly, changing one lifestyle habit could increase the possibility of improving another one. Outside the context of WHPPs, PA and fruit and vegetable intake appeared to facilitate each other (Fleig et al., 2015). In the study by Johnson et al. (2008), participants with overweight and obesity who took part in the multiple lifestyle habit program and progressed to the action/maintenance stage of a particular behaviour were at least three times more likely to show improvement in another lifestyle habit. In the case of a program targeting a single habit, individuals who are not interested in changing that lifestyle habit would not engage in that program. This in turn decreases the opportunity for other changes to take place. In another weight control RCT of 1-year in women with overweight/obesity, exercise motivation was one of the facilitators for improvement in eating self-regulation (Mata et al., 2009). This study illustrates "Transfer." Transfer is used interchangeably with "Carry-over mechanisms" and "spill-over" (Barnett & Ceci, 2002; Lippke, 2014; Lippke et al., 2012; Mata et al., 2009). As explained in Lippke et al. (2012), it is "the process when lessons learned in one context are applied to another context." For instance, an individual would be more likely to transfer to another behaviour if the latter is similar in terms of planning its adoption and integration in their individual's life (Knäuper et al., 2004, cited in Lippke et al., 2012). Experience, skills, resources, knowledge, and self-efficacy could be transferred to other behaviours or domains (Lippke, 2014). This carry-over mechanisms and some factors (i.e., self-efficacy, intention and plans), along with compensatory cognitions, form the

Compensatory Carry-Over Action Model (Lippke, 2014). Geller et al. (2017) mentioned that presently there is a lack of effective mechanisms of multiple health behaviour change. More understanding regarding the cross-relationship between behaviours is necessary. In the context of WHPPs, offering a multiple-lifestyle-habit program could be beneficial as participants could start by changing in one of their unhealthy habits and eventually move toward changing another.

Thirdly, programs that target several lifestyle habits can greatly improve individual's health compared to a single habit program. In fact, outside the context of WHPPs, a systematic review and meta-analysis (N = 8 RCTs) reported that in adults with BMI $\geq$ 25 kg/m^2 multiple health behaviour change interventions targeting PA and diet were more beneficial on long-term weight loss compared to those targeting one of these behaviours alone (Johns et al., 2014). A scoping review (22 articles) found similar conclusions in various sub-groups of the population (e.g., adolescents, adults, healthy, obesity) (Maisano et al., 2020). In the context of workplace, a meta-analysis (N = 22 studies) concluded that WHPPs targeting two lifestyle habits (namely PA and diet) were more effective at improving weight-related outcomes compared to programs targeting only PA (Verweij et al., 2011). A systematic review and meta-analysis (N = 24 studies) reported that WHPPs targeting PA did not significantly improve biochemical markers (Mulchandani et al., 2019). Similarly, a systematic review of reviews by Proper and Van Oostrom (2019) did not observe a positive impact on biochemical marks such as blood lipid and glucose levels following WHPPs targeting PA and/or diet in the five relevant reviews. It is important to note that these studies on multiple health behaviour targeted mostly PA and eating habits. However, in a WHPP targeting six lifestyle habits, the proportion of employees with improved systolic and diastolic blood pressure, total cholesterol level and blood triglycerides increased six months following baseline (Huang et al., 2013). However, this study lacked a control group. While a look at the comparative effects of single vs. multiple lifestyle habits within the same study in the context of WHPPs targeting multiple lifestyle habits (more than four) has not been done, findings suggest that multiple lifestyle habit WHPPs may be more beneficial than single lifestyle habit ones for improving health.

Fourthly, to decrease the risk of certain chronic diseases, a particular unhealthy lifestyle habit could be avoided or improved e.g., physical inactivity. However, targeting multiple lifestyle habits can be much more beneficial (Tuomilehto et al., 2001; Tuomilehto et al., 2011). Outside the context of WHPPs, a study aimed at examining the association between four positive health-related factors—being PA, never smoking, BMI < 30 kg/m^2, and adopting “healthy dietary principles”—and the RR of developing chronic diseases (Ford et al., 2009). Controlling for covariates such as age, sex, as well as educational and occupational status, individuals presented a higher number of positive health-related factors, their risk of developing chronic diseases progressively decreased (Ford et al., 2009). Among those who never smoked, compared to those who had none of the positive health-related factors, the adjusted hazard ratios for those who had 1, 2, and 3 factors were 0.53 (95% CI: 0.42 to 0.68), 0.41 (95% CI: 0.32 to 0.52), and 0.32 (95% CI: 0.24-0.44). In the context of interventions, Tuomilehto et al. (2001) observed that a personalized counselling intervention regarding weight reduction, eating habits, and PA was able to keep individuals with overweight with impaired glucose tolerance from presenting with type 2 diabetes after 3.2 years. Compared to the control group, there was 58% lower cumulative incidence of this chronic disease (hazard ratio = 0.4; 95% CI: 0.3 to 0.7) in the intervention group (Tuomilehto et al., 2001). Therefore, multiple lifestyle habit programs can decrease the risk of developing chronic diseases. Furthermore, smoking and physical inactivity are risk factors of cardiovascular diseases, targeting both lifestyle habits can be much more beneficial than focusing on only one. Participants (n >90,000) were separated into different categories for exercise and smoking to examine the link between exercise, smoking, and cardiovascular mortality risk (O'Donovan et al., 2017). Among participants who exercised ≥60 minutes/week, compared to those who never smoked, current smokers had a hazard ratio of 2.6 (95% CI: 1.3 to 5.0) for cardiovascular mortality. Compared to this optimal reference category, the hazard ratio for current smokers who were not exercising was 3.6 (95% CI: 2.4 to 5.5) for this outcome (O'Donovan et al., 2017). In the same study, O'Donovan et al. (2017) observed that the RRs of all-cause mortality were additive. These findings show the importance of targeting multiple lifestyle habits in the context of chronic disease prevention or risk reduction. A systematic review of RCTs (42 studies) compared the effects of single vs. multiple lifestyle habit programs in all settings, offered to working-age adults, and lasting at least a year long on cardiovascular risk factors, mortality and morbidity (Ketola et al., 2000). Primary prevention multiple lifestyle habit programs were more efficient at decreasing the risk factors, and it was suggested that optimally multiple lifestyle habits for cardiovascular diseases be included (Ketola et al., 2000). For reducing chronic disease risk and improving individuals' health, it is much more advantageous to offer a WHPP targeting multiple lifestyle habits rather than focusing on one lifestyle habit only.

To conclude on this portion, based on a systematic scoping review conducted by King and colleagues (2015), out of the 220 studies included, 56% of multiple behaviour interventions have focused on PA and eating habits. This represents a limitation of this literature because it does not include other essential lifestyle habits such as sleeping, smoking, stress management and alcohol use, which can also influence major chronic diseases. Also, studies on the effects of offering more than two lifestyle habits interventions are few. It is important to note that this review was conducted in the general adult population aged at least 16 years old (King et al., 2015). It included interventions in all settings, as well as interventions on many health behaviours such as seat belt use, sun protection, and sexual behaviour (King et al., 2015).

Cons of multiple lifestyle habits program

However, offering multiple lifestyle habits does not exclude disadvantages. Firstly, implementing a program that targets many lifestyle habits at once may not lead to optimal outcomes, particularly those using the simultaneous approach. Outside the context of WHPPs, the review of systematic reviews and meta-analyses (22 articles) by Sweet and Fortier (2010) reported that single behaviour interventions yielded larger ESs. Compared to multiple health behaviour interventions, most studies included in that meta-analysis supported single behaviour interventions to change PA or diet (Sweet & Fortier, 2010). The authors explain that interventions targeting both lifestyle habits simultaneously may place a burden on certain individuals thereby decreasing their effectiveness (Sweet & Fortier, 2010). A meta-analysis (N = 69 RCTs) reported that while multiple risk behaviour interventions led to small improvements in PA and diet compared to any comparator, targeting smoking simultaneously with other risk behaviours may yield suboptimal results (Meader et al., 2017). The authors mention that “any comparator” meant attention control and single risk behavior non-pharmacologic interventions, which are not quite the same. It is also noteworthy that this article included individuals aged ≥16 years old and included studies on behaviours (e.g., sexually risky behaviours) (Meador et al., 2016). A systematic review (N = 6 RCTs) mentioned that, in interventions for adults as far as smoking was concerned, two trials indicated that a sequential approach may be more beneficial (James et al., 2016). A meta-analysis found that internet-based interventions that targeted multiple lifestyle habits (PA, eating habits, smoking, and/or alcohol consumption) had smaller effects (weighted ES = 0.12, 95% CI: 0.08 to 0.17) than those targeting one of those health behaviours (weighted ES = 0.17, 95% CI: 0.09 to 0.24) (Webb et al., 2010). Wilson and colleagues (2015) performed a meta-analysis studying the relationship between the number of behavioural recommendations and clinical change (not limited to workplace interventions). Examples of recommendations were to do 30 minutes of moderate intensity PA on five days of the week, quit smoking, increase fruit and vegetable intake, and/or to "reduce calories" (Wilson et al., 2015). They reported that a moderate number of recommendations (i.e., 2-3) led to the most beneficial outcomes. That number was less demanding cognitively and left participants with enough motivation to implement the advice (Wilson et al., 2015). Although this study was on the number of recommendations, it will most likely be the case for multiple lifestyle habits, which are more complex. No studies were identified in the context of WHPPs specifically regarding the different numbers of lifestyle habits targeted and their positive effects on health and lifestyle habits. However, a meta-analysis (32 studies) found that the average ES of WHPPs targeting a single risk factor was 0.4, while those targeting multiple ones were 0.2 (Marshall, 2004). Thus, offering a program targeting many lifestyle habits, particularly at once, may not always lead to optimal results, especially for smoking.

Secondly, developing, implementing, and evaluating multiple lifestyle habits program can be more challenging than a single lifestyle habit program, and consequently be costlier than a single program. Programs targeting multiple lifestyle habits would have various interventions in place, and this will, in most cases, requires more administrative staff to manage and coordinate the program (Linnan et al., 2008). Indeed, lack of staff resources was reported by 50% of respondents (directors, managers, or staff from human resources or benefits department) who were questioned about common barriers/challenges for the success of their WHPPs (Linnan et al., 2008). Also, the data collection process and data handling could become difficult due to the various interventions that are in place. Moreover, in Linnan et al. (2008), nearly half of respondents reported that lack of funding was one of the barriers/challenges for the success of their WHPPs. In the case of a multiple lifestyle habit program, this barrier may be even more important, particularly for small size businesses that are not equipped with proper resources (Chenoweth, 2011, p.180). In fact, a program composed of only PA may be difficult enough for a small business, which may not have a fitness room (Chenoweth, 2011, p.180). So a program with several lifestyle habit interventions might require different expertise to be involved (Prochaska et al., 2010), which will come with additional cost. Furthermore, the budget for the program needs to consider program evaluation and will have an influence on the evaluation plan particularly in small businesses (Selleck et al., 1989). Evaluating a program targeting multiple lifestyle habit by a second or third party (e.g., research team) may be costlier than a single program because more interventions were probably in place (Prochaska et al., 2010). Therefore, in the context of multiple lifestyle habit programs, more resources in terms of staff and time are needed, which will in turn lead to a greater cost than a single lifestyle habit program. However, health professionals offering multiple lifestyle habit programs did not perceive these challenges as being the most important. Indeed, Prochaska et al. (2010) sent online surveys to health professionals—including researchers of the Society of Behavioural Medicine—to identify which advantages and disadvantages related to multiple-health-behaviour-change programs were important for them from a list. Participants had to rate importance on a scale of five points from not important to extremely important. Respondents who worked with multiple lifestyle habit programs rated the benefits much higher on the importance scale compared to challenges (Prochaska et al., 2010). The scores for "Require multiple expertise" and "Require a greater magnitude for development and evaluation costs" was 3.3 ± 1.2 and 3.2 ± 1.1, respectively (Prochaska et al., 2010). Although this study was not limited to the context of WHPP, it could be assumed that this may also be true for WHPPs.

Thirdly, in terms of research, as researchers, one of the main interests when evaluating a WHPP is to be able to find what intervention or what feature or combination caused the improvements. In a program that targets multiple lifestyle habits at once, it is difficult to determine which lifestyle habit had the greatest impact on the outcomes if lifestyle habit changes occurred simultaneously. Moreover, as mentioned, targeting multiple lifestyle habits would be beneficial to decrease the risk of a chronic disease, but determining which lifestyle habit led to the greater risk reduction in the program may be challenging. Indeed, changing one unhealthy lifestyle habit could decrease the risk of two or more chronic diseases (Sheiham, 2000; Sheiham & Watt, 2000). It would also be difficult to infer causal relationships between the various interventions and the outcomes. Moreover, a program that targets multiple lifestyle habits would require more complex analyses and statistical model compared to a single lifestyle habit pre-post design. In the study by Prochaska et al. (2010), respondents rated 2.9 ± 1.2 and 2.8 ± 1.2 for "Make it difficult to describe causal relationships among intervention components; with multiple components the individual effects will be harder to isolate" and "Make it difficult to discern the relative contribution of individual behavioural changes to desired outcomes (e.g., which behavioural change contributed the most to the reduction in systolic blood pressure?)," respectively. Participants rated 3.0 ± 1.3 for "Require more sophisticated statistical modeling" (Prochaska et al., 2010). Thus, statistical analysis and interpretation of multiple lifestyle habit programs are a concern for health professionals. This rating may have been higher if respondents were all researchers required to perform these analyses. To conclude, offering a multiple lifestyle habit can also be challenging for researchers as this may complicate the interpretation of the effects of the program on outcomes.

1.3.3 Potential benefits for employers

Studies have examined different types of WHPPs on health- and lifestyle-habit outcomes. In this section the potential benefits of such programs for employers (Figure 4) will be presented first; reported benefits for employees will be discussed in the next section.

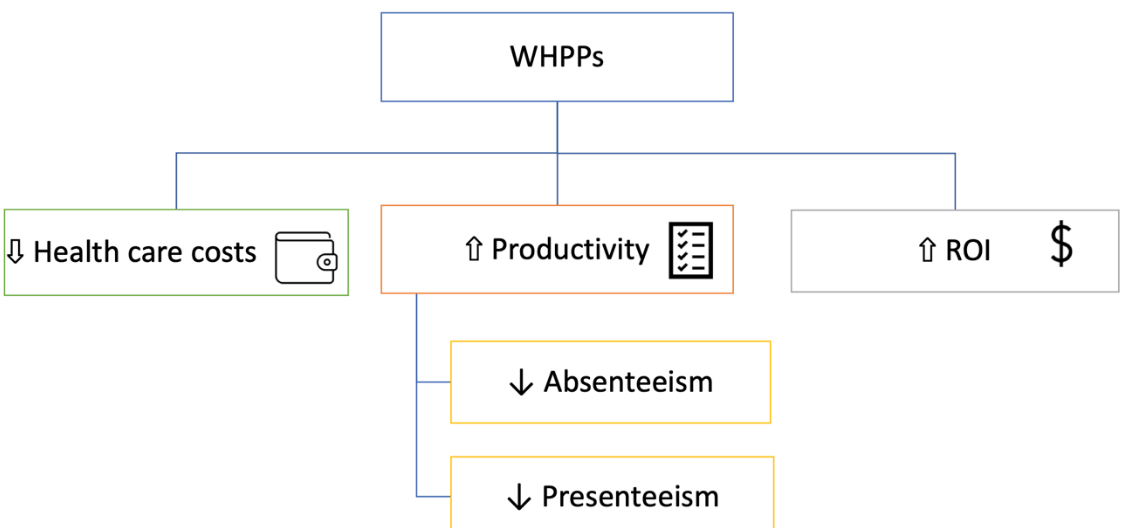

Figure 4. – Potential benefits of WHPPs offered to employees on companies.

ROI: Return on investment; WHPPs: Workplace Health Promotion Programs.

1.3.3.1 Decreased heath care costs

Offering WHPPs to employees can decrease health care costs and thereby benefit employers. Goetzel et al. (1998) analyzed health care claims of nearly 46,000 employees over six years and observed that when compared to those who did not have any risk factors, employees with seven risk factors cost 228% more to their employers in terms of health care costs. Among the seven risk factors were two unhealthy lifestyle habits namely physical inactivity and tobacco use

(Goetzel et al., 1998). Thus, by offering services such as WHPPs, employers could reduce employees' health care costs.

Indeed, a long-term analysis of a 4-year WHPP provided by the company Johnson & Johnson in the United States showed a decrease in medical care cost by $ 224.7 per employee per year (Ozminkowski et al., 2002). More importantly, the overall health care saving per employees after one year into the program was lower ($ 92.0) than after three ($ 355.5) and four years ($ 413.1) (Ozminkowski et al., 2002). Although this study did not have a control group, it shows positive effects of WHPPs on health care costs. These findings are supported by a meta-analysis and a systematic review (Aldana, 2001; Baicker et al., 2010). For example, a meta-analysis comparing 22 studies that reported health care costs stated that an average of $ 358 per employee per year was saved in WHPP groups compared to no-program control groups (Baicker et al., 2010). One systematic review mentioned that there was an association between WHPPs and decreased health care costs among their 72 studies published before August 2000, especially in fitness WHPPs (Aldana, 2001). The authors did mention that the average study duration was 3.3 years, so whether these positive results will be present in the future is unknown.

In some cases, offering WHPPs can prevent steeper increases in medical costs. In fact, a school district offered a 3-year WHPP including health campaigns on diet, PA, weight loss, posture and balance, and health maintenance, and assessed health care costs three years before and three years during the WHPP (Merrill & LeCheminant, 2016). Among employees for whom health care medical claims cost data were available before the program (n = 2,438), while the average medical cost payment increased by 16% in non-participants, it only increased by 4% in employees who participated in at least one of the years of the program. Moreover, among the 2,438 employees, while those who took part in the behaviour change campaigns for at least one year had a 5% increase in average medical claims payments, these payments increased by 28% in non-participants (Merrill & LeCheminant, 2016). Taking these results together, WHPPs are a good service to offer to employees because they either prevent a larger hike or decrease health care costs compared to not offering programs at all, which can be advantageous for employers.

1.3.3.2 Decreased absenteeism

One of the main benefits that companies can achieve by offering services such as WHPPs is a decrease in productivity loss, which arises from two sources: absenteeism and presenteeism

(Schultz et al., 2009). Absenteeism is defined as the act of not being physically present at work due to illness or disability (Pronk & American College of Sports Medicine, 2009). Presenteeism is defined as the act of being present at work, but not necessarily productive (a decrease in work performance) due to impaired health problems (Burton et al., 1999; Pronk & American College of Sports Medicine, 2009). Presenteeism will be discussed below.

In Canada, a full-time employee missed nearly 8, 9, and 10 days of work due to illness or disability in 2018, 2019, and 2020, respectively (Statistics Canada, 2021a). By offering WHPPs, companies could decrease absenteeism and improve work productivity. For instance, among 6,246 school employees, absenteeism was 20% lower in those who took part in a WHPP targeting mainly behaviours including PA, eating habits, sleeping habits, and sedentary behaviour for two years compared to a no-program control group (Aldana et al., 2005). It is important to note that such programs may be offered as early as possible to preserve employees' health so that they can be healthy for longer and be able to maintain their healthy lifestyle habits such as doing PA later in life. Along these lines, a systematic review and meta-analysis (N = 46 studies) reported that there was moderate evidence that WHPPs could decrease (RR = 0.8, 95% CI: 0.6 to 1.1) sickness absences (Kuoppala et al., 2008). Another meta-analysis (138 reports in total) reported that some PA WHPPs may lower absenteeism because ES was only significant for two-group post-test (ES = 0.2, 95% CI: 0.1 to 0.3) (Conn et al., 2009). A meta-evaluation concluded that WHPPs were one of the most effective strategies to reduce this outcome (Chapman, 2012). More recently, a meta-analysis showed that workplace interventions that target productivity, performance, absenteeism and/or presenteeism were effective at decreasing absenteeism [mean difference = -2.7 days (95% CI, -4.5 to -0.8)] based on five moderate quality RCTs (Tarro et al., 2020). These meta-analyses highlight the positive effects of WHPPs on absenteeism.

Participation of high-risk employees seems to provide a greater benefit. A fairly old study by Bertera (1993) observed that the 2-year multimodal WHPP targeting multiple behaviours decreased the percentage of individuals who initially had ≥3 behavioural risk factors by 14%. Concurrently, the average number of self-reported absences due to illness decreased 12% in these individuals. All these studies suggest that WHPPs can decrease absenteeism, especially in high-risk employees, thereby helping employers.

1.3.3.3 Reduced presenteeism

The second source of productivity loss is presenteeism. Offering WHPPs may improve this variable, which may benefit employers. Shi et al. (2013) examined the effects of a 12-month multimodal WHPP including coaching for healthy lifestyle habits such as diet, smoking cessation, and PA on presenteeism, among other variables. Presenteeism decreased nearly 2% in participants whose modifiable well-being risks (measured as physical health, health behaviour, social and emotional health, work-related, and financial health) were reduced by 5% compared to baseline (Shi et al., 2013). This is in agreement with a systematic review (N = 14 studies) which reported that WHPPs can have a positive impact on presenteeism (Cancelliere et al., 2011). As described by the authors, the literature on presentism is “young and heterogenous” and future studies should use a standard metric to measure this outcome and examine the difference between diverse types of worksites (Cancelliere et al., 2011). This is in agreement with Tarro et al. (2020)’s meta-analysis on RCTs studying the effects of workplace interventions. The authors were able to identify only seven studies on presenteeism and reported that there was an insufficient number of studies to perform a meta-analysis. Taking all these results together, compared to absenteeism, there seems to be a fewer number of studies documenting this outcome following WHPPs. These programs seem to decrease presenteeism, but more studies are necessary.

1.3.3.4 Improved return on investment

Employers offering WHPPs would hope to save money for the cost of the service they provide their employees. The return on investment (ROI) is a financial metric, which consists of the ratio between the financial benefits/savings and the cost of the service that generated the savings (O'Donnell, 2015; Pronk & American College of Sports Medicine, 2009). For instance, a ROI of 2.0:1.0 means that $ 2.0 return/saving could be expected for every $ 1.0 invested in the program (Pronk & American College of Sports Medicine, 2009).

Many studies have examined the ROI of WHPPs for companies and have shown some savings. For instance, a study (n >43,800) examining the impact of a 2-year WHPP targeting multiple lifestyle habits including PA, smoking, and eating habits found that for every dollar invested in the program US $ 2.1 was saved due to a decrease in disability costs (Bertera, 1990). Participation in the 2-year WHPP studied by Aldana and colleagues (2005) saved absenteeism costs compared to non-participation, which translated into a ROI of 15.6:1.0. The meta-analysis by

Baicker et al. (2010) also found that WHPPs generated, on average, a ROI of 2.7:1.0 in terms of absenteeism cost saving (average study duration: 2 years) and 3.3:1.0 due to medical cost savings (average study duration: 3 years) (Baicker et al., 2010). All these studies indicate that a ROI of at least 2.1:1.0 could be achieved via WHPPs. A recent systematic review (7 studies) concluded that the longer a WHPP offered its services, the greater the positive ROI, particularly after three years (Astrella, 2017). Along these lines, a systematic review examined the ROI of WHPPs targeting at least one risk factor of chronic diseases (PA, healthy diet, tobacco use, and harmful alcohol consumption) (Baid et al., 2021). The authors included studies based in the United States that were at least four weeks long. Only two out of 25 studies were methodologically rigorous enough and had low risk of selection bias, and they did not provide any evidence that such programs can lead to positive ROI in the short term (Baid et al., 2021). Nevertheless, WHPPs may generate saving compared to the cost of the service. Longer study duration may be necessary to see a positive impact of WHPPs on ROI.

1.3.4 Potential benefits for employees

Studies have shown that WHPPs could have positive effects on health-related outcomes such as blood pressure and body weight resulting from healthy lifestyle habits. Table 3 summarizes some benefits of WHPPs on employees' health and lifestyle habits that have been reported in studies. Some of these will be discussed in detail in this section. Table 3 also includes potential benefits for companies, which were discussed earlier. In the following section, these outcomes will be presented.

Table 3 - Summary of some potential benefits of workplace health promotion programs on employers and employees.

Categories	References Authors (year)	Specific outcomes	Employers	Employees
Others	Baicker et al. (2010)	Return on investment	✓	✓
	Baicker et al. (2010)	Decreased health care costs	✓	✓
Work-related outcomes	Tarro et al. (2020)	Decreased absenteeism	✓	✓
	Cancellière et al. (2011)	Decreased presenteeism	✓	✓
	Parks and Steelman (2008)	Improved job satisfaction		✓

	Montano et al. (2014)	Occupational stress		✓
General perceptions	Edmunds et al. (2013)	Improved life satisfaction		✓
	Edmunds et al. (2013)	Improved perceived general health		✓
	Martin et al. (2019)	Decreased depressive symptoms and anxiety		✓
	Hartfiel et al. (2012)	Decreased stress (general)		✓
Physical outcomes	Prabhakaran et al. (2009)	Decreased blood pressure		✓
	Prabhakaran et al. (2009)	Improved blood lipide profile		✓
	Proper et al. (2019); Verweij et al. (2011)	Improved body weight and body composition		✓
Lifestyle habits	Proper et al. (2003a); Reutman and Lewis (2019)	Physical activity level		✓
	Maes et al. (2012); Ni Mhurchu et al. (2010)	Dietary outcomes		✓
	Redeker et al. (2019)	Sleep habits		✓
	Smedslund et al. (2014)	Smoking cessation		✓
	Yuvaraj et al. (2019)	Alcohol consumption		✓

1.3.4.1 Health-related outcomes

Overall life satisfaction and self-perceived health

Offering WHPPs can improve overall life satisfaction and perceived health. Indeed, a WHPP including PA, eating habits, sleeping habits, weight management, and stress management interventions was offered for one year (Merrill et al., 2011). Compared to baseline, there was a significant increase in employees' life satisfaction (7.6 to 7.8 on 1 to 10) and self-perceived health (7.5 to 7.7 on 1 to 10) scores (Merrill et al., 2011). These small effects of the program could be considered positive results because the authors explained that during the same period companies had to eliminate jobs due to national economic reasons (Merrill et al., 2011). A quasi-experimental study offered a 6-month WHPP targeting only PA and found that, compared to baseline, employees reported increased general health (3.5 ± 0.8 to 3.9 ± 0.9 on a scale from 1 to 5) and life satisfaction (20.6 ± 6.3 to 23.1 ± 5.6 on 5 items with 7-point Likert scale each) (Edmunds et al., 2013). More recently, health care workers who participated in a WHPP targeting stress management and resilience training had increased life satisfaction (22.8 ± 7.1 to 27.5 ± 5.7 on 5 items with 7-point Likert scale each) at 3-month post-program compared to baseline scale among study completers (Berkland et al., 2017). It is important to note that all three studies did not have a control group, making it difficult to judge the actual effects of WHPPs on these outcomes. Nevertheless, there is some evidence that such programs can improve employees' overall life satisfaction and self-perceived health.

Job satisfaction

WHPPs are offered at work, and they seem to improve employees' job satisfaction. A systematic review (79 studies) reported that, based on high and moderate quality studies, WHPPs targeting mental health outcomes had positive effects on job satisfaction (Czabała et al., 2011). A meta-analysis (17 studies) concluded that WHPPs, in general not limited to PA, increased job satisfaction (ES = 0.4, 95% CI: 0.1 to 0.8) (Parks & Steelman, 2008). However, participation in the 1-year WHPP targeting multiple lifestyle habit conducted by Merrill et al. (2011) showed a decrease in job satisfaction score compared to baseline (8.0 to 7.8 on 1 to 10). However, the authors did mention that there was job elimination during the study due to national economic reasons (Merrill et al., 2011); therefore it could be thought that job satisfaction would have decreased even further without the program. Because this study did not have a control group, the results should be interpreted cautiously. Taking these results together, WHPPs seem, in certain cases, improve this outcome.

Depressive symptoms and anxiety

Offering WHPPs can decrease depressive symptoms and anxiety in employees who take part in these programs. Indeed, the systematic review of review articles conducted by Proper and Van Oostrom (2019) suggested that based on six review articles on the effectiveness of WHPPs including those offering psychological interventions such as CBT, WHPPs can improve depressive symptoms and anxiety. Another systematic review concluded that, based on one of the eight high-quality studies, there was moderate evidence that WHPPs targeting only PA could improve depression symptoms (Chu et al., 2014). For example, depression scale decreased to a greater extent in employees who participated in a 24-week RCT offering WHPP focusing on PA and behaviour modification compared to no-program control group (-59 vs. -31% change, respectively) (Atlantis et al., 2004). However, based on two RCTs of high-quality, in WHPPs targeting PA, anxiety did not decrease significantly compared to control groups (Chu et al., 2014). However, based on two RCTs of high quality, there was strong evidence that WHPPs using yoga could decrease this outcome (Chu et al., 2014), suggesting that the modality of PA might be important for these outcomes. In their meta-analysis, Martin et al. (2009) included 17 studies and reported that WHPPs had a small, but positive effect on depressive symptoms (mean difference = 0.3, 95% CI: 0.1 to 0.4) and anxiety (mean difference = 0.3, 95% CI: 0.1 to 0.5) regardless of whether the WHPPs focused directly or indirectly on mental health. Therefore, the focus of the WHPP could be placed on other outcomes such as lifestyle habits (e.g., PA, smoking, and alcohol consumption), or psychological well-being (e.g., stress and mental health stigma) and could still be beneficial for these mental health outcomes (Martin et al., 2009). WHPPs targeting eating habits also seem to be beneficial. For example, an RCT studied the impact of a plant-based nutrition program on depression and anxiety measures for 18 weeks (Agarwal et al., 2015). The authors reported that employees in the intervention group had decreased depression and anxiety measures compared to those in the control group who did not receive any instructions [adjusted between-group difference intention-to-treat results: 3.7 (95% CI: 0.5 to 6.9) and 3.6 (95% CI: 0.3 to 6.9) respectively]. All these results show positive effects of WHPPs on depressive symptoms and anxiety.

Occupational stress and stress in general

WHPPs can decrease occupational stress and employees' stress in general. For example, in the study by Berkland and colleagues (2017), the percentage of employees reporting high stress levels decreased following a WHPP that focused on stress management and resilience among study completers (98% at baseline to 67% at 3-month post-program). Since WHPPs take place at work, studies have also examined the effects of WHPPs on occupational stress specifically. The systematic review of review articles performed by Proper and Van Oostrom (2019) retrieved articles published between 2009 and 2018 on occupational stress. The authors identified the work by Montano et al. (2014), who performed a meta-analysis included 36 randomized controlled WHPPs with varying interventions (e.g., CBTs, ergonomics, health education, PA, eating habits, and stress management). WHPPs had a small, but positive effect (mean difference = -0.4, 95% CI: -0.7 to -0.1) on job stress (Montano et al., 2014). A meta-analysis (38 articles; published after 1976) reported that the ES of WHPPs targeting management of occupational stress was 0.7 (Richardson & Rothstein, 2008). This represents at least moderate effects of WHPPs on stress, thereby showing that WHPPs targeting occupational stress can effectively decrease this outcome. A scoping review performed by Ryan et al. (2017) slightly questioned the evidence on the effects of such programs on management of work-related stress. Indeed, Ryan et al. (2017) identified 50 articles published up to April 2016 on web-based WHPPs, from which 88% were on those using interventions aiming at the individual-level for improving work-related stress and well-being. Based on these articles, there was low to moderate quality evidence that this type of WHPP was effective at improving occupational stress. However, few studies on WHPPs aiming at the organization-level or multimodal were identified and those provided limited evidence (Ryan et al., 2017). This would suggest that individual-level interventions may be more beneficial at improving this outcome. WHPPs targeting stress management seem to be beneficial for decreasing occupational stress and potentially stress in general.

Regarding WHPPs including PA as an intervention to reduce stress, the systematic review conducted by Chu et al. (2014) reported that the impact of WHPPs including at least PA interventions on stress relief (occupational and general stress) was inconclusive based on seven RCTs. However, programs with yoga seem to be beneficial for stress based on two low quality RCTs (Chu et al., 2014). For example, a weekly 50-minute yoga session decreased stress in the program group [mean (standard error) baseline and at eight weeks = 24.0 (1.0) and 21.3 (0.9), respectively] compared to no-program control group [mean (standard error) baseline and at eight weeks = 25.7 (1.6) and 25.4 (1.3), respectively] (Hartfiel et al., 2012). It is possible that there are certain modalities of PA that are more advantageous for decreasing stress. Certain modalities of activity were observed to decrease occupational stress in a recent systematic review (Bischoff et al., 2019). Nine studies had conducted programs to reduce occupational stress in health professionals using PA interventions only. Specific activities (i.e., yoga and qigong) were concluded to be effective strategies to reduce this outcome in these employees (Bischoff et al., 2019). The authors mentioned that studies did not report on the duration, frequency and intensity of their activities, making it difficult to evaluate the effect of occupational PA programs on work-related stress reduction (Bischoff et al., 2019). Thus, WHPPs can decrease stress including occupational stress, and certain modalities of activity seem to be more beneficial for these outcomes.

Physiological outcomes

Some studies suggest that offering WHPPs may improve some biometric outcomes, to a certain extent. In fact, Muto and Yamauchi (2001) conducted a 1-year RCT composed of a no-program control group and a group receiving a WHPP targeting multiple lifestyle habits including PA, eating habits, and stress management for a year. Employees had to present at least one of the following risk factors at baseline to be included in the study: BMI, systolic/diastolic blood pressure, total cholesterol, high-density lipoproteins cholesterol, triglycerides, and fasting blood glucose. At 6-month after the end of the program, employees in the program group compared to the control group showed greater improvements in total cholesterol (-6.4 ± 24.3 and +4.5 ± 22.7 mg/dL, respectively) and triglycerides (32.1 ± 128.4 and 0.2 ± 101.3 mg/dL, respectively) (Muto & Yamauchi, 2001). Among employees who had abnormal ratings for each of these outcomes at baseline, greater improvements in the program group compared to the control group were observed for total cholesterol (-15.3 ± 25.0 and +0.5 ± 25.8 mg/dL, respectively) and triglycerides (-62.9 ± 144.0 and -16.2 ± 119.1 mg/dL, respectively). This study seems to indicate some positive changes following their WHPP. However, based on systematic reviews and meta-analysis WHPPs do not seem to be effective at decreasing blood lipid levels, blood pressure, and blood glucose (Freak-Poli et al., 2020; Groeneveld et al., 2010; Mulchandani et al., 2019; Proper et al., 2003b; Proper & Van Oostrom, 2019). Even the ESs are small. For instance, the meta-analysis by Conn and colleagues (2009) studying the effects of WHPPs focusing PA reported that ESs for lipids ranged between 0.1 and 0.2. Taking these results together, for now, there do not seem to be overwhelmingly positive effects of WHPPs on biometric measures.

Body weight and body composition measures

One of the advantageous of offering WHPPs is decreases in the body weight and body composition measures of employees. In fact, WHPPs targeting PA and/or diet can improve outcomes related to weight such as body weight, waist circumference, BMI, and percentage of body fat (Mulchandani et al., 2019; Proper & Van Oostrom, 2019; Sandercock & Andrade, 2018). For instance, Rezai et al. (2020) analyzed the data of 518 employees who were offered a 12-week WHPP mainly targeting PA and nutrition. The authors reported that at the end of the program, there were improvements in weight (-11.9 pounds equivalent to 5.4 kg), BMI (-1.9 kg/m^2), and waist and hip ratio (-0.1). This study lacked a control group (Rezai et al., 2020). In the RCT by Muto and Yamauchi (2001), while body weight decreased by 1.0 ± 3.2 kg in employees who participated in the 1-year program targeting multiple lifestyle habits, it increased by 0.5 ± 2.2 kg control group without program at six months after the end of the program. Additionally, although small in change, BMI decreased by 0.3 ± 1.1 kg/m^2 in participants in contrast to the control group (+0.2 ± 0.8 kg/m^2). Among employees with a BMI ≥25.0 kg/m^2 at baseline, those in the program showed a greater difference compared to control group (-0.6 ± 1.1 vs. +0.1 ± 0.7 kg/m^2, respectively) (Muto & Yamauchi, 2001). Weight-related outcomes improve following WHPPs, but the reported changes are small. Indeed, Schröer et al. (2013) identified systematic reviews and meta-analysis (N = 15 articles) on the effects of WHPPs targeting PA, healthy weight, and nutrition on weight and stated that all programs lead to small improvements in weight (Schröer et al., 2013). Furthermore, the meta-analysis by Conn and colleagues (2009) examining the effects of WHPPs targeting PA reported that ESs varied between 0.07 and 0.13 for BMI, weight, abdominal girth, and percent body fat (Conn et al., 2009), which are indicative of programs' effects varying between very small and small on these outcomes. Another meta-analysis (N = 22 studies) reported that there was low quality evidence that WHPPs targeting PA reduce body weight (-1.1 kg; 95% CI: -1.8 to - 0.4) or BMI (-0.1 kg/m^2; 95% CI: -0.7 to -0.3) among studies lasting between 4 weeks and 3 years (Verweij et al., 2011). Also, it was mentioned that there is moderate quality of evidence indicating decrease in body weight (mean difference = -1.2 kg; 95% CI: -1.6 to -0.7) or BMI (mean difference = -0.3 kg/m^2; 95% CI: -0.5 to -0.2) following WHPPs targeting PA and dietary behaviour (Verweij et al., 2011). Conclusions were not drawn for both outcomes for WHPPs targeting only dietary behaviour due to a small number of studies. Thus, it may be beneficial to offer WHPPs targeting PA alone or in combination with dietary behaviours for body weight and BMI. It has been noted that data collection of body composition measures are inconsistent between studies (Sandercock & Andrade, 2018). Nevertheless, considering all these results, WHPPs targeting particularly PA and/or diet can have small, but positive effects on weight-related outcomes.

1.3.4.2 Lifestyle habits

To improve the above-mentioned health-related outcomes, it is important that WHPPs improve lifestyle habits. Changing employees' unhealthy lifestyle habits can improve their health and prevent potential consequences of these unhealthy lifestyle habits discussed earlier in this thesis. Although studies have shown that WHPPs can be beneficial for employees' health, results of several systematic reviews and meta-analyses make one question the effectiveness of such programs at improving different lifestyle habits and consequently certain health-related outcomes. An overview of this challenge will be briefly presented in the current section.

Offering health services such as WHPPs allows employees to become more active even at work. The systematic review conducted by Proper and colleagues (2003b) examined the effectiveness of WHPPs targeting PA on PA, physical fitness, and health. Based on the 26 RCTs and nonrandomized control trials published from 1980 to 2000, there was strong evidence that such programs improved PA (Proper et al., 2003b). An example of a such program is the “A Million Steps” WHPP challenge that was implemented in two companies and consisted of reaching a million steps in a month (Gonzalez-Dominguez et al., 2017). Employees were able to reach this goal and when their steps were converted to an equivalent of minutes per week, on average, participants exceeded 150 moderate PA per week (Gonzalez-Dominguez et al., 2017). Another example is the WHPP called “Move-A-Thon” that encouraged employees to do 3,000 steps daily for two weeks in exchange for money that would be donated to charity (Reutman & Lewis, 2019). The authors reported that employees achieved three times more steps per day than the number of steps that was aimed for. Although these studies showed the benefits of such programs on PA, they lacked control groups. Moreover, several systematic reviews and meta-analyses dating from 1988 reported small ESs (i.e., 0.2-0.4) of such programs, inconclusive results, and little evidence on their positive effects (Conn et al., 2009; Dishman et al., 1998; Malik et al., 2014; Marshall, 2004; Wong et al., 2012). For example, the meta-analysis conducted by Marshall (2004) analyzed studies published after 1997. Among the six articles that provided enough data to calculate ESs, ESs varied between 0.3 and 0.4. Moreover, effects were smaller in randomized studies compared to those with a quasi-experimental design (Dishman et al., 1998). More recently, the study by Freak-Poli and colleagues (2020) investigating the effectiveness of WHPPs using a pedometer as an intervention component also examined other outcomes such as PA and long-term health outcomes. The authors updated their results on the Cochrane Database with evidence up to December 2016 and mentioned there would not be another update because more sophisticated devices are replacing pedometer. Freak-Poli et al. (2020) reported that pedometer-based programs did not influence PA at least one month following the programs when compared to control groups and that “the effect is very uncertain.” This result was observed based on six studies (study duration: 1 week to 2 years) with very low-certainty evidence and high heterogeneity (Freak-Poli et al., 2020). The control group in this case was either a group without any intervention or “minimal intervention,” which could be an

HRA accompanied by newsletters on PA benefits, motivational messages, 15-minute individual sessions with a booklet on general recommendations on PA, or an optional periodic health screening (Freak-Poli et al., 2020). No studies offered pedometer as the sole intervention; it was accompanied with other components such as walking groups, counselling or dietary advice. Taking all these results together, WHPPs targeting PA can have positive effects on PA, but the effects seem to be small. Also, strategies to improve long-term effects of these programs on this outcome are also necessary.

WHPPs may improve certain eating habit-related outcomes. In fact, two systematic reviews, one focusing on WHPPs targeting weight loss and/or healthy eating and another targeting healthy diet, reported positive effects on fruit, vegetable, and total fat intakes, as well as "dietary behaviour" (Maes et al., 2012; Ni Mhurchu et al., 2010). Two other systematic reviews indicated that multimodal WHPPs are the most effective at improving fruit, vegetable, and fat intakes (Engbers et al., 2005; Kahn-Marshall & Gallant, 2012). While these studies show some positive effects of WHPPs on eating habits, two other systematic reviews make one question their effectiveness on eating habit-related outcomes. For example, a systematic review conducted by Geaney et al. (2013) wanted to study the effects of WHPPs targeting dietary modification alone and combined with nutrition education on dietary behaviour. The dietary modifications in question were changes in the dietary content, such as decreasing salt in the offered foods or meal, modifying portion size, and varying the availability/non-availability of healthy/unhealthy food options (Geaney et al., 2013). Depending on the database, the time frame of search varied slightly with the earliest start year being 1900 and the end being 2011 (N = 12 articles; study duration varied between 3 and 24 months) (Geaney et al., 2013). Based on five studies, there was limited evidence of WHPPs using dietary modification combined with nutrition education could influence fruit and vegetable intake. Geaney et al. (2013) stated that the effects of such programs in the long-term were also not clear. Measuring tools varied between studies and high heterogeneity was too high to perform a meta-analysis (Geaney et al., 2013). More recently, Glympi et al. (2020) conducted a literature review on the effects of WHPPs targeting eating habits on diet, dietary behaviour, but also health-related outcomes of office workers published between 1999 and 2009 (N = 25 articles). The authors concluded that studies were heterogenous in terms of outcomes, design, number of participants and gender distribution, as well as duration, and that all studies reported at least one positive effect. While multimodal-type WHPPs seem to be beneficial for improving eating habits, other types of programs do not provide overwhelmingly positive effects on eating habit-related outcomes.

Another potential benefit of WHPPs is their positive effects on sleep habits in employees who participate. Indeed, a recent pilot, web-based WHPP targeting sleep habits called “WarmUapp” was offered to employees in multinational company i.e., China, France, Spain and the United States (Montagni et al., 2019). The WarmUapp program consisted of an initial individualized face-to-face session with a health professional and access to a tablet application (Montagni et al., 2019). It aimed to create awareness of sleep-related problems and consequences. Compared to baseline, at 6-month follow-up the proportion of employees sleeping at least seven hours during weekends increased (81% to 87%) (Montagni et al., 2019). However, this program did not contain a control group. Redeker and colleagues (2019) reviewed WHPPs initiated by employers in the aim of improving employees’ sleep habits. A total of 60 papers published from 1966 to December 2017 was identified. The authors concluded that this type of program can improve sleep duration. However, the evidence is weak (Redeker et al., 2019). WHPPs may also improve sleepiness: employees were 1.7 times less likely to reported sleepiness after the program (Montagni et al., 2019). The WHPP study by Montagni et al. (2019) also found an improvement in sleep quality, i.e., the proportion of those reporting sleep difficulties decreased (48% to 31%). Redeker et al. (2019) also found an improvement in sleep quality following the WHPP studies in their review. Furthermore, WHPPs may have a positive impact on sleep disorders. Indeed, a systematic review by Robbins et al. (2019) examined the effectiveness of WHPPs on sleep duration among studies published up to September 2018. The studies (N = 20 articles) could offer any type of intervention such as PA, yoga and CBT for insomnia (Robbins et al., 2019). The authors mentioned that 50% of the studies observed a significant improvement in sleep duration. Thus, there may be some type of WHPPs that were more successful at improving sleep-related outcomes. However, that was not the aim of their systematic review. Nevertheless, WHPPs may be beneficial for improving this outcome. However, there is not strong evidence supporting their effectiveness at improving sleep habit-related outcomes.

Employees offered WHPPs can potentially quit smoking after participating in these programs. A meta-analysis examining the effectiveness of WHPPs targeting smoking cessation was conducted by Fisher et al. (1990). The authors included 20 controlled studies (1980-1989) and reported a modest overall effect (weighted mean ES: 0.2; 95% CI: 0.1 to 0.3). Smedslund and team (2004) wanted to update the meta-analysis of Fisher et al. (1990) and studied the "quit rates" of 19 controlled studies published between 1989 and 2001. The weighted OR at 6-months was 2.0 (95% CI: 1.4 to 2.9), at 12 months 1.6 (95% CI: 1.2 to 2.1), and at more than 12 months, 1.3 (95% CI: 0.9 to 1.9) (Smedslund et al., 2004). The authors reported that such programs were effective in the short-term (six months), but as they progressed in time, the effects decreased to no effect from these programs after 12 months. Taking these results together, WHPPs seem to have positive effects on smoking habits but they fade away with time. Certain types of interventions may be more advantageous to offer compared to others in the context of WHPP. In fact, Cahill et al. (2008) conducted a systematic review on smoking cessation programs at work (51 studies published from 1966/1985 to 2008) and stated that group programs and those targeting the individual were more likely to increase smoking cessation compared to none or minimal intervention control groups. However, other types of interventions such as self-help material were less effective (Cahill et al., 2008). The authors added that they did not observe any effects of "comprehensive" programs targeting multiple risk factors. Cahill and Lancaster (2014) performed another review on the effectiveness of smoking cessation programs at work and included in total 57 studies published up to 2013. This was updated in the Cochrane Database. The conclusions remained essentially the same (Cahill & Lancaster, 2014). The group therapy programs, individual counselling, and programs with multiple interventions targeting only or mainly smoking cessation increased the likelihood (OR = 1.7, 95% CI: 1.1 to 2.8, OR = 2.0, 95% CI: 1.5 to 2.5, and OR = 1.6, 95% CI: 1.1 to 2.1, respectively) of quitting smoking compared to the control group with no or minimal interventions (Cahill & Lancaster, 2014). There was strong evidence for the latter effects. These results suggest that certain type of interventions such as individual counselling and group programs were more likely to promote smoking cessation in employees compared to the control group. Overall, WHPPs do have positive effects on employees' smoking habits, but those targeting multiple lifestyle habits may not be effective at improving this behaviour.

Alcohol consumption may decrease following employees' participation in WHPPs. Several systematic reviews have analyzed the effects of WHPPs targeting alcohol consumption (Ames & Bennett, 2011; Lee et al., 2014). One of these stated, "it seems that approaches aimed at preventing alcohol problems and evaluations of interventions in the workplace have met with some, if not limited, success, and still are in developmental stages" (Ames & Bennett, 2011). Thus, WHPPs targeting the prevention aspect of excessive alcohol consumption require more research. Furthermore, WHPPs may improve alcohol consumption. Indeed a systematic review and meta-analysis conducted by Yuvaraj et al. (2019) evaluated the effectiveness of WHPPs targeting alcohol consumption. Parallel arm RCTs (N = 7 articles), regardless of baseline alcohol consumption levels, published up to 2018 were included (Yuvaraj et al., 2019). The authors concluded that there is weak evidence that such programs can decrease alcohol consumption (pooled mean difference of -2.3 Standard Units of Alcohol/week; 95% CI: -4.2 to -0.3) compared to standard care/control groups. WHPPs can also improve excessive alcohol use. In Yuvaraj et al. (2019) when employees were separated into high vs. low alcohol consumers, WHPPs significantly decreased (pooled mean difference = -2.6 Standard Units of Alcohol/week, 95% CI: -4.7 to -0.6) consumption only in those who had excessive alcohol consumption at baseline (more than 15 standard drinks per week). Lee and colleagues (2014) performed a systematic review examining the effects of WHPPs targeting excessive alcohol consumption in industries that were dominated by men. It included eight studies published between 1990 and 2014. The authors stated that there is limited evidence that such programs can have positive effects on alcohol use problems, but these programs were feasible (Lee et al., 2014). Considering these results, WHPPs targeting alcohol consumption can decrease alcohol consumption to a greater extent in those who have excessive consumption. However, there seems to be weak and limited evidence for their effectiveness.

WHPPs targeting stress management have been offered, but no studies seem to have examined their effects on stress management itself (i.e., as an outcome). For example, studies mostly investigated the effectiveness of WHPPs targeting stress management type interventions on stress-related outcomes (DeFrank & Cooper, 1987; Richardson & Rothstein, 2008; Ryan et al., 2017; Tetrick & Winslow, 2015; van der Klink et al., 2001). Only one study included an outcome close enough to stress management and reported a small ES. It is the meta-analysis conducted by van der Klink et al. (2001) that examined the effectiveness of WHPPs using interventions to reduce occupational stress (48 studies published between 1977 and 1996). Regardless of the type of intervention, the effects on psychologic resources and responses, which included coping skills, were small (ES = 0.3) (van der Klink et al., 2001). Another systematic on this topic was later conducted, but it did not seem to include coping skills as an outcome (Richardson & Rothstein, 2008). As mentioned, stress management was either included as an outcome into a broader outcome such as psychologic resources and responses as in van der Klink et al. (2001) or was not measured

(Richardson & Rothstein, 2008; Ryan et al., 2017; Tetrick & Winslow, 2015). There is a lack of studies on the effect of WHPPs on stress management as an outcome. Documenting this lifestyle habit could explain how occupational stress improves because an improvement in stress levels does not necessarily mean that individuals manage their stress better.

1.3.5 Conclusion on workplace health promotion programs

This third section of literature review defined WHPPs as any initiatives taken by the employer to improve its employees' health and well-being (Goetzel & Ozminkowski, 2008). It also highlighted certain types of interventions that are included these programs. Interventions can target various levels of influence, but multimodal WHPPs seem to lead to the most benefits. However, no studies have examined the effects of a program with different arms with increasing numbers of interventions on health and lifestyle habits. Furthermore, although there may be disadvantages associated with WHPPs targeting multiple lifestyle habits within the same program, it may be balanced by their advantages. Furthermore, outside the context of WHPPs, most multiple lifestyle habit studies have examined PA and diet (King et al., 2015). Numerous potential benefits of WHPPs for employers and employees have been reported in studies, and this may have a positive effect on society. However, many systematic reviews and meta-analyses report limited evidence, inconclusive results, and small ESs on health and lifestyle habits. This challenge points out the importance of examining other factors that may improve the effectiveness of these programs and consequently help employees improve their health and lifestyle habits as well. Moreover, most studies have examined the effectiveness of their program, but few studies have explored for whom their WHPPs were beneficial (Muir et al., 2019). These limits in the literature justify the implementation of a WHPP with increasing number of interventions.

1.4 Intention and behaviour association in the context of workplace health promotion programs

Considering the above mentioned challenge of improving employees' lifestyle habits using WHPPs, it may be important to study other factors such as intention because theories state that it is associated with behaviour (Ajzen, 1985; Prochaska & DiClemente, 1983; Schwarzer, 2008). One of the main behaviour change models is Ajzen and Fishbein's model called the Theory of Reasoned Action; it includes "intention" (Browning & Thomas, 2006, p.9). The term "behavioural intention" is defined as “indication of how hard people are willing to try, of how much of an effort they are planning to exert, to perform a behaviour” (Ajzen, 1991, p.181). According to this theory, attitudes toward the behaviour and subjective norms predict each other as well as the intention (Ajzen, 1991). Attitudes towards the behaviour, which is the evaluation/appraisal (positive or negative) of performing the behaviour, are influenced by certain outcomes linked to the behaviour that are valued by the individual (Ajzen, 1991). Subjective norms, which is the perceived social pressure to engage in the behaviour in question or not, are influenced by the person’s perception of whether referent individuals or groups of importance approve/disapprove engaging in that behaviour, and whether they engage in the behaviour themselves (Ajzen, 1991, 2020). Then, intention is the predictor of behaviour, with stronger intention leading to an actual behaviour change (Ajzen, 1991). For another behaviour it is possible that attitude predominates as a determinant over subjective norms and vice versa (Godin, 2012).

Later this theory was renamed the Theory of Planned Behaviour and included a third predictor called “perceived behavioural control” (Ajzen, 1991). This component is described as “people’s perception of the ease or difficulty of performing the behaviour of interest,” which is influenced by a person’s control beliefs (Ajzen, 1991, p.183). Control belief refers to barriers and facilitators associated with engaging in a given behaviour (Ajzen, 1991). Perceived behavioural control will influence behavioural intention, which will then influence a given behaviour (indirect influence). It could also directly influence that behaviour (Ajzen, 1991). In the context of Internet-based interventions targeting PA, eating habits, smoking, and/or alcohol consumption, and not limited to workplace, the Theory of Planned Behaviour was noted to be effective on behaviours (ES = 0.36, 95% CI: 0.15 to 0.56) (Webb et al., 2010). Their comparator group either received no intervention or a control intervention. The Theory of Planned Behaviour could predict and explain many behaviours including PA and eating habits and smoking (Armitage & Conner, 2001; Blue et al., 2001; Bogers et al., 2004; Close et al., 2018; Conner & Sparks, 2005; Godin & Kok, 1996; McDermott et al., 2015; Topa & Moriano, 2010; Webb & Sheeran, 2006). Nevertheless, the utility of this theory has been questioned for smoking (Topa & Moriano, 2010). Within the context of WHPPs specifically, several studies have examined the association between the initial intention to improve a given lifestyle habit and the improvement of lifestyle habit following the program (Hennrikus et al., 1995; Huddy et al., 1995; Lippke et al., 2015; Miller et al., 2016). In these studies some have targeted certain populations at risk or presented with chronic disease (Miller et al., 2016).

It is important to note that the association between intention and behaviour is not perfect (Godin, 2012). Indeed, previous studies have reported a discordance between intention and behaviour called the “intention-behaviour gap” (Rhodes & de Bruijn, 2013; Rhodes & Quinlan, 2015; Webb & Sheeran, 2006). For example, Rhodes et al. (2008) stated that based on a Canadian survey, 87% of Canadians intended to be physically active, but only 43% were considered meeting PA guidelines. Thus, although intention is important to change behaviour, it may not be sufficient (Godin, 2012). Individuals can be categorized into four profiles: those who hold a positive intention and enact the behaviour, those who hold a positive intention but do not enact, those who hold negative intention but enact the behaviour, and those who hold negative intention and do not enact (Godin et al., 1986; Orbell & Sheeran, 1998; Sheeran, 2002). The intention-behaviour gap arises from individuals who hold a positive intention and do not act the behaviour compared to non-intenders who perform the behaviour (Rhodes & de Bruijn, 2013; Sheeran, 2002). In the context of PA, most of the stability of this association arises from those who do not have the intention to perform PA and do not act the behaviour (Rebar et al., 2019). Studies outside the context of WHPPs have examined the intention-behaviour gap in a specific lifestyle habit such as PA and certain eating habits (Allan et al., 2011; Godin et al., 1986; Rhodes & de Bruijn, 2013). A meta-analysis conducted by Webb and Sheeran (47 experimental tests in total; 2006) wanted to examine the influence of intention on behaviour in experimental studies. The authors reported that medium to large (ES = 0.66) changes in intention could lead to small to medium improvements in behaviour (ES = 0.36). It is important to note that their analyses were performed with studies on a broad range of behaviours including the study behaviour, condom use, course enrollment, smoking, skin examination and low-fat diet, just to name a few (Webb & Sheeran, 2006). Furthermore, for certain lifestyle habits, this gap has been studied in young individuals such as college or University students who may not have the same barriers as adults in the general population (Arigo et al., 2022; El Ansari & Lovell, 2009; Rhodes & de Bruijn, 2013; Webb & Sheeran, 2006). However, the sample-weighted ES for student sample was not significantly different from the one for non-students (ES = 0.38 vs. 0.33) in the relationship between change in intention and behaviour (Webb & Sheeran, 2006).

Although not the focus of the current thesis, many studies have tested various variables that can moderate the relationship between intention and behaviour for different behaviours (Cooke & Sheeran, 2004; Webb & Sheeran, 2006). Some properties of intention have been identified as moderators. Indeed, temporal stability was tested as a moderator of the association between intention and behaviour in a meta-analysis (N = 44 studies) conducted by Cook and Sheeran (2004). This association was stronger in individuals who maintained the same level of intention throughout time ($r_+ = 0.67$) compared with those who exhibited less stable intentions ($r_+ = 0.30$) (Cooke & Sheeran, 2004). Among the other moderators (cognitive properties) that were tested, temporal stability was concluded to be the strongest one (Cooke & Sheeran, 2004). Another example is certainty regarding the intention to perform a behaviour. Compared to those who had low certainty ($r_+ = 0.41$), individuals who had high certainty ($r_+ = 0.64$) showed a stronger association between intention and its behaviour (Cooke & Sheeran, 2004). It is important to note this meta-analysis included many behaviours such as voting, product choice, and donation behaviour and included some of the lifestyle habits (exercise, healthy eating, and smoking) (Cooke & Sheeran, 2004; Webb & Sheeran, 2006). Personality has been tested as a moderator of this association. For example, being conscientious was observed to moderate the association between intention and being physically active, with being more conscientious leading to a stronger association (Conner et al., 2007; Rhodes et al., 2007; Rhodes & Dickau, 2013). This seems to be particularly true depending on whether it is an unusual or usual context (Conner et al., 2007). Other types of variables have also been assessed as moderators. For example, variables related to the study's methodology had more impact on the association between intention and behaviour. This was true in samples of ≥150 participants compared to a smaller size as well as interventions with an alternative intervention compared to control group (Astrella, 2017; Webb & Sheeran, 2006). Self-efficacy, age, and sex/gender are examples of multitudes of variables that have been tested as moderators of different intentions and their behaviours (Godin, 2012; Rhodes & Dickau, 2013; Weijzen et al., 2009). However, no moderating effects were observed for certain lifestyle habits, or definite conclusions could be drawn (Godin, 2012; Rhodes & Dickau, 2013). A moderator of a given health behaviour may not be a moderator for another one. For example, while habit [i.e., a "phenomenon" by which behaviour is automatically triggered to specific cues (Wood & Neal, 2009, cited in Gardner, 2015)] was a moderator of the relationship intention-behaviour for cycling and healthy snack and milk consumptions, it was not a moderator of alcohol consumption (Danner et al., 2008). Studies have also used some of these variables as mediators. For example, self-efficacy mediated the moderating effect of planning (which will be presented below) of the association between intention and behaviour (Lippke et al., 2009); such that those with poor self-efficacy may not benefit from the mediating effect of planning on this association (Lippke et al., 2009).

Planning is one variable that has been observed to mediate the relation between intention and behaviour (Godin, 2012; Lippke et al., 2009; Schwarzer et al., 2007). This mediating effect allows individuals, researchers, and/or professionals to "bridge" the intention-behaviour gap. One of such strategies is implementation intention. Known as "if–then" it is a strategy consisting of planning an appropriate action in advance when presented with a critical situation (Gollwitzer, 1993, 1999; Gollwitzer & Sheeran, 2006). It allows individuals to specify, for example, the "what," "where," "when," and "how" of an action (Gollwitzer, 1993). Based on Sheeran and Webb (2016) this tool has been the most researched and validated one or doing the transition from intention to behaviour. Implementation intention has been shown to have positive effects in changing health behaviour including healthy eating and PA (Adriaanse et al., 2011; Armitage, 2007a, 2007b; Bélanger-Gravel et al., 2013; Gollwitzer & Sheeran, 2006). This strategy allows individuals to overcome four specific situations that may hinder the adoption of behaviour: inhibition (forgetting/missing an opportunity) of initiating a behaviour, deviation from their behavioural goal, disengagement in the behaviour and pursuit of multiple goals (Gollwitzer & Sheeran, 2006).

1.4.1 Conclusion on the intention-behaviour relationship in the context of workplace place health promotion programs

This fourth section of the literature review defined intention as an indication of how hard an individual is willing to try/how much effort this person is planning to invest to execute a given behaviour (Ajzen, 1991, p.181). Intention is proposed as the most important determinant of behaviour (Ajzen, 1991; Godin, 2012). However, there is a gap between intention and behaviour which has been reported in the literature. Although it is not one of the objectives of the current thesis, many variables such as temporal stability, sex, and intervention type have been tested as moderators of the association between intention and behaviour. One of the well-known strategies for reducing the gap between intention and behaviour is implementation intention, which has been observed to increase the link between intention and several behaviours. In the context of WHPPs, very few studies seem to have examined the association between baseline intention and improvement of many lifestyle habits simultaneously following a multimodal WHPP targeting multiple lifestyle habits. To my knowledge, studies also did not examine whether, when compared to offering limited number of interventions, offering many interventions targeting multiple lifestyle habits could yield a larger number of associations between intention and its corresponding behaviour.

1.5 Conclusion of the literature review

To conclude, adopting healthy lifestyle habits such as an active lifestyle, healthy eating habits, healthy sleep habits, not smoking, reduced alcohol consumption, and efficient stress management can improve one's health by preventing and reducing the risk of chronic diseases. While recommendations exist for most of these behaviours, there are still many people who do not adhere to them. Knowing that most people work and spend most of their waking time at work, health promotion efforts may be more emphasized in the workplace. This setting has many advantages such as reaching a large proportion of the population and making use of an established communication channel. Health promotion programs have been offered at work. Many studies have shown that they are beneficial for employees, companies, and society since they improve health- and work-related variables. However, systematic reviews and meta-analyses on the effects of these programs on health-related variables and lifestyle habits call their effectiveness into question. Furthermore, studies have not analyzed the effects of packages of increasing numbers of interventions within the same WHPP. As stated by certain theories and models, intention and behaviour are associated, but most studies have examined the effectiveness of health promotion programs at work and usually do not dive further into their program (Ajzen, 1985, 1991; Muir et al., 2019; Prochaska & Velicer, 1997). It is possible that in the context of multimodal WHPP targeting multiple lifestyle habits offered to worker in Quebec, intention is associated with improvement in behaviour, therefore making it essential to investigate this question. Furthermore, does offering a larger number of interventions compared to lesser ones could yield a greater number of associations between intention and behaviour in the context of such program in this population. Moreover, although systematic reviews and meta-analyses report small effects, this shows the average result of the studied sample. It is important to note that within those samples, there are employees who will improve their health and lifestyle habits. Considering this possibility, it is also essential to discover the baseline characteristics of those who improve their lifestyle habits after taking part in WHPPs. This may help multiple lifestyle habit workplace program practitioners identify subgroups of employees who will benefit and potentially develop complementary interventions for those who do not improve.

1.6 Research questions and hypotheses

Based on gaps that have been identified in the literature, the current thesis attempts to answer the following questions:

1. Did a WHPP called the *Activate Your Health* program offered to Canadian (Quebecers) employees lead to improvement in health- and lifestyle habit-related outcomes? More specifically, which package of interventions, called “option,” of this program was the most beneficial; options varied by the increasing number of interventions included: *Control*, *Light*, *Moderate*, and *High*?
2. What were the health- and lifestyle habit-related predictors of intention to improve various lifestyle habits at baseline?
    a. Was the baseline behavioural intention associated with its behavioural improvement after participating in the program?
    b. Which option of the *Activate Your Health* program led to the greatest number of intention-to-behavioural-improvement conversions?
3. Among employees have the potential to improve at baseline, who (which baseline characteristics) were more likely to improve their lifestyle habits and health risk factors such as BMI and stress at work in the context of a WHPP?

The hypothesis for each of the above questions are as follows:

1. The *Activate Your Health* program will allow employees to improve most health- and lifestyle habit-related outcomes, and the package with the highest number of interventions i.e., *High*, will be the most beneficial.
2. Many baseline variables such as age, sex, BMI, number of health problems and not adhering to a given lifestyle habit would be predictors of intention to improve PA, eating habits, sleep habits, smoking, alcohol consumption and stress management.
    a. Each positive intention will be associated with its behavioural improvement.

   b. The option with the greatest number of interventions, i.e., *High,* will lead to the largest number of intention-behaviour-improvement conversions.
3. In employees who have the potential to improve, participants' age, sex, option of the *Activate Your Health* program, number of health problems, and perceived life satisfaction will be predictors of improvement in lifestyle habits and health risk factors following this program.

1.7 Presentation of articles

Based on the lack in the literature and the objectives that were identified, the current thesis will try to fulfill the gaps by using the data collected by Capsana (Capsana, 2020). Capsana is an organization in Quebec that was founded in 1988. It has dedicated more than 30 years towards the promotion of health and healthy lifestyle habits. Capsana is also dedicated to preventing and managing chronic diseases. As mentioned on their website, their goals are to empower individuals so that they play an active role in their own health and to foster a healthy environment. Capsana is also responsible for public campaigns such as TOUGO and Quit to Win! Challenge. Capsana created a WHPP called the *Activate Your Health* program. This program is offered to companies in Quebec; the evaluation component is co-financed by the Public Health Agency of Canada and Capsana. Many types of interventions are offered, and many lifestyle habits are targeted. Their WHPP program is composed of different options (*Control, Light, Moderate*, and *High*). The option *Limited*, halfway between control and *Light*, was removed from all the following articles because none of the companies selected this option.

In the current thesis, Article 1 is on the study design of the *Activate Your Health* program (Chapter 2). Then, Article 2 will present the results of the evaluation of this program that was performed using the data collected at baseline data and following one cycle of intervention delivery (Chapter 3). Due to the ongoing pandemic that took place in Canada in March 2020, the data collection of the following cycles of the program were affected. Therefore, for the purpose of the current thesis, the end of the first cycle of the program will be referred to as "post-program" or "post-intervention." Because the *Activate Your Health* program was composed of four different options, changes in outcomes in time in the different options were analyzed.

In the context of WHPPs, studies have looked at the intention to participate in WHPP or the association between intention to change lifestyle habits on participation-related variables (Ott-

Holland et al., 2019; Sloan & Gruman, 1988; Street & Lacey, 2018). Other studies have looked at factors influencing intention to take part or participation in their WHPP (Aittasalo & Miilunpalo, 2006; Hong et al., 2010; Middlestadt et al., 2011; Niessen et al., 2013; Robroek et al., 2012; Röttger et al., 2017; Song et al., 2021). Some studies have evaluated the effectiveness of their program, which used a theory of planned behaviour, but seem to not have examined the evolution or progression from intention to action following their WHPPs (McEachan et al., 2011). Keller and colleagues (Keller et al., 2016) studied the effect of self-efficacy and planning as predictors of PA in a WHPP that was offered to intenders. Similarly, Aittasalo and Miilunpalo (2006) were interested in studying the reach of occupational health care professional's PA counselling among physically inactive participants, who intended to improve PA. Another study measured the intention to increase staircase use in the future, a variable taken after the end of their program which was a campaign aimed at changing employees' attitudes toward staircase use with the goal of increasing it (Eves et al., 2012). To my knowledge, there seems to be no studies examining the initial intention to improve different lifestyle habits and their behavioural change following a WHPP targeting multiple lifestyle habits in Canadian (Quebec) workers. For example, is holding a positive intention to improve PA at the start of a WHPP associated with an improvement in PA following that multimodal program targeting multiple lifestyle habits? It is important to study these associations between initial intention to improve a certain behaviour and its behavioural improvement. If the initial intention of employees is in fact associated with an improvement in that behaviour, workplace health promotion practitioners can screen participants based on intentions. For example, instead of offering a program targeting eating habits to all employees, only those who have a positive intention to improve this lifestyle habit could be selected. Identifying employees' initial intention can also help program practitioners to offer interventions specific to employees' positive intentions among many other interventions (multiple lifestyle habit). For instance, if an individual holds a positive intention to improve PA but does not intend to improve eating habits, then workplace health promotion practitioners can offer the interventions on PA to that specific individual while offering the interventions on eating habits to another sub-group of employees who holds a positive intention to change eating habits. This would not only allow program organizers to provide a program tailored to each employee but would also properly allocate resources and efforts. Moreover, it will also save some cost since the program will be offered to those who are more likely to benefit. Furthermore, the number of interventions offered in the context of such program may have an impact on the number of associations between intention to improve various lifestyle habits and behaviour. If initial intentions are associated with their behavioural improvements, then factors predicting each positive intention could also be studied. By finding predictors of intention to improve various lifestyle habits, baseline characteristics of employees who most probably hold each positive intention at baseline could be identified. For example, if age was a predictor of initial intention to improve PA, younger individuals could be targeted for this lifestyle habit, as they would more likely intend to improve this health behaviour. Therefore, Article 3 presented in Chapter 4 aimed to study the predictors of intention to improve various lifestyle habits as well as the associations between initial intention to improve a lifestyle habit and its improvement following a WHPP. Because this program had different options, this article also explored what option led to the greatest number of significant associations between intention and behavioural improvement.

Finally, as highlighted in the literature review, systematic reviews and meta-analyses report small ESs, inconclusive results, and/or limited evidence regarding the effectiveness of WHPPs on improving health- and lifestyle habit-related variables. However, in these studies, the results represent the average of their samples. In this sample, there are individuals who will positively respond to the program. It would be interesting to investigate who these individuals are. What characteristics do they have at baseline? This would make identifying subgroup of employees who can be approached in the context of these programs possible. Moreover, based on a systematic review published fairly recently, it was noted that fewer studies have examined factors that predict health behaviour change in the context of such programs, at least in those targeting PA (Muir et al., 2019). Knowing such factors will allow program practitioners to tailor their programs to a specific set of individuals sharing characteristics as they will be more likely to show behavioural change. Therefore, in Article 4, the baseline characteristics of employees who improved each lifestyle habits following the *Activate Your Health* program were explored (Chapter 5).

1.8 Contribution of the co-authors

The data that were used to write all the articles included in the present thesis come from the *Activate Your Health* program. As mentioned earlier this program was created by Capsana. Capsana was also in charge of offering the program and its interventions as well as collecting the data from all participating companies around Quebec, Canada. They gave access to the anonymized data to the research team. The conception of the evaluation component was done by Marie-Eve Mathieu, Suzanne Laberge, and Jonathan Tremblay. The study received the ethical approval of the Comité d'éthique de la recherche en santé of the Université de Montréal. The study was also registered in clinical trials (NCT02933385). In the research group, François Lecot was involved in data management at the start of the program; this task was later taken over by Thiffya Arabi Kugathasan. Marie-Eve Mathieu, Jo-Anne Gilbert, François Lecot, Suzanne Laberge, and Jonathan were co-authors on at least one of the four articles. They revised the manuscript and gave valuable feedback to improve articles and presentations' abstracts. All co-authors agreed to include all four articles as a part of the current thesis.

1.9 Contribution during doctoral years

The literature review of each article was performed by Thiffya Arabi Kugathasan with the help of Marie-Eve Mathieu. The analyses of each article were done by Thiffya Arabi Kugathasan with the support of Miguel Chagnon, the senior statistician of the University. As for the interpretation of the results of each article, following the first interpretations of results by Thiffya Arabi Kugathasan, Marie-Eve Mathieu and Miguel Chagnon assisted in the final interpretations. Thiffya Arabi Kugathasan wrote the first complete drafts of all four articles included in the current thesis.

During the doctoral years, Thiffya Arabi Kugathasan wrote a professional article regarding low participation rate in WHPPs, which appeared in *InfoKin*'s December 2019 issue. She also wrote a letter to the editor regarding active workstation, published in the *Journal of Occupational and Environmental Medicine*, and she contributed to another article on active workstation by her colleague. During her transition period from masters to doctorate, she also co-authored a systematic review on the use of active workstations in participants with overweight/obesity, which appeared in *Obesity Reviews*. She also co-authored an article on the introduction of two active workstations into offices of white-collar workers. She helped with the qualitive data analysis, and a resulting article was submitted to the journal *Work*.

Thiffya Arabi Kugathasan also presented the *Activate Your Health* program and the results of all the articles in seven congresses or events as poster or oral presentations. She has done two international presentations: International Society for Physical Activity and Health (virtual) and Saltin International, PhD, Symposium: Exercise as Medicine in a Mechanistic Perspective

(Snekkersten, Denmark). She also presented at the 2020 virtual congress of the Canadian Society for Exercise Physiology (national). One of her presentations has published abstracts that appeared in Applied Physiology, Nutrition, and Metabolism. Thiffya Arabi Kugathasan also won best oral presentation at the Research Day of the School of Kinesiology and Physical Activity Sciences. She also won the *Promotion of Physical Activity and Sports Award 2020* Honorary Award of the School of Kinesiology and Physical Activity Sciences.

Briefly, other than these academic activities, she has also been involved as treasurer in her student association for two consecutive years. She also assisted professors by correcting exams and assignments of bachelor's students. She also lectured in École de kinésiologie et des sciences de l'activité physique. She was also a part-time research assistant during the first year and a research coordinator in the last year of her doctoral studies.

Chapter 2 – Article 1

Activate Your Health, a 3-year, multi-site, workplace healthy lifestyle promotion program: study design

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Status: Published in *BMC Public Health*

Introductory statement: This chapter begins with some documentation that was requested by the journal such as regularity forms and a table summarizing the World Health Organization Trial Registration Data. This is followed by the standard sections of an article: abstract, background, methods/study design, and discussion. Table 1, a list of abbreviations, declarations and references are then presented. Since the initial registration into *ClinicalTrials*, this study has been slightly modified thus some differences can be found in outcome measures for example.

Clinicaltrails.gov, registration number: NCT02933385 (updated on the 26th of March 2019, initially registered on the 5th of October 2016).

Name and contact information for the trial sponsor:

Public Health Agency of Canada:

Julie Brière

Program Officer/Agente de programme

Center for Grants & Contributions/Centre des subventions et contributions

Public Health Agency of Canada/Agence de la santé publique du Canada

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Email address: plamontagne@soscuisine.com

Roles and responsibilities of the different groups overseeing the project:

Sponsors

(*SOScuisine* and Sprouts)

Provide an initial financial support and intervention tools

Trial management committee and data collection

(Capsana, Senior Director: Isabelle D'Aoust)

Recruitment of participating companies

Communication with the participating companies

Data collection from each participant

Data entry

Data anonymization all the data

Intervention delivery

Data verification, in collaboration with the research team

Control the data access (sharing data with the research committee only)

Provide a general portrait of the employees to the respective companies

CAPSANA is the owner of the data but gives to the Université de Montréal a non-exclusive and perpetual user license for non-commercial teaching and research purposes. Both institutions share the decision towards publication of the results.

<u>Research committee</u>

(Principal investigator Marie-Eve Mathieu)

Study design

Preparation of the protocol and revision

Data analysis

Evaluation of the program

Agreement of the final protocol

Advice trial management committee and data collection

Final decision of the changes to the protocol

Writing publications and submission of the articles

Presentation of the results

Protocol version 1 (May 12, 2019)

World Health Organization Trial Registration Data Set:

Data category	**Information**
Primary Registry and Trial Identifying Number	NCT02933385
Date of Registration in Primary Registry	October 5, 2016
Secondary Identifying Numbers	NONE
Source(s) of Monetary or Material Support	Public Health Agency of Canada and Capsana
Primary Sponsor	Public Health Agency of Canada and Capsana
Secondary Sponsor(s)	*SOScuisine* and Sprouts
Contact for Public Queries	Isabelle D'Aoust www.capsana.ca 300, rue Léo-Pariseau, 18e étage, bureau 1810 Montréal (Québec) H2X 4B3
Contact for Scientific Queries	Pr. Marie-Eve Mathieu me.mathieu@umontreal.ca Tel. 514-343-6737 EKSAP, Université de Montréal, P.O. Box 6128, Downtown Station, Montreal, Canada. H3C 3J7. Université de Montréal
Public Title	Activate Your Health, a workplace healthy lifestyle promotion program: study design

Scientific Title	Activate Your Health, a 3-year, multi-site, parallel-group, workplace healthy lifestyle promotion program: study design
Countries of Recruitment	Canada
Health Condition(s) or Problem(s) Studied	Lifestyle habits and health risk factors
Interventions	Four different arms varying by the number and type of interventions included (one control group with no intervention). Personalised online menus, support in creating a favorable environment, challenges, conferences, health coaching, closing events, health screening and flexibility assessment, CANRISK questionnaire, distribution of publications, social health platform, and activity tracker.
Key Inclusion and Exclusion Criteria	Program offered to everyone who is not at risk upon adoption of health lifestyle habits. Pregnant women were excluded.
Study Type	Interventional Non-randomized, Double blind (subject, investigators and outcomes assessors), evaluate which combinations of healthy lifestyle habits are the most beneficial.
Date of First Enrollment	December 2016
Sample Size	Target: 5000.
Recruitment Status	Completed
Primary Outcome(s)	Self-administered questionnaire filled at baseline and after years 1, 2, 3. Physical activity parameters, eating habits, smoking habits, alcohol consumption, sleeping habits, stress level and intention to improve these habits.
Key Secondary Outcomes	Health screening by nurses at baseline and after years 1, 2, 3.Waist circumference, weight, height, body mass index (BMI), plasma HDL and HDL/total cholesterol ratio, blood glucose concentration, systolic

	and diastolic blood pressure, flexibility level and risk factor profile are assessed.
Ethics Review	Approved (November 1, 2016) Guillaume Paré, CERES 333 Queen-mary, 2e étage, bur. 220-3 Montreal, QC H3V 1A2 514-343-6111 ext. 2604 ceres@umontreal.ca
Completion date	Ongoing study
Summary Results	NONE
IPD sharing statement	No

Abstract

Background: Workplace Health Promotion Programs (WHPP) have been shown to be an efficient way of improving workers' health. These programs can be incorporated in the worker's daily schedule and improve their productivity at work. Improving employees' health also benefits the employers by increasing their return on investment and lowering healthcare costs. The *Activate Your Health* program, created by Capsana in 2015, is a WHPP targeting multiple lifestyle habits for a three-year period. This WHPP includes tailored web-based interventions and the support of different health professionals throughout the years. We hypothesize that this approach will yield long-term lifestyle changes. The objective of the current paper is to describe the *Activate Your Health* program's design.

Methods/design: Eleven companies are taking part in this WHPP and had to choose among five different options of this program and all their employees were encouraged to participate. Each option differs by the number and type of interventions included. The limited option, which is considered the control group, only consists in completing a questionnaire regarding their health status, lifestyle habits and behaviors. On the other end, the extensive option receives a combination of multiple interventions: online menus, health challenges, support in creating a healthy work environment, coaching by health professionals (nurse, nutritionist, and kinesiologist), health screening and flexibility assessment, online resources, social health platform, and activity tracking. The remaining options are in between these options and vary by the amount of intervention. Baseline data are already gathered; two other data collection periods will take place after one and two years into the program. The primary outcomes of the current program are physical activity and fitness measures, nutritional data, smoking habits, stress and intention to change.

Discussion: The *Activate Your Health* program will allow us to compare which combinations of interventions are the most effective. It is expected that the extensive option will be the most advantageous to improve lifestyle habits. The results will indicate the strength and weakness of each intervention and how it could be improved.

Trial registration: Clinicaltrails.gov, registration number: NCT02933385 (updated on the 26th of March 2019, initially registered on the 5th of October 2016).

Keywords: Workplace, health promotion program, lifestyle habits, lifestyle change

BACKGROUND

The World Health Organization states that chronic conditions are the leading cause of death and disability worldwide [1]. More than one out of every five Canadian lives with one of the following chronic conditions: cardiovascular disease, cancer, chronic respiratory disease, or diabetes [2]. These four chronic diseases represent 67% of annual deaths [3].

In Canada, 50% of workers live with a minimum of one chronic condition [4]. This situation increases absence rates due to functional limitations and creates a financial burden to the employers [5]. Moreover, poor health and unhealthy lifestyle habits were observed to decrease productivity [6]. Thus, decreasing chronic conditions is crucial. This could be achieved by adopting healthy lifestyle habits [7, 8]: i.e., being physically active, eating healthy, limiting alcohol and tobacco, and having good sleep habits, [9] which can prevent at least 70% of major chronic diseases [10]. Engaging in 180 minutes of moderate intensity physical activity (PA) per week, which is roughly the recommended amount of PA, decreases the risk of mortality [11]. However, it has been noted that the Canadians lack compliance to the recommendations for a healthy lifestyle. For example, 78% of Canadians are not sufficiently active and 60% have poor eating habits [12]. It is also encouraging to note that partly fulfilling the recommendations could have beneficial effects on health. For example, a sedentary individual who does any PA would benefit from a decrease in mortality risk [11].

Some of the reasons for failing to comply with these healthy lifestyle recommendations are a lack of time, social norms, built environment and cost [13]. As workers spend roughly eight hours per day at work [14], a program targeting changes in the lifestyle habits could begin at the workplace. To do so, some companies have started seeking the help of health specialists to improve their workers' lifestyle habits and working environment by implementing a workplace health promotion program (WHPP). Studies indicate that these programs are beneficial for the workers' physical [15, 16] and mental [17, 18] health, but also improve their work performance by increasing productivity [19, 20] and decreasing absenteeism [21]. These changes indirectly reduce health-care costs [22] and increase "return on investment (ROI)" [19, 22]. Hence, WHPP would advantage the workers, employers and the society as a whole [23-25]. However, this type of program needs to be designed properly. For example, a WHPP offering only a health-related questionnaire and/or an online platform does not lead to a successful outcome [26]. Moreover, to detect the population health effects and to yield a positive ROI, a minimum of three years of implementation is suggested [26].

Capsana is a Canadian organization dedicated to promoting healthy lifestyle habits, and preventing and managing chronic diseases in the workplace for the past 25 years. In 2015, Capsana [27] created a program called "Activate Your Health". This WHPP allows workers to adopt healthy lifestyle habits in their workplace with web-based and tailored interventions along with personalized advice over a 3-year period. The program also helps workers identify their risk factors associated with chronic diseases. In addition, it also assists the employers in changing the culture of health within the company in the goal of supporting the employees in achieving a better health profile and lifestyle habits. The eventual goals of the evaluation component of the *Activate Your Health* program are to evaluate the effectiveness of this WHPP on the short and long term, investigate which workers would benefit the most, compare the responses to the different interventions, and identify the challenges associated with the implementation of this type of program in the participating workplaces. We hypothesize that the option targeting several lifestyle habits at once will yield the biggest improvement in health and work-related parameters. The aim of the current paper is to describe the *Activate Your Health* WHPP.

METHODS/DESIGN

Study design

The *Activate Your Health* program is an already-existing three-year program that was designed and implemented by Capsana in Canada (Quebec). This quasi-experimental study with an exploratory framework takes into account previously identified limitations regarding WHPP and interventions that previously have been shown to be beneficial [26, 28, 29]. The baseline data was collected between December 2016 and July 2018. The employees will be re-evaluated one and two years into the program. There was no specific risk associated with participating in this program other than the ones associated with the adoption of an active lifestyle. The Health Research's Ethic Committee of Université de Montréal approved this study (16-063-CERES-D(1)). The study was registered on Clinicaltrials.gov on 16th of October 2016, and was updated on the 26th of March 2019 (NCT02933385).

All the gathered information was kept confidential and was not shared with any employers. The employers received only an overall report regarding the health of their employees without any given individual's portrait. Participating employees were aware of this and also knew that the data collected throughout the *Activate Your Health* WHPP would be part of a research study. Only certain Capsana's employees associated with data management and the research team had access to this information.

Recruitment of participants/Study population

Through phone calls and in-person meetings, Capsana contacted the different companies to participate in their *Activate Your Health* program. Eleven companies are taking part in the current project. Among the participating companies, six were related to banks, two were related to financial markets, one was a graveyard parish, one was related to workplace health safety and security, and one was a marketing firm. The participating companies encouraged their employees to take part in this WHPP and participation was on a voluntary basis. Only pregnant women could not partake in the program. After an information session about the *Activate Your Health* WHPP and motivating their willingness to participate, an email was sent out to all the employees. Those who completed the online consent form (written) were able to fill the self-administered questionnaire.

Intended sample size explained

Based on recruitment experience for similar workplace interventions, financial support available and pilot data yielding significant benefits for the employees and their organizations with 656 participants, this program had the potential to enrol 6,000 employees [30]. Therefore, *Activate Your Health* included as many employees as possible. Also, the purpose of this program is to evaluate for the first time the overall impact of the different options on a lot of health-related variables and lifestyle habits therefore the goal was to involve as many participants. The data collected for this program will thus be used for the first time to evaluate this program and will serve as a model for sample size calculation of future studies.

Study intervention/Allocation to interventions

Capsana and their sponsors are offering the interventions throughout the year and at the same time of year throughout the 3-year period (ex: a company that received an intervention in January 2017 will receive the same intervention in January 2018, 2019). Table 1 summarizes the different interventions included in each of the five options (A to E) and the number of companies enrolled in each of them. Briefly, option A had the most extended number of interventions, and involved numerous web-based and innovative tools to improve lifestyle habits. Moreover, some interventions in option A and B were tailored and personalized to the participants' needs while participants in option E will not receive any interventions other than the informational/motivational sessions at baseline and at the end of each year (control group). There was no concomitant care or interventions that were prohibited while taking part in this program.

The companies had to choose one out of the five options offered by Capsana. Most of the companies (n=8) chose option C and none picked option D. One company chose two different options (one group was placed in option A while the others in option E). One company won a promotional draw and Capsana placed it in one of the five options (Option E). In-person interventions took place at the workplace whereas the web-based ones were accessible anywhere.

Each company started the interventions at a different time point as each company differed by the administrative work necessary for the implementation of such program. Employees were unaware that other companies were participating in the *Activate Your Health* program and that the others could have a more or less beneficial option than theirs. Participants could also withdraw from the program at any given time. Participants are welcome to communicate with the research team if they have any questions/concerns during the program. Participants are also questioned at the end of the study regarding any adverse effects that took place during the study period. An employee from Capsana visited at least once a year each company to improve the adherence that will also be monitored by completing a questionnaire at the end of each year. The research team assisted annually to at least one data collection session and one of the interventions offered in this WHPP.

Data collection tools

Self-administered questionnaire – Year 1, 2, and 3

All employees taking part in *Activate Your Health* are asked to fill out an online self-administered questionnaire that is based on an adaptation of existing questionnaires, lifestyle guidelines and opinion of health experts. Participants are asked to provide basic socio-demographic, anthropometric, health, medication and work information and extreme values are checked before inclusion. Lifestyle habits are also auto-reported: PA (frequency, duration and intensity), eating habits, smoking, alcohol consumption, sleeping habits, and stress level. As the *Activate Your Health* program aims to modify the employees' lifestyle habits, their intention to improve their habits is also evaluated. Once the questionnaire is submitted to Capsana, each of them is assigned a questionnaire ID to anonymize the data. The data are kept for seven years by the Data Monitoring Committee. The Data Monitoring Committee is led by the principal investigator (MEM) in collaboration with one member of Capsana. It supervises data collection and analyses. For any further details please contact the principal investigator. After which, a total health score is calculated on 100 points: the higher the score, the better their health (100 equals optimal health and lifestyle habits). This score and action plan are sent to the employees personally.

Detailed description of each intervention

Personalized online menus – Year 1, 2, and 3

Each employee has access to an online platform called SOScuisine: it offers weekly menus, discounts, recipes and grocery shopping lists adapted to the employee's preferences and health goals (improve cholesterol, manage diabetes, weight control, etc.).

Support in creating a favorable environment – Year 1, 2, and 3

Health professionals visit each participating companies to host and present an information booth on how to create a favorable environment to improve their employees' health (PA, nutrition and life balance). For example, they show the employees how to be active around their workplace, and highlight the healthiest menus in their cafeteria or vending machine in order to improve their eating habits.

Health Challenge – Year 1, 2, and 3

Employees are invited to participate individually or as a team in a 4-week activity called Health Challenge. It is publicized at their workplace and participation is voluntary. This intervention aims to guide companies and their workers towards better eating habits (i.e., five servings of fruits and vegetables/day), PA level (be physically active 30 minutes/day) and mental wellness (take time to relax). Capsana guides and motivates the employees who take part in this challenge. Employees who successfully fulfill the challenge receive an incentive (i.e., a sport bag). The participating company managed this intervention.

Conferences –Year 1, 2, and 3

Different health professionals (nurse, kinesiologist, physician, psychologist, etc.) present a 60-min conference each at the work site of participating company at different time points into the study. The purpose of these sessions is to inform and educate employees on the importance of adopting and maintaining a healthy lifestyle. The health professional also gives tips and ideas to help employees achieve these goals. More conferences emphasizing mental well-being are planned.

Coaching – Year 1, 2, and 3

Employees are offered assistance in maintaining or improving their lifestyle habits. They have the opportunity to talk, through the phone or in person, to a nurse and receive personal motivational coaching to enhance, among others, psychological health, well-being and lifestyle habits, and to reduce stress (Year 1). The following years, they will have the opportunity to talk to a nutritionist (Year 2), and to an exercise specialist/kinesiologist (Year 3).

Closing events – Year 1, 2, and 3

At the end of each year, at the work site, employees will take part in a closing event organized by Capsana. An example of this is "Jeux Spin [31]" which consisted of various recreational activities such as soccer in an inflatable structure. It is to note that for logistic reasons, these events are offered to the participating companies (not just the participants of the *Activate Your Health* program). These events aim to congratulate the employees for taking control over their own health and motivate them to maintain their acquired/improved habits.

Health screening and flexibility assessment – Year 1, 2, and 3

A team of nurses meets the employees individually to screen for their risk factors. The goal of this intervention is to identify any abnormal blood profile (unfasten state). It serves as an indicator and does not replace a regular blood test. If any abnormal results were found, employees were encouraged to consult their family doctor in order to do a follow-up. The plasma HDL level and HDL/total cholesterol ratio (CardioChek P.A.®-LIT001539, QC, Canada) and glucose concentration (Contour®Next - 85303759, New Jersey, US) are measured. Blood pressure is manually taken using the conventional auscultatory method (stethoscope: 3M™ Littmann® Classic II S.E-MMM2201, US; sphygmomanometer: Welch Allyn & Tycos model, Boston, US). Employees are asked to stand erect in order to take their height using a vertical stadiometer

(Seca213, Hamburg, Germany), and weighed using a scale (Tanita-BF-350, IL, US). Waist circumference is measured at the iliac crests using a measuring tape. The "sit-and-reach" test (Sit and Reach Test Tester- EN-121085, NY, US) is performed to determine posterior chain flexibility. The results of these tests are available to the employees at the end of their session, and the nurse gave appropriate health advice to improve their health profile.

CANRISK questionnaire – Year 1, 2, and 3

During the screening session, participants also complete the CANRISK [32] questionnaire to determine their risk of developing prediabetes or diabetes. It consists of 12 multiple-choice questions, resulting in a score that is associated with three risk categories: low (<21 points), moderate (21-32 points), and high (>32 points). Employees also receive this score with the interpretation.

Distribution of publications – Year 1, 2, and 3

During the conferences, screening and informational sessions, interested employees receive Capsana's documentation (flyers/brochures/booklets/etc.) on chronic diseases (diabetes and cardiovascular health), mental health, medication, etc. These resources are also available on Capsana's website.

Social health platform – Year 1, 2, and 3

Each employee has access to a Social health platform (Sprout [33]), which allows employees to interact with one another. They can set goals, create an interest group, and challenge their colleagues and themselves. For example, an employee could challenge a colleague to take the stairs as often as they can.

Activity tracking – Year 1

Capsana offered an accelerometer bracelet (Vívosport, Garmin, 2017) to 250 employees selected at random and invited them to track their own physical activity information through the Garmin website or phone application.

Optional: Quit to Win! Challenge

This intervention is part of the provincial program (« J'arrête, j'y gagne! ») initiated by Capsana [34]. Only the interested companies take part in this challenge. It is promoted at the workplace and information booth with documentation available to all the employees. Those who are interested are invited to stop their tobacco use for six weeks, and Capsana guides and assists the employees throughout. Employees are guided through this challenge and the winner receives an incentive such as a trip to Jamaica.

Outcomes measures

Yearly assessments of a broad range of physical and psychological health outcomes will be performed to assess yearly changes and changes from baseline of each option.

Primary outcomes:

Physical activity parameters, eating habits, smoking habits, alcohol consumption, sleeping habits, stress level and intention to improve these habits are measured.

Secondary outcomes:

Waist circumference, weight, height, body mass index (BMI), plasma HDL and HDL/total cholesterol ratio, blood glucose concentration, systolic and diastolic blood pressure, flexibility level and risk factor profile are assessed.

Statistical analyses

In future analyses, option D will be excluded as no company selected this option. To examine if the different options have similar baseline characteristics, i.e., to verify the homogeneity between the four options for the selected baseline variables one-way ANOVA analysis with the effect size (partial eta squared) and Chi-square test with Cramer's V effect size will be used. Future studies will also explore the effect of each option on all outcomes. For continuous variables, mixed models for repeated measures with two factors will be used to analyze the effect of time and option on each outcome following one and two years of measurements. As for the categorical variables, generalized estimating equations (GEE) will be used. Possible confounders will be considered. Future studies will also take into account the cluster effect as the participants within the same company undergo the same implementation process and working environment, and therefore individual results from a same participating company could be dependent on each other. In future studies, intent-to-treat analysis will be used as well as multiple imputations. In addition, a particular consideration will be given to the sex and weight category of the participants.

DISCUSSION

There is a growing body of literature confirming that WHPPs are advantageous for employees' physical and mental health, and this has been confirmed objectively and/or subjectively [35-38]. WHPP also improves employee's lifestyle habits, which are related to the presence of chronic diseases [9, 10]. These programs benefit the individual, company and the society [23-25]. The current study describes a recently implemented program called *Activate Your Health* that aims to improve employees' lifestyle habits through a WHPP in the working environment. The data collected through this WHPP will be used for the first time to evaluate the efficacy of this large-scale program.

One of the potential strengths of the *Activate Your Health* is that it targets multiple modifiable lifestyle habits and biometric measures associated with a decrease in the risk of cardiovascular disease and stroke [39]: eating healthy, being physically active, discontinuing smoking, and maintaining a healthy weight, blood pressure range, blood cholesterol and glycaemia. Recent studies in the field targeting at least three habits [40, 41] were observed to be effective. Therefore, it is expected that multiple lifestyle habits in one option would lead to greater health benefits for employees. Adherence rates in WHPP are generally in the low range [42] (< 50%), and web-based interventions, when tailored, were observed to be effective [43] only for a short period of time after the study period [44]. In the current study protocol, the web-based tailored interventions are accompanied with the support of different health professionals (nurse, nutritionist and exercise specialist/kinesiologist) throughout the 3-year period. Therefore, the adherence rate and effectiveness of the options A, B and C are expected to be higher. In addition, a study [45] with a similar approach, i.e., targeting six health behaviors, but differing in the study population (male participants at high risk of cardiovascular disease without a control group), the variety of interventions offered (3.5 h of health promotion class), and study duration (six months) led to an increase in physical activity, improved stress management, diet control, blood pressure, total cholesterol and BMI, which are some of the variables that will be included in future studies.

Therefore, *Activate Your Health* might lead to similar or better results as it regroups any health profile of employees, has a longer study period, provides different interventions that are web-based, and support the company in creating a favorable work environment.

One of the advantages of the *Activate Your Health* program is the varying number of interventions, which allows us to compare the effect of different combinations of interventions on health and work-related variables. We did exclude the option D as none of the companies chose that option. We can deduct that such an option might be less appealing for companies. It would have been interesting to compare the option A, which contains all the interventions targeting eating and PA habits vs. the option D, which had only interventions improving eating habits. Nevertheless, we do have the limited option (control group) that did not receive any interventions to compare the effectiveness with the other options. Moreover, Nöhammer et al. (2010) suggested that WHPP could benefit from documenting the employee's perspective of the interventions. At the end of the current WHPP, a questionnaire regarding each intervention will be sent to all the employees, in order to study their perspective. Also, throughout the year, Capsana also supports each company in the creation of a favorable environment by providing advice and/or help [46]. Modifying the work environment by decreasing unhealthy food available at the work site within the company, for example, could have positive impact on the employees' health and the organization as a whole [46].

Some limitations should be considered. The data collection method consists of filling questionnaires. Most of the variables of interest, such as PA level and eating habits, in the current program and its variations come from these self-reported answers. Objective measures such as accelerometer data could have been used to identify the changes that are taking place within the different options. Moreover, participants who have successfully changed their lifestyle habits will be more inclined to remain actively involved in the *Activate Your Health* program, and to be reassessed, which was the case in another study [47]. In addition, Nilsen et al. [47] (2014) noted the majority of their participants with diabetes who dropped out were the participants with a poor life satisfaction and needed help with their lifestyle habits. Taking these observations into account, specific analysis will be performed to examine this aspect in *Activate Your Health*.

In the *Activate Your Health* program, among other advantages, assessing employees' health using health-related assessments, targeting several lifestyle habits at once, offering tailored interventions, providing social platforms, improving the workplace environment, and offering a three-year program would most likely improve employees' lifestyle habits [46]. Future studies will also focus on gender and body weight status response. In the end, the goal would be to articulate which type of intervention works best and for whom, to consolidate but also to improve interventions.

Table 1. Details on the interventions included in each option (n=11 companies).

	OPTIONS				
	Extensive				Limited
INTERVENTIONS	A (n=1)	B (n=1)	C (n=8)	D (n=0)	E (Control) (n=2)
Personalised online menus	X	X	X	X	
Support in creating a favourable environment	X	X	X	X	
Health Challenge	X	X	X	X	
Conferences	X	X	X		
Coaching	X	X	X		
Closing events	X	X	X		
Health screening and flexibility assessment	X	X			
CANRISK questionnaire	X	X			
Distribution of publications	X	X			
Social health platform	X	X			
Activity tracker	X				
Optional: Quit to Win! Challenge	X	X			

LIST OF ABBREVIATIONS

BMI: Body mass index

PA: Physical activity

ROI: Return on investment

WHPP: Workplace Health Promotion Program

DECLARATIONS

Ethics approval and consent to participate

The Health's Research Ethic Committee of Université de Montréal approved this study (16-063-CERES-D(1)). Participants consented online (written) before filling the self-administered health questionnaire.

Consent for publication

All the participants included in *Activate Your Health* program consent for publication. No additional individual person's data in any form (details, images or videos) were used.

Availability of data and material

Not applicable. The results will be communicated to the participants and to other relevant groups via publications (open access will be prioritized) and presentations, including webinars.

Competing interests

All the authors (TAK, FL, SL, JT, MEM) declare a potential conflict of interest as the program is co-financed by the Public Health Agency of Canada and Capsana. However, none of the authors work for Capsana.

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Capsana is also in charge of providing the interventions, collecting the data, allowing the research team to access these data and approving the submission of reports for publication.

Author's contribution

For the current paper, TAK wrote the current manuscript. FL performed the data management, provided feedback on the draft and final manuscript. SL and JT: Conception and substantial revision. MEM: Conception; contributed to the design, substantial revision and supervised the research team. All authors have read and approved the manuscript. In the future, MEM will remain the last author and the student or co-investigator leading a publication project will be the first author. Other contributors will be second to second-to-last authors, in diminishing order based on their contribution.

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Chapter 3 – Article 2

Activate Your Health: Impact of a Real-Life Programme Promoting Healthy Lifestyle Habits in Canadian Workers

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Introductory statement: This chapter begins with the details requested by the journal (e.g., number of words, tables, and figures) and declarations. This is followed by the standard sections of an article: abstract, background, methods, results, discussion, and conclusion. The references are then presented followed by the figure, Tables 1 to 3, and the supplementary documents that were requested by the journal. Comment: Participation in WHPPs varies based on sex i.e., women participate more than men (Grossmeier, 2013; Sloan & Gruman, 1988). Also, sex was a predictor of health behaviour change in WHPPs (Ablah et al., 2015; Cook et al., 2015; Davey et al., 2009; McEachan et al., 2011; Ross & Wing, 2016). Therefore, the potential sex differences in the effects of the program on outcomes were explored.

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All the authors (TAK, JAG, SL, JT, MEM) declare that a potential conflict of interest may exist because this WHPP is co-financed by the Public Health Agency of Canada and Capsana. Otherwise, none of the authors are connected to Capsana.

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The Health Research Ethics Committee of Université de Montréal approved this study [16-063-CERES-D(1)]. The study was registered on Clinicaltrials.gov on October 5, 2016 and updated on March 26, 2019 (NCT02933385).

ABSTRACT

The workplace has been suggested as a good setting for the promotion of healthy lifestyles. This article examines the impact of *Activate Your Health* programme, provided over an average of 1.35 years, on employee health and lifestyle habits (actual and intention to improve). Companies selected one of the programme's four options (number of interventions in parentheses): *Control* (2), *Light* (8), *Moderate* (13) and *High* (14). Employees (n=524) completed an online questionnaire at baseline and post-intervention. Mixed effect models and generalised estimating equations models were used, where appropriate. There was an interaction effect of time by option for the number of employees intending to improve sleep habits (p = .030): +11.0% in *Light* (p = .013). No significant interaction effect of time by option was observed for body weight, body mass index, number of health problems or lifestyle habits (actual and intention to improve). When stratified by sex, there was an interaction effect of time by option for the number of women intending to improve sleep habits (p = .023): -26.1% in *Moderate* (p = .014). There was an interaction effect of time by option for body weight in men (p = .001): -0.58 kg in *High* (p = .031) and +2.58 kg in *Control* (p = .005). Other outcomes of interest were stable or improved post-intervention, regardless of option. The *Activate Your Health* programme allowed employees to maintain or improve outcomes related to health and lifestyle habits. A package like *High* may be beneficial for body weight regulation in men.

BACKGROUND

Chronic health conditions, such as diabetes, cancer, and cardiovascular diseases, require long-term management (World Health Organization and Public Health Agency of Canada, 2005). A primary feature of these conditions is their negative impact on social, psychological and economic aspects of an individual's life (World Health Organization, 2005). According to the World Health Organization (2021), major chronic conditions account for 71% of all deaths worldwide, and 80% of all heart disease, stroke and diabetes as well as more than 40% of cancers are preventable (World Health Organization, 2008).

Unhealthy lifestyle habits, such as physical inactivity, poor eating habits and tobacco consumption, contribute to the development of major chronic conditions (Willett et al., 2006). However, the adoption of healthy lifestyle habits remains a challenge worldwide. According to recent Canadian surveys, 84% of adults do not meet national physical activity (PA) guidelines in bouts of 10 minutes or more (Clarke et al., 2019), and 71% of those aged 12 years and over eat fruit and vegetables less than 5 times a day (Statistics Canada, 2019). In addition, 16% of Canadians aged 15 years and over exceed national drinking guidelines, while more than 18% of those aged 12 years and over smoke daily or occasionally (Government of Canada, 2016).

The workplace has been identified as a good setting for the promotion of healthy lifestyle habits (World Health Organization, 2008) owing to the large quantity of time that employees spend there and the large number of people that can be reached at once (Bureau of Labor Statistics, 2018; Dishman et al., 1998). Moreover, established communication channels within companies allow interventions to reach the majority of employees (Bull et al., 2008).

Capsana is a Canadian organisation dedicated to preventing and managing chronic diseases and promoting healthy lifestyle habits in the workplace (Capsana, 2020). In 2015, it created a workplace health promotion programme (WHPP) called *Activate Your Health*, including a research component, which was implemented in companies in Quebec, Canada (Kugathasan et al., 2019). This WHPP is composed of a variety of intervention packages (hereafter, options) from which each company can choose. Depending on the option, employees receive in-person and web-based interventions to help improve their health and lifestyles. The current study aims to evaluate the impact of the *Activate Your Health* programme on primary outcomes related to employees' health, intentions and actual lifestyle habits (including potential sex differences) and explores which package led to the largest improvements.

METHODS

Study design

The impact of the *Activate Your Health* WHPP was evaluated using a quasi-experimental pre-post design. The Université de Montréal Health Research Ethics Committee approved this study [16-063-CERES-D(1)]. The study was registered on Clinicaltrials.gov on October 5, 2016 and updated on March 26, 2019 (NCT02933385). Capsana was in charge of offering the interventions and collecting the data. Employees were made aware that a research group would use their anonymous data to perform statistical analyses and that their data would remain confidential. More details regarding the study can be found in Kugathasan et al. (2019).

Study population

Eight companies were included in the current study: banking institutions/sites (n=6), graveyard administration (n=1), and an organisation dedicated to workplace health, safety and security (n=1). Due to the COVID-19 health crisis that began in March 2020 in Canada, resulting in logistical issues, such as closure of all companies, the post-intervention data from one company were incomplete. Participation was voluntary, and pregnant women were excluded from the research component. More details can be found elsewhere (Kugathasan et al., 2019).

Study interventions and the allocation of options

At least one company selected each of the *Control, Light, Moderate*, or *High Activate Your Health* options [Table 1; 1 option/company; (Kugathasan et al., 2019)]. One company wanted to offer two options to their employees: *Moderate* and *Control*; employees wishing to take part in *Moderate* paid an annual fee of CAD $20 to partially cover the cost of the programme.

One employee was excluded due to inaccurate option allocation. The company that was excluded from analysis due to no data collection had chosen the *Light* option.

[insert - Table 1. Description of the specific interventions included in each option of the *Activate Your Health* programme - here]

Data collection

The primary data collection tool was an online health risk assessment (HRA), a self-completion questionnaire adapted from validated questionnaires, national/provincial recommendations and health experts' opinions (Kugathasan et al., 2019). The current study used baseline data gathered between December 2016 and July 2018 and post-intervention data collected between April 2018 and January 2020. On average, 1.35 (min 1.05 – max 2.46) years elapsed per company between these two periods of data collection. Upon completion of the HRA, employees received quick feedback consisting of a global score (0 and 100 points) for their health status and a comparison of their health profile and lifestyle habits to available national/provincial recommendations. To boost participation in some companies, employees who completed the HRA were eligible to win gift cards (CAN$25 and CAN$100) or books on relevant topics, such as healthy lifestyle habits.

Outcomes

Sociodemographic and anthropometric variables

The HRA provided participants' age, sex, weight and height. Body mass index (BMI) was calculated as: weight (kg)•height (m)$^{-2}$.

Number of current health problems

Employees indicated their current health problems from a given list (Supplementary material 1). Health problems were then summed up to obtain total number of current health problems.

Assessment of lifestyle habits (low/high risk)

Employees were classified as either low- or high-risk for each lifestyle habit, depending on whether they adhered to national/provincial recommendations, when possible.

Physical activity level

Participants were asked, "How many days per week (0, 1, 2, 3, 4, 5, 6, or 7) are you physically active (e.g., by walking instead of driving to your destination, or by doing recreational activities, such as bicycling, playing tennis, dancing, swimming, etc.)?" Employees who reported being physically active at least once per week had to answer two follow-up questions: 1) "On your physically active days (including when you walk), how many minutes (<10, 10, 20, 30, 40, 50, 60, 75, 90 or >90 minutes) on average do you spend on PA?" and 2) "What is your level of shortness of breath (none, slight, or enough to make conversation difficult) during your periods of PA?" The number of days of PA per week was multiplied by the number of minutes of PA per day to obtain the weekly minutes of PA.

It is recommended that adults engage in 150 minutes of moderate-to-vigorous PA per week (Canadian Society for Exercise Physiology, 2019). Employees who rated their shortness of breath during PA as "none" and/or accumulated less than the recommended minutes of weekly PA were considered to be at high-risk.

Eating habits

From a dropdown menu, employees chose their daily number of servings of fruit (0, 1, 2, 3, 4, 5, or ≥6) and vegetables (0, 1, 2, 3, 4, 5, or ≥6). The size of each serving of fruit and vegetables was inspired by the 2007 Canada Food Guide (Government of Canada, 2007). Moreover, employees were asked three separate questions evaluating how often they limited the amount of fat, sugar and salt in their diet, with the following answer options: most of the time, occasionally, or rarely/never.

Frequency of fruit and vegetable consumption is an approximation of diet quality (Garriguet, 2009). The number of fruit and/or vegetable servings were added together and compared to Canada's Food Guide recommendations of at least seven servings of fruit and/or vegetables for women aged 18 years and over and men aged 50 years and over, and at least eight servings for men aged 18-50 years (Government of Canada, 2007). Employees who did not reach the minimal serving amount were classified as being high-risk.

Sleep habits

Employees were asked, "How often (often, sometimes, or rarely/never) do sleep problems interfere with your daily activities and well-being?" Those who responded "often" were categorised as high-risk. Employees were also classified as high-risk if they selected sleep disorders on the list of current health problems. In addition, the following question was asked to employees, "Of the following signs, which have you experienced in a significant, continuous way for at least two weeks?" Those who selected "yes" for sleep disturbance were classified as high-risk.

Smoking habits and alcohol consumption

Employees were asked how often (every day, occasionally or do not smoke) they used tobacco products, excluding e-cigarettes. Participants also had to report the number of alcoholic drinks they consumed per week (< 1, 1-3, 4-10, 11-15, 16-21, or >21). One drink was defined as 12 oz./340 mL of beer, 5 oz./150 mL of wine or 1.5 oz./45 mL of spirits (Éducalcool, 2019).

Employees who smoked occasionally or every day were considered to be at high-risk. Women who consumed more than 10 alcoholic drinks per week and men who consumed more than 15 per week were classified as high-risk (Éducalcool, 2019).

Intentions to improve each lifestyle habit

Participants were classified intro having a positive (yes) or a negative (no or "does not apply to me") intention to improve the following lifestyle habits in the following six months: do more PA, improve eating habits, improve sleep habits, stop smoking, reduce alcohol consumption and better manage stress.

General health and life satisfaction

To capture general health, employees were asked, “Considering your age, how (excellent, very good, good, fair, or poor) would you describe your general health?” To assess overall life satisfaction, they were asked, “In general, what is your level of satisfaction (very satisfied, satisfied, neither satisfied nor unsatisfied, unsatisfied, very unsatisfied) with your life, including personal and professional aspects?”

Stress levels at work and in general

Employees answered very high, high, moderate, low, very low, or does not apply, I don’t work to the following question: “What is your stress level at work?”. Employees were asked, “What is your stress level away from work (in your relationships, parenting, caring for ageing parents, lack of time for self, isolation, health issues, financial strains, etc.)?” They could choose from very high, high, moderate, low or very low. Stress management was also evaluated by asking: “How good (very good, good, average, poor or very poor) are your stress coping skills?”

Mental health measures

Employees were asked if they significantly experienced (yes or no) depressed moods and/or pronounced decreased interest or pleasure in activities continuously for two weeks or more. Moreover, employees who selected “depression” or “anxiety disorder” in the health problems section were also categorised as positive for these mental illnesses.

Analyses

One-way ANOVA with eta squared and Chi-square test with Cramer’s V were used to examine differences between the options; Tukey HSD and Bonferroni post-hoc tests were used, respectively. To study the effect of time, option and their interaction (time x option) for each outcome, mixed effect models (Tukey-Kramer post-hoc tests) and generalised estimating equations models (Post-Hoc tests) were used, where appropriate, for continuous and categorical variables. To examine a significant interaction effect, analyses were performed per option and time. The analyses controlled for baseline differences in their respective outcome. The analyses were stratified by sex. Analyses considered company-level clustering. For categorical variables, only those options containing at least one observation were analysed. The analyses were performed using SPSS Statistics (IBM, Armonk Corp., NY) version 26.0 and SAS v9.4 (SAS Institute Inc., Cary, NC). Results are reported as mean (standard deviation) or n (column %) unless otherwise specified. Changes in proportions are reported as in percentage point change (ex: a change from 10% to 12% is reported as +2%). Statistical significance was set to a P value ≤ .05.

RESULTS

Five hundred and twenty-four employees completed the baseline HRA and the post-intervention HRA. More details regarding the number of employees in the programme and classification of companies according to the International Standard Classification of Occupations could be found in the Supplementary material 2 (International Labour Organization, 2012).

More details on baseline characteristics of employees in each option could be found in the Supplementary material 3. Briefly, the average age varied between 41 and 45 years and was not significantly different between the different options. In each option, at least 47.8% of employees were women, with a significantly larger number of women participating in the *Light* (77.9%) and *Moderate* (74.2%) options compared to *High* (47.8%). The average body weight was significantly different between options, it was significantly higher in *Light* [80.23 (20.90)] kg compared to *Moderate* [70.86 (16.69)] kg and *High* [72.06 (15.80)] kg. The average BMI was significantly different between options, it was significantly higher in *Light* [28.63 (7.55)] kg/m^2 compared to *Control* [24.51 (3.73)] kg/m^2, *Moderate* [24.85 (4.32)] kg/m^2 and *High* [24.24 (4.14)] kg/m^2.

Overall, ≥41.9% of employees did not currently have any health problem in each option. Generally, ≥77.8% of employees reported being at least satisfied with their life in each option, with a significantly higher proportion of employees being unsatisfied with their life in *Control* (5.6%) compared to *High* (0.3%). Also, significantly more employees reported being very satisfied with their life in *High* (29.2%) compared to *Light* (15.3%). Overall, most employees (≥87.2%) reported good to excellent perceived general health in each option, with a significantly higher number of employees having excellent perceived general health in *High* (22.1%) compared to *Light* (8.0%).

Overall, ≥71.0% of employees reported moderate or lower perception of general stress levels in each option, with significantly more employees reporting high stress levels in general in *Moderate* (29.0%) compared to *High* (10.6%). Overall, most employees reported moderate or lower perception of stress levels at work in each option (≥65.6%), however there were no significant differences between the options. Overall, ≥91.4% of employees reported moderate to very high perceived stress management in each option, and there were no significant differences between the options.

Intervention effects

Changes in all employees

There was a significant interaction effect for the intention to improve sleep habits. The percentage of employees with the intention to improve this habit increased by 11.0% in *Light* ($p = .013$). There was no significant interaction effect for body weight, BMI, current number of health problems, days of PA, the various perceptions (life satisfaction, general health, stress levels at work, stress levels in general and stress management), mental health measures and limiting fat, sugar and salt (all $p > .05$; Table 2 and Table 3). In addition, there was no interaction effect for risk due to poor lifestyle habits and intention to improve other habits (all $p > .05$; Table 3).

[insert - Table 2. Changes in outcomes related to health and lifestyle and various perceptions between baseline and post-intervention in each option (n=524) - here]

[insert - Table 3. Changes in intention, risk level and mental health status between baseline and post-intervention in each option (n=524) - here]

Changes in women only

There was a significant interaction effect for the intention to improve sleep habits [$\chi^2(3) = 9.55$, $p = .023$] and, in *Moderate*, the percentage of women having the intention to improve this habit decreased significantly (-26.1%, $p = .014$). There was an increase in frequency of limiting fat intake [+0.08; $\chi^2(1) = 6.81$, $p = .009$] and salt intake [+0.14; $F(1, 604) = 5.50$, $p = .019$], regardless of option. There was a decrease in perceived stress levels at work, regardless of option [$\chi^2(1) = 5.61$, $p = .018$]. Overall, there was a decrease in the percentage of women having the intention to stop smoking, regardless of option [-2.9%; $\chi^2(1) = 4.26$, $p = .039$; excluding the option *Control*]. The percentage of women having the intention to reduce alcohol consumption increased by 6.2%, regardless of option [$\chi^2(1) = 7.08$, $p = .008$]. The interaction and time effects for all other variables, including sleep habits, were not significant (all $p > .05$; Supplementary materials 4 and 5).

Changes in men only

There was a significant interaction effect for body weight [$F(3, 419) = 5.38$, $p = .001$]. Body weight decreased by 0.58 kg in *High* ($p = .031$) and increased by 2.58 kg in *Control* ($p = .005$). Similarly, there was a significant interaction effect for BMI [$F(3, 419) = 4.91$, $p = .002$] (Figure 1), with a decrease in BMI by 0.22 kg/m^2 in *High* ($p = .008$) and an increase by 0.78 kg/m^2 in *Control* ($p = .014$). Regardless of option, there was an increase in the percentage of men having the intention to reduce alcohol consumption [+6.5%; $\chi^2 (1) = 5.16$, $p = .023$]. There was no significant interaction or time effects for any other outcomes (all $p > .05$; Supplementary materials 6 and 7).

[insert - Figure 1. Mean ± standard error (SE) bar for men's body mass index between baseline and post-intervention of the *Activate Your Health* programme (n=216) - here]

DISCUSSION

The purpose of the current study was to examine the impact of the *Activate Your Health* programme on outcomes related to employees' health and lifestyle habits (both actual and intention to improve). Overall, there was an increase in the number of employees intending to improve their sleep habits in *Light*. When the analyses were stratified by sex, there was a decrease in the percentage of women having the intention to improve sleep habits in *Moderate*. There was a decrease in body weight and BMI in men in *High*, while these variables increased in *Control*. Most of the other variables related to lifestyle habits were stable or improved post-intervention, regardless of option.

There were positive changes in the intentions to improve sleep and smoking habits. The number of employees who intended to improve sleep habits increased in *Light* only (+11%). Since there were no significant changes in the proportion of employees reporting optimal sleep habits, the programme may have created awareness of this habit, which translated into a higher percentage of employees having the intention to improve their sleep habits. When the analyses were stratified by sex, there was a decrease in the number of women who intended to improve sleep habits in *Moderate* only. In this option, this change was accompanied by a non-significant increase in the number of women in the optimal sleep category (+17%). Therefore, several women in that option may have improved their sleep habits, thereby no longer having the intention to improve that habit. Systematic reviews have reported that employer-initiated interventions to improve sleep may improve sleep (duration and quality) and reduce complaints of sleepiness (Redeker et al., 2019; Robbins et al., 2019). For example, a 4-week WHPP consisting of taking 10,000steps daily significantly improved sleep duration (6.1±0.9 to 6.2±1.0 hours), sleep latency (19.3±15.7 to 15.4±15.1 min), and sleep quality score (Pittsburgh Sleep Quality Index decreased from 3.8±2.2 to 3.3±2.0) (Hori et al., 2016). Another WHPP that targeted sleep habits in addition to other health behaviours such as PA and eating habits for 1-year observed that the mean number of nights of restful sleep significantly increased from 3.7 at baseline to 4 after the program (Merrill et al., 2011). Measuring sleep duration or quality may have provided further insights into the impact of the *Activate Your Health* programme on sleep habits. In this programme, the percentage of employees having the intention to stop smoking decreased (-2.7%), while the number of employees reporting no tobacco use increased (+2.1%), regardless of option. This may indicate that some employees, who had quit smoking, reported no longer having the intention to improve this habit. Following a pilot study consisting of distributing smoking cessation educational material in addition to other health and safety materials to male construction workers, 45% of current smokers reported being more likely to quit smoking and to reduce tobacco exposures (Caban-Martinez et al., 2018). It has been mentioned elsewhere that a medium-to-large change in intention may lead to a small to medium change in behaviour (Webb and Sheeran, 2006). Therefore, to reduce the potential gap between intention and behaviour, programme practitioners may wish to study employees' initial intentions to improve various lifestyle habits using WHPP.

The *Activate Your Health* programme, which is not a weight-loss programme, may have helped in body weight control. Given the 1.05- to 2.46-year gap between baseline and post-intervention, it may have allowed employees to maintain their body weight or slow down weight gain generally observed with ageing in adult population, regardless of option. Indeed, in the current study, participants gained, on average, 0.54 kg while the age-related weight gain in Canada varies between approximately 0.25 and 0.50 kg per year (Hopman et al., 2007; Orpana et al., 2007). WHPPs, especially those targeting PA and/or eating habits, can have positive effects on weight-related outcomes (Proper and Van Oostrom, 2019). The body weight of men in *Control* increased by 3.1%. An increase or decrease of less than 3% in body weight is associated with the risk of presenting hypertension later (Earnest and Church, 2016). The larger the percentage of weight loss, the more the metabolic syndrome risk factors decrease (Earnest and Church, 2015). Thus, the weight gain of men in *Control* was probably large enough to elevate their cardiometabolic risks. It is worth noting that the body weight of men in the *High* option, which contained a variety of interventions targeting multiple lifestyle habits, improved over time (-0.58 kg). A systematic review reported that there was moderate quality evidence that WHPPs combining PA and dietary behaviour interventions [mean difference = -1.19 kg, 95% confidence interval (CI) = -1.64 to -0.74] significantly decreased body weight (Verweij et al., 2011). Also, there was low quality evidence that those targeting PA reduced this outcome (mean difference = -1.08 kg, 95% CI = -1.79 to -0.36)(Verweij et al., 2011). Furthermore, a very recent scoping review reported that, in men, most studies (68%) showed reduction in body weight following their WHPP and that programmes targeting PA and nutrition were more effective at improving this outcome (Bezzina et al., 2022). For example, compared to usual care group, a 6-month WHPP focusing on PA and nutrition had positive effects on body weight and BMI of male blue-collar workers post-programme (Beta = -1.06, 95% CI = -1.87 to -0.26 and Beta = -0.32, 95% CI = -0.57 to -0.08, respectively) (Viester et al., 2018). Therefore, a more intensive package of interventions, similar to those in *High*, may be more favourable to improvements in the weight status of men. Measurements of body fat percentage or waist circumference would have provided better insights into body composition changes. Furthermore, no significant changes in body weight and BMI were observed in women, even in *High*. This could be explained by the fact that the average BMI of women in all options, except for *Light*, were in the ideal weight category at baseline. This was not the case in men, for whom the average BMI was in the overweight category in each option.

Throughout the *Activate Your Health* programme, changes in most lifestyle habits did not differ across the four options. A 4-year study that offered a WHPP interventions comparable to a certain extent to the ones in the current programme also did not observe any changes in health-related behaviour such as PA, vegetable and fruit intake, smoking, and alcohol intake (Kilpatrick et al., 2016). Systematic reviews and meta-analyses have also reported limited effectiveness of WHPPs to improve different lifestyle habits (Conn et al., 2009; Maes et al., 2012; Malik et al., 2014; Marshall, 2004; Yuvaraj et al., 2019). Nevertheless, in the current programme employees maintained most of their lifestyle habits. In another study, the extent to which employees participated in a WHPP was associated with reductions in their health risk status (alcohol use, back care, depression, driving, nutrition, PA, tobacco use, stress and weight) (Seaverson et al., 2019). Therefore, it is possible that the degree of participation in the *Activate Your Health* programme (not monitored on an individual basis) was not high enough to lead to significant changes in the health risk status of employees. In addition, participants did not receive continuous motivation and support, which seem essential for behavioural change to take place (Kelly and Barker, 2016), from health professionals or programme agents for example. Moreover, a systematic review mentioned that published studies on WHPP and lifestyle habits showed positive clinical outcomes, but there may have been publication bias (Pelletier, 2011). Programmes with none to small effects also contribute to the scientific literature by showcasing study design weaknesses, and the difficulties and limitations faced by the researchers or WHPP facilitators.

Systematic reviews have questioned the effectiveness of WHPPs targeting PA (Freak-Poli et al., 2020; Malik et al., 2014; Marshall, 2004). A positive change in PA was expected in *High* because it included an activity tracker draw. Use of activity trackers has been shown to be an effective strategy (Poirier et al., 2016; Ringeval et al., 2020). However, in the current programme, the number of employees adhering to PA recommendations did not increase significantly for any option. A 9-month WHPP, which mainly involved PA counselling, reported improvements in daily total energy expenditure and cardiorespiratory fitness without significant change in the proportion of employees adhering to public health moderate-intensity PA recommendation (Odds ratio = 1.46; 95% CI = 0.76 to 2.79) (Proper et al., 2003). Viester and colleagues (2018) observed that significantly higher proportion of employees adhered to public health guidelines of vigorous-intensity PA in the group receiving a 6-month WHPP compared to usual care at 6-month (36% vs. 21%). However, there was no significant difference at 12-month between these groups (38% vs. 27%) (Viester et al., 2018). It is possible that categorising PA levels as adhering/non-adhering, may underestimate actual habit changes. For example, a small increase in the number of minutes of light PA may have been undetected as only total minutes of moderate-to-vigorous intensity PA were considered as adhering to recommendations. Furthermore, using a questionnaire to measure lifestyle habits such as PA requires memory and recall skills that may lead to inaccurate reporting of PA (Sallis and Saelens, 2000).

WHPPs targeting multiple risk factors including smoking and mostly at least another lifestyle habits have shown limited effectiveness on smoking cessation (Cahill and Lancaster, 2014). One of the studies that illustrated this conclusion was a 3-month tailored, telephone-based WHPP aiming smoking cessation and higher consumption of fruits and vegetables (Sorensen et al., 2007). Among smokers and recent quitters at baseline, at 6-month post-baseline there was a larger proportion of employees who reported not smoking (≥7 days) in the program group compared to control group (19% vs. 8%, $p = 0.03$) (Sorensen et al., 2007). A 3.5-year WHPP focusing on PA and smoking was offered to four companies (Bergström et al., 2008); there were significantly greater declines in the proportion of smokers in three companies (-0.45 to -0.60) compared to the control site without program. Following the current multiple-lifestyle-habit WHPP, there was a significant small reduction in the proportion of smokers (all participants), regardless of option. It is possible that the *Activate Your Health* programme mostly motivated employees who were ready to stop smoking to actually quit. This agrees with a review by Fishwick et al. (2013), which suggested that smoking cessation programs should be offered to employees who are trying to quit smoking.

Regarding the other variables, all employees reported a significant decrease in stress levels at work, regardless of option. WHPPs, especially those using e-health and cognitive behavioural techniques, have been found to have small positive effects on depression, anxiety and job-related stress (Proper and Van Oostrom, 2019). However, the number of employees in the current study reporting a loss of pleasure, feelings of depression and anxiety were stable, regardless of option. The main interventions of the *Activate Your Health* programme did not always target mental health, and this may explain the absence of improvement in these variables even in the extensive options. Moreover, perception of life satisfaction, general health, stress levels in general and stress management did not change significantly across the various options. This may be explained by already high levels of life satisfaction and good perceptions of general health among majority of employees when they decided to participate in the current programme. At the very least, these percentages did not deteriorate following participation in the programme.

To our knowledge, this is the first quasi-experimental study composed of a different combination of online and in-person interventions that targets a variety of lifestyle habits in this population. The main strength of the *Activate Your Health* programme is that it takes place in a real-life setting, administered with minimal input from the research group. In addition, the analyses consider the potential cluster effect associated with the fact that participants in the same company undergoing the same implementation process in the same work environment. This study is not without limitations. Because employees were not randomly assigned to each option, the results may be biased owing to sociodemographic variables and lifestyle habit differences at baseline. However, given that, in most cases, the company pre-selected the WHPP option for their employees, it would have been impractical to conduct a randomised control trial. Moreover, the data in the current study are not considered missing at random, therefore the results best reflect only those who adhered to the protocol and completed the HRA at both time points. This situation limits the generalizability of the results to a populational level. The results may also have been affected by self-reporting issues, such as social desirability and recall bias (Althubaiti, 2016; Fisher, 1993; Sallis and Saelens, 2000). Furthermore, between-group contamination may have occurred in one large company that offered two options (*Control* and *Moderate*), as employees in the control group may have attended interventions offered to the more extensive option. Furthermore, time difference between baseline and post-intervention data collection planned for one year varied depending on the company, which can have an impact on results. Nevertheless, all companies received their respective package of intervention between baseline and post-intervention data collection. As soon as the last intervention ended in each company, the data collection took place. Although the current results may be representative of workplace in the province of Quebec, particularly white-collar workers, it should be noted that they cannot be generalized to other sub-group of workers, work environment and workplace elsewhere in Canada. Moreover, for security reasons, two companies, both large financial institutions, discontinued the social health platform and/or personalised menu online interventions, which may explain the lack of improvement in eating habits in the most extensive options. It should also be noted that the reported daily number of fruit and vegetables were added to categorise adherence to eating habit recommendations.

However, actual consumption may have been underestimated due to the limited choice of answers from which employees could select (variable was collected top-coded; n=3).

CONCLUSION

Workplaces offer an opportunity to promote healthy lifestyle habits and the *Activate Your Health* programme helps employees to maintain or improve certain lifestyle habits or health outcomes. In men, this programme led to reduced body weight in the most extensive option which consisted of in-person and online interventions, including coaching and health screening, which targeted a variety of lifestyle habits. This suggests that a similar intervention package could be the most beneficial for weight management in men. Follow-up research is necessary to determine the long-term effects of this real-life setting programme on the health and lifestyle habits of company employees.

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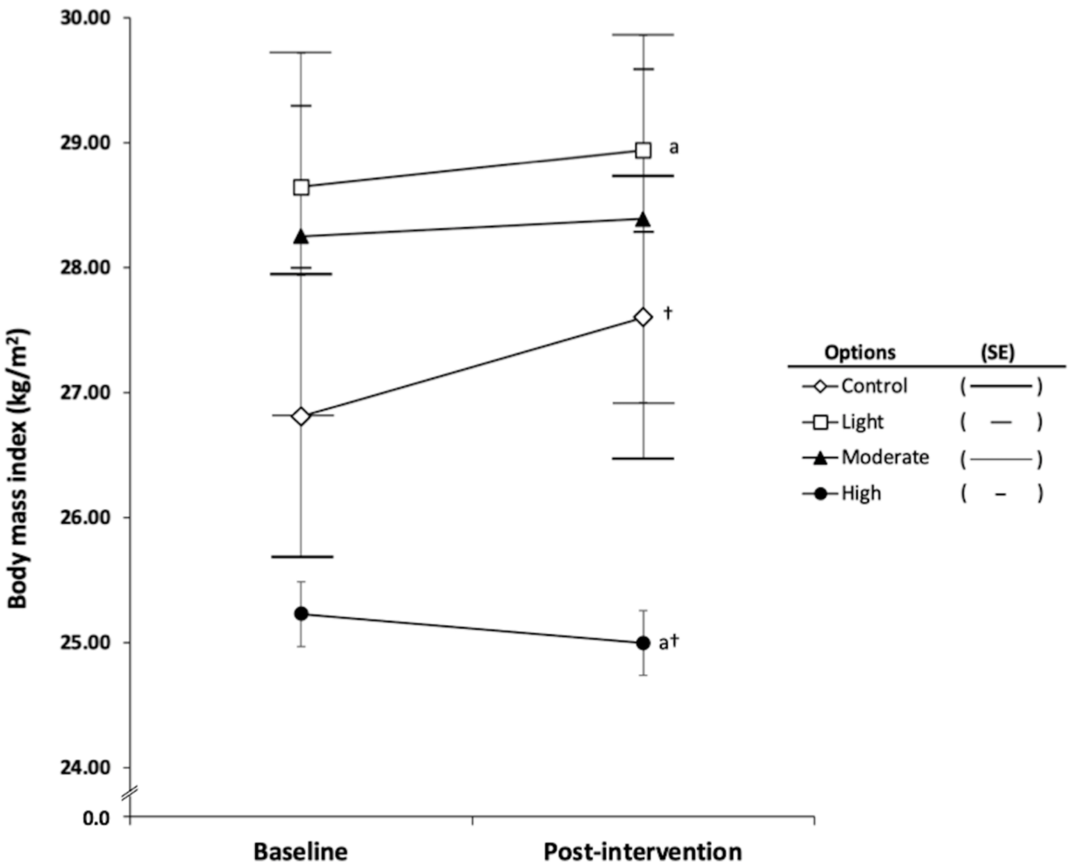

Caption Figure 1. Mean ± standard error (SE) bar for men's body mass index between baseline and post-intervention of the *Activate Your Health* programme (n = 216). [a]: Significantly different from the other option, based on Tukey-Kramer, p-value adjusted for multiple tests at both time points (≤ .05). [†]: Significantly different from the first time point (≤ .05).

Table 1: Description of the specific interventions included in each option of the *Activate Your Health* programme

Specific interventions	Description	Options			
		C	**L**	**M**	**H**
Number of companies		**2**	**5**	**1**	**1**
Mandatory: Health risk assessment	Employees filled an online self-questionnaire, which was an adaptation of validated questionnaires, national/provincial recommendations and opinion of health experts. They received quick feedback that included a health score and a comparison of their health profile and lifestyle habits to national/provincial recommendations.	X	X	X	X
Personalised online menus	Employees had access to *SOScuisine* that contains weekly menus, discounts and grocery shopping lists tailored to the employees' preferences and health goals.		X	X	X
Support in fostering a healthy environment	Health professionals hosted an information booth on how to make the worksite a place that could foster healthy lifestyle habits and provided suggestions to employees on how to be healthy around the workplace.		X	X	X
The *Health Challenge*	Employees wishing to take part in this challenge or in an alternative challenge could do so with the support of Capsana. This intervention consists of suggesting objectives related to healthy lifestyle habits on which employees could work for 4-6 weeks. The aim of this challenge is to help employees initiate a positive change regarding physical activity, eating habits and mental health. Employees are encouraged, and various tips that are easy to adopt are also proposed.		X	X	X
Conferences	Health professionals (nurses, kinesiologists, physicians, psychologists, etc.) gave, in general, one to three conferences to employees based on the desire of each company between baseline and post-programme. Each conference was an hour long. The presentations were on topics related to health and lifestyle habits.		X	X	X

Coaching	A health professional assisted once each employee in maintaining and/or improving their mental well-being and/or lifestyle habits.	X	X	X
Closing events	Employees participated in an event that consisted of a recreational activity to celebrate their participation in the programme and to motivate them to continue their efforts.	X	X	X
Health screening and flexibility assessment	Nurses assessed cardiometabolic risk factors (plasma HDL level and HDL/total cholesterol, blood glucose concentration, blood pressure, height, weight and waist circumference) and the back flexibility of each employee.		X	X
CANRISK questionnaire	Employees completed the CANRISK questionnaire, which determines the risk of developing pre-diabetes or diabetes based on 12-multiple choice questions and received quick feedback regarding their risk levels (https://www.pharmacists.ca/cpha-ca/assets/File/education-practice-resources/CanriskuserguideforpharmacistsFR.pdf).		X	X
Distribution of publications	Interested employees received handouts prepared by Capsana on topics such as chronic conditions and mental health (informational/educational material).		X	X
Social health platform	Employees had access to an online platform on which they could set goals and challenge their colleagues.		X	X
Activity tracker	Employees randomly received an accelerometer bracelet to follow their daily physical activity level using the manufacturer's website or a mobile application.			X

<u>Optional:</u> Informational/ Motivational session	Session aimed to encourage employees to complete the health risk assessment.	X	X	X	X
<u>Optional:</u> Smoking cessation: *Quit to Win! Challenge*	Employees who wished to participate in a 6-week provincial programme for smoking cessation could do so with Capsana's assistance.			X	X

Caption Table 1: *C: Control*; HDL: High-density lipoprotein; H: *High*; L: *Light*; M: *Moderate*.

Table 2: Changes in outcomes related to health and lifestyle, and various perceptions between baseline and post-intervention in each option (n=524)

OUTCOMES		OPTIONS: *Control* (n=18)	*Light* (n=163)	*Moderate* (n=31)	*High* (n=312)	EFFECTS: Option ***F* (3, 1035)**	Option ***P***	Time ***F* (1, 1035)**	Time ***P***	Option*Time ***F* (3, 1035)**	Option*Time ***P***
		Mean (Standard deviation)									
Body weight (kg)	Pre-	70.87 (15.30)	80.23 (20.90)	70.86 (16.69)	72.06 (15.80)	1.49	.217	5.12	**.024**	1.46	.225
	Post-	72.86 (16.35)	80.90 (21.12)	71.26 (16.63)	72.45 (16.23)						
Body mass index (kg/m^2)	Pre-	24.51 (3.73)	28.63 (7.55)[a]	24.85 (4.32)	24.24 (4.14)[a]	3.29	**.020**	2.82	.094	0.18	.912
	Post-	24.92 (4.25)	28.80 (7.58)[a]	25.08 (4.50)	24.43 (4.72)[a]						
Number of current health problems	Pre-	0.72 (1.18)	1.15 (1.47)	1.16 (1.24)	0.63 (0.94)	0.75	.521	1.86	.173	0.67	.570
	Post-	1.00 (0.69)	1.28 (1.45)	1.06 (1.24)	0.73 (1.09)						
Physical activity days	Pre-	4.00 (1.57)[a]	2.55 (1.86)[abc]	4.29 (1.58)[b]	4.13 (1.89)[c]	13.91	**<.001**	0.08	.784	0.17	.919
	Post-	4.06 (1.39)[a]	2.58 (1.98)[abc]	4.13 (2.00)[b]	4.05 (1.93)[c]						
Limit_fat (/2)	Pre-	1.56 (0.62)	1.36 (0.68)	1.26 (0.82)	1.49 (0.65)	1.63	.180	2.17	.141	0.42	.736
	Post-	1.56 (0.51)	1.40 (0.67)	1.42 (0.67)	1.56 (0.61)						
Limit_sugar (/2)	Pre-	1.39 (0.78)	1.40 (0.66)	1.39 (0.72)	1.53 (0.67)	0.28	.838	1.52	.218	0.05	.986
	Post-	1.44 (0.71)	1.45 (0.70)	1.45 (0.68)	1.57 (0.62)						
Limit_salt (/2)	Pre-	1.39 (0.78)	1.36 (0.73)	1.06 (0.73)	1.35 (0.75)	1.28	.281	1.54	.215	0.80	.496
	Post-	1.28 (0.83)	1.47 (0.71)	1.19 (0.75)	1.45 (0.68)						
Perceived life satisfaction (/4)	Pre-	2.89 (0.96)	2.95 (0.67)[a]	2.87 (0.92)	3.13 (0.72)[a]	3.05	**.028**	1.47	.225	0.94	.420
	Post-	2.94 (0.73)	2.96 (0.80)[a]	3.10 (0.65)	3.12 (0.73)[a]						
Perceived general health (/4)	Pre-	2.83 (0.79)	2.40 (0.87)[a]	2.42 (0.89)	2.81 (0.84)[a]	10.38	**<.001**	0.42	.518	1.39	.243
	Post-	2.72 (1.07)	2.40 (0.90)[a]	2.68 (0.70)	2.81 (0.87)[a]						
Perceived stress level at work[1] (/4)	Pre-	1.94 (0.64)	2.17 (0.88)	2.10 (0.70)	2.21 (0.77)	5.69	.128	6.63	**.010**	1.56	.669
	Post-	1.61 (0.92)	2.09 (0.88)	2.13 (0.89)	2.11 (0.80)						
Perceived stress level in general (/4)	Pre-	1.44 (0.86)	1.52 (1.03)	1.94 (0.89)	1.54 (0.87)	1.12	.341	0.00	.974	0.81	.486
	Post-	1.67 (0.97)	1.49 (0.92)	1.77 (0.88)	1.49 (0.86)						
Perceived stress management (/4)	Pre-	2.83 (0.79)	2.64 (0.89)	2.68 (0.70)	2.74 (0.77)	0.92	.430	0.00	.976	0.21	.887
	Post-	2.89 (0.83)	2.60 (0.95)	2.71 (0.74)	2.70 (0.79)						

Caption Table 2: Results of analyses using mixed effect models except [1]: generalised estimating equations models (main effects of time and option were estimated without the interaction term in the model, and degrees of freedom of χ^2 value are 1 and 3 respectively). Significant results are in **bold**. [a, b, c]: Significantly different from the other option with the same letter in a given row based on Tukey-Kramer p-value adjusted for multiple tests (≤ .05).

(/2): 0 being never limiting intake

(/4): 0 being very poor/very low

Table 3: Changes in intention, risk level, and mental health status between baseline and post-intervention in each option (n=524)

		OPTIONS				EFFECTS					
		Control (n=18)	*Light* (n=163)	*Moderate* (n=31)	*High* (REF; n=312)	Option		Time		Option*Time	
		n (%)				**χ^2 (Df=3)**	***P***	**χ^2 (Df=1)**	***P***	**χ^2 (Df=3)**	***P***
INTENTION TO IMPROVE (YES)											
Physical activity	Pre-(REF)	10 (55.6)	140 (85.9)[a]	26 (83.9)	206 (66.0)[a]	29.00	**<.001**	0.31	.578	3.23	.358
	Post-	9 (50.0)	134 (82.2)[a]	23 (74.2)	210 (67.3)[a]						
Eating habits	Pre-(REF)	6 (33.3)	133 (81.6)[a]	25 (80.6)[b]	175 (56.1)[ab]	49.49	**<.001**	0.11	.735	2.88	.411
	Post-	9 (50.0)	127 (77.9)[a]	24 (77.4)[b]	175 (56.1)[ab]						
Sleeping habits[1]	Pre-(REF)	6 (33.3)	59 (36.2)	20 (64.5)[a]	132 (42.3)[a]	3.92	.271	0.19	.665	8.75	**.033**
	Post-	6 (33.3)	77 (47.2)[†]	15 (48.4)	129 (41.3)						
Alcohol consumption	Pre-(REF)	4 (22.2)	15 (9.2)[a]	11 (35.5)[b]	53 (17.0)[ab]	11.18	**.011**	12.24	**<.001**	3.72	.293
	Post-	2 (11.1)	28 (17.2)[a]	12 (38.7)[b]	74 (23.7)[ab]						
Tobacco consumption	Pre-(REF)	3 (16.7)	15 (9.2)	2 (6.5)	21 (6.7)	4.37	.224	5.16	**.023**	2.84	.418
	Post-	2 (11.1)	14 (8.6)	1 (3.2)	10 (3.2)						
Stress management	Pre-(REF)	6 (33.3)	87 (53.4)[a]	24 (77.4)[b]	145 (46.5)[ab]	16.28	**.001**	0.11	.739	1.77	.621
	Post-	7 (38.9)	93 (57.1)[a]	21 (67.7)[b]	145 (46.5)[ab]						
FREQUENCY OF EMPLOYEES AT LOW-RISK											
Physical activity	Pre-(REF)	9 (50.0)	46 (28.2)[a]	13 (41.9)	174 (55.8)[a]	37.42	**<.001**	0.00	1.00	4.36	.226
	Post-	10 (55.6)	50 (30.7)[a]	18 (58.1)	164 (52.6)[a]						
Eating habits	Pre-(REF)	4 (22.2)	18 (11.0)	7 (22.6)	52 (16.7)	3.65	.302	0.19	.663	1.23	.746
	Post-	4 (22.2)	21 (12.9)	6 (19.4)	46 (14.7)						
Sleep	Pre-(REF)	15 (83.3)	116 (71.2)	21 (67.7)	245 (78.3)	3.15	.369	1.47	.225	7.75	.051
	Post-	12 (66.7)	113 (69.3)	25 (80.6)	235 (75.3)						
Alcohol	Pre-(REF)	16 (88.9)	158 (96.9)	26 (83.9)	296 (94.9)	6.32	.097	0.04	.842	3.83	.280
	Post-	16 (88.9)	159 (97.5)	29 (93.5)	293 (93.9)						
Tobacco	Pre-(REF)	15 (83.3)	144 (88.3)	28 (90.3)	296 (94.9)	7.19	.066	5.76	**.016**	4.12	.249
	Post-	14 (77.8)	150 (92.0)	30 (96.8)	300 (96.2)						
FREQUENCY OF REPORTED MENTAL HEALTH ISSUE (PRESENCE)											
Pleasure	Pre-(REF)	1 (5.6)	40 (24.5)[a]	8 (25.8)[b]	31 (9.9)[ab]	25.31	**<.001**	0.01	.918	1.42	.700
	Post-	3 (16.7)	41 (25.2)[a]	6 (19.4)[b]	31 (9.9)[ab]						
Anxiety	Pre-(REF)	1 (5.6)	23 (14.1)[a]	3 (9.7)	14 (4.5)[a]	9.50	**.023**	0.11	.739	1.75	.626
	Post-	1 (5.6)	19 (11.7)[a]	2 (6.5)	17 (5.4)[a]						
Depression[§]	Pre-(REF)	4 (22.2)	25 (15.3)[a]	4 (12.9)	29 (9.3)[a]	8.49	**.014**	0.07	.786	0.73	.693
	Post-	4 (22.2)	29 (17.8)[a]	0 (0.0)	27 (8.7)[a]						

Caption Table 3: Df: Degree of freedom. Results of analyses using generalized estimating equations models. Main effects were estimated without the interaction effect in the model except for [1]: main effects were estimated with interaction effect in the model. Significant results are in **bold**. [a, b, c]: Significantly different from the other option with the same letter in a given row based on Post-Hoc tests (≤ .05). [†]: Significantly different from the first time point (≤ .05). [§]: Due to a cell count of zero, *Moderate* was not included in the analysis (n=493, Df of option and interaction are 2).

Supplementary material 1

List of health problems

Employees who selected one of the following options for a given health problem was considered to currently have that problem: “yes, but I have never received treatment prescribed by a doctor/specialist” or “yes, and I am currently receiving treatment prescribed by a doctor/specialist.”

High blood pressure,

High or abnormal cholesterol or triglyceride levels,

Diabetes,

Heart disease (e.g., angina, heart attack, heart failure),

Stroke,

Cancer,

Osteoarthritis or another type of arthritis,

Osteoporosis,

Asthma or chronic lung disease (e.g., chronic bronchitis, emphysema),

Chronic back or neck pain,

Migraines or chronic headaches,

Depression,

Anxiety disorder (e.g., panic disorder, phobia, obsessive-compulsive disorder, post-traumatic stress disorder) or any other mental health problem,

Neurodegenerative disease (e.g., multiple sclerosis, ALS, Alzheimer, Parkinson’s),

Attention deficit disorder with or without hyperactivity (ADD or ADHD), and

Sleep disorders (e.g., insomnia, sleep apnea).

Supplementary material 2

Table: Number of employees on three different occasions: those who were invited, those who completed the health-risk assessment at baseline and those who completed the health-risk assessment at baseline and at post-intervention in each company.

	Number of employees		
	Invited	**Baseline assessment n (% of invited)**	**Baseline and post-programme assessment n (% of baseline)**
Company classification - option	7051	2647 (37.5)	524 (19.8)
Professionals: Business and administration professionals			
1 – Control	200	25 (12.5)	1 (4.0)
2 – Light	4462	1363 (30.5)	70 (5.1)[1]
Technicians and Associate professionals: Business and administration associate professionals			
3 – Moderate or Control	700	293 (41.9)	48 (16.4)
4 – High	1025	624 (60.9)	312 (50.0)
Clerical Support workers: Customer services clerks			
5 – Light	93	70 (75.3)	25 (35.7)
6 – Light	95	83 (87.4)	16 (19.3)
7 – Light	169	114 (67.5)	40 (35.1)
Services and Sales workers: Protective services workers			
8 – Light	307	75 (24.4)	12 (16.0)

Companies are classified according to the International Standard Classification of Occupations. [1]: Data collection coincided with COVID-19 health crisis.

Supplementary material 3

Table: Baseline characteristics of employees in each option (n=524)

VARIABLES	OPTIONS					
	Control (n=18)	*Light* (n=163)	*Moderate* (n=31)	*High* (n=312)	*P* value	Effect size
Age (years)	44.50 (6.28)	41.80 (9.83)	44.13 (6.86)	40.66 (9.89)	0.091	0.012
Sex†						
Women	9 (50.0)	127 (77.9)[a]	23 (74.2)[b]	149 (47.8)[ab]	**<0.001**	0.289
Men	9 (50.0)	36 (22.1)[a]	8 (25.8)[b]	163 (52.2)[ab]		
Body weight (kg)	70.87 (15.30)	80.23 (20.90)[ab]	70.86 (16.69)[a]	72.06 (15.80)[b]	**<0.001**	0.047
Body mass index (kg/m²)	24.51 (3.73)[a]	28.63 (7.55)[abc]	24.85 (4.32)[b]	24.24 (4.14)[c]	**<0.001**	0.121
Absence of current health problem†	11 (61.1)	75 (46.0)	13 (41.9)	180 (57.7)	**0.047**	0.123
Perceived life satisfaction†						
Very unsatisfied	1 (5.6)[a]	1 (0.6)	1 (3.2)	1 (0.3)[a]		
Unsatisfied	0 (0.0)	5 (3.1)	2 (6.5)	8 (2.6)		
Neither satisfied or unsatisfied	3 (16.7)	20 (12.3)	3 (9.7)	32 (10.3)	**0.030**	0.120
Satisfied	10 (55.6)	112 (68.7)	19 (61.3)	180 (57.7)		
Very satisfied	4 (22.2)	25 (15.3)[b]	6 (19.4)	91 (29.2)[b]		
Perceived general health†						
Bad	0 (0.0)	5 (3.1)	1 (3.2)	1 (0.3)		
Not bad	0 (0.0)	14 (8.6)	3 (9.7)	15 (4.8)		
Good	7 (38.9)	68 (41.7)	11 (35.5)	94 (30.1)	**0.002**	0.141
Very good	7 (38.9)	63 (38.7)	14 (45.2)	133 (42.6)		
Excellent	4 (22.2)	13 (8.0)[a]	2 (6.5)	69 (22.1)[a]		
Perceived stress level in general†						
Very low	3 (16.7)	32 (19.6)	2 (6.5)	34 (10.9)		
Low	5 (27.8)	46 (28.2)	7 (22.6)	117 (37.5)		
Moderate	9 (50.0)	57 (35.0)	13 (41.9)	124 (39.7)	**0.029**	0.120
High	1 (5.6)	25 (15.3)	9 (29.0)[a]	33 (10.6)[a]		
Very high	0 (0.0)	3 (1.8)	0 (0.0)	4 (1.3)		

Perceived stress level at work†						
Very low	0 (0.0)	3 (1.8)	0 (0.0)	5 (1.6)	0.085	0.110
Low	3 (16.7)	33 (20.2)	5 (16.1)	35 (11.2)		
Moderate	14 (77.8)	71 (43.6)	19 (61.3)	178 (57.1)		
High	0 (0.0)	46 (28.2)	6 (19.4)	78 (25.0)		
Very high	1 (5.6)	10 (6.1)	1 (3.2)	16 (5.1)		
Perceived stress management†						
Very low	0 (0.0)	3 (1.8)	0 (0.0)	0 (0.0)	0.467	0.086
Low	0 (0.0)	11 (6.7)	1 (3.2)	12 (3.8)		
Moderate	7 (38.9)	53 (32.5)	11 (35.5)	108 (34.6)		
High	7 (38.9)	70 (42.9)	16 (51.6)	141 (45.2)		
Very high	4 (22.2)	26 (16.0)	3 (9.7)	51 (16.3)		

One-way ANOVA and †Chi-Square were used to analyse the baseline characteristics and Tukey HSD and Bonferroni post-hoc tests were used, respectively. The results are reported as mean (standard deviation) or n (column %). The effect size (partial eta squared for one-way ANOVA and Cramer's V for Chi-square) of each variable is also provided. Statistical difference was set at a P value ≤ .05 and is in **boldface**. [a, b, c]: For a given variable, for each row, the options with the same letter are significantly different from each other based on their respective post-hoc tests.

Supplementary material 4

Table: Changes in outcomes related to health and lifestyle, and various perceptions between baseline and post-intervention in each option in women (n=308)

OUTCOMES		OPTIONS: *Control* (n=9)	*Light* (n=127)	*Moderate* (n=23)	*High* (n=149)	EFFECTS: Option *F* (3, 604)	Option *P*	Time *F* (1, 604)	Time *P*	Option*Time *F* (3, 604)	Option*Time *P*
		Mean (Standard deviation)									
Body weight (kg)	Pre-	59.47 (8.89)[a]	76.67 (21.16)[ab]	64.33 (12.09)	62.17 (13.21)[b]	4.11	**.007**	3.59	.059	0.29	.830
	Post-	60.86 (9.52)[a]	77.28 (21.27)[ab]	64.91 (12.45)	63.64 (15.78)[b]						
Body mass index (kg/m^2)	Pre-	22.21 (2.58)[a]	28.63 (8.31)[ab]	23.67 (3.84)	23.16 (4.63)[b]	4.70	**.003**	1.70	.193	0.62	.604
	Post-	22.25 (3.25)[a]	28.77 (8.34)[ab]	23.93 (4.04)	23.81 (5.85)[b]						
Number of current health problems	Pre-	1.00 (1.50)	1.17 (1.40)	1.17 (1.27)	0.74 (0.91)	0.44	.727	0.34	.560	1.00	.392
	Post-	1.11 (0.78)	1.34 (1.45)	0.96 (1.11)	0.94 (1.19)						
Physical activity days	Pre-	3.78 (0.97)	2.62 (1.86)[ab]	4.39 (1.41)[b]	3.85 (1.81)[a]	7.01	**<.001**	0.29	.587	0.17	.919
	Post-	3.89 (0.78)	2.40 (1.94)[ab]	4.22 (1.98)[b]	3.74 (1.99)[a]						
Limit_fat[1] (/2)	Pre-	1.67 (0.71)	1.39 (0.69)[a]	1.39 (0.78)	1.59 (0.62)[a]	10.57	**.014**	6.81	**.009**	2.15	.541
	Post-	1.78 (0.44)	1.45 (0.66)[a]	1.65 (0.49)	1.68 (0.52)[a]						
Limit_sugar (/2)	Pre-	1.56 (0.73)	1.41 (0.66)	1.43 (0.79)	1.56 (0.70)	0.55	.649	2.66	.104	0.23	.873
	Post-	1.78 (0.44)	1.47 (0.69)	1.48 (0.73)	1.62 (0.62)						
Limit_salt (/2)	Pre-	1.44 (0.88)	1.42 (0.71)	1.04 (0.77)	1.40 (0.72)	1.06	.366	5.50	**.019**	0.80	.491
	Post-	1.44 (0.88)	1.54 (0.69)	1.35 (0.71)	1.54 (0.65)						
Perceived life satisfaction (/4)	Pre-	3.00 (0.71)	2.92 (0.69)[a]	2.91 (0.95)	3.13 (0.71)[a]	3.00	**.030**	0.58	.446	0.45	.716
	Post-	3.00 (0.71)	2.93 (0.79)[a]	3.13 (0.63)	3.16 (0.74)[a]						
Perceived general health[2] (/4)	Pre-	3.22 (0.67)[abc]	2.36 (0.87)[ad]	2.43 (0.95)[b]	2.74 (0.79)[cd]	22.43	**<.001**	0.91	.340	2.16	.541
	Post-	3.33 (0.50)[abc]	2.36 (0.90)[ad]	2.74 (0.62)[b]	2.77 (0.82)[cd]						
Perceived stress level at work[3] (/4)	Pre-	2.22 (0.67)	2.17 (0.87)	2.00 (0.74)	2.23 (0.72)	1.49	.685	5.61	**.018**	2.24	.524
	Post-	1.78 (0.83)	2.06 (0.87)	2.09 (0.90)	2.11 (0.75)						
Perceived stress level in general (/4)	Pre-	1.78 (0.83)	1.67 (1.00)	1.87 (0.87)	1.58 (0.92)	0.60	.614	0.99	.320	0.14	.935
	Post-	1.78 (1.20)	1.58 (0.94)	1.74 (0.92)	1.44 (0.91)						
Perceived stress management (/4)	Pre-	2.67 (0.87)	2.54 (0.92)	2.57 (0.66)	2.62 (0.78)	0.43	.729	0.13	.723	0.08	.971
	Post-	2.78 (0.83)	2.53 (0.97)	2.57 (0.66)	2.62 (0.78)						

Results of analyses using mixed effect models except [1, 2] and [3]: generalised estimating equations models (main effects of time and option were estimated without the interaction term in the model, and degrees of freedom of χ^2 value are 1 and 3 respectively). Significant results are in **bold**. [a, b, c]: Significantly different from the other option with the same letter based on Tukey-Kramer p-value adjusted for multiple tests for a given row (≤ .05).

(/2): 0 being never limiting intake

(/4): 0 being very poor/very low

Supplementary material 5

Table: Changes in intention, risk level, and mental health status between baseline and post-intervention in each option in women (n=308)

		OPTIONS				EFFECTS					
		Control (n=9)	*Light* (n=127)	*Moderate* (n=23)	*High* (REF; n=149)	Option		Time		Option*Time	
		n (%)				**χ^2 (Df=3)**	***P***	**χ^2 (Df=1)**	***P***	**χ^2 (Df=3)**	***P***
INTENTION TO IMPROVE (YES)											
Physical activity	Pre-(REF)	6 (66.7)	111 (87.4)^{a}	21 (91.3)	107 (71.8)^{a}	13.78	**.003**	0.92	.336	3.30	.348
	Post-	5 (55.6)	109 (85.8)^{a}	17 (73.9)	107 (71.8)^{a}						
Eating habits	Pre-(REF)	3 (33.3)	105 (82.7)^{a}	19 (82.6)^{b}	82 (55.0)^{ab}	33.32	**<.001**	0.29	.588	1.88	.597
	Post-	3 (33.3)	98 (77.2)^{a}	18 (78.3)^{b}	85 (57.0)^{ab}						
Sleeping habits[§]	Pre-(REF)	4 (44.4)	52 (40.9)	17 (73.9)^{a}	68 (45.6)^{a}	2.84	.416	3.11	.078	9.55	**.023**
	Post-	4 (44.4)	63 (49.6)	11 (47.8)†	63 (42.3)						
Alcohol consumption	Pre-(REF)	2 (22.2)	11 (8.7)	8 (34.8)^{a}	23 (15.4)^{a}	7.91	**.048**	7.08	**.008**	2.74	.434
	Post-	1 (11.1)	21 (16.5)	10 (43.5)^{a}	31 (20.8)^{a}						
Tobacco consumption[1]	Pre-(REF)	0 (0.0)	13 (10.2)	2 (8.7)	9 (6.0)	3.58	.167	4.26	**.039**	2.81	.246
	Post-	0 (0.0)	11 (8.7)	1 (4.3)	3 (2.0)						
Stress management	Pre-(REF)	3 (33.3)	78 (61.4)	19 (82.6)^{a}	74 (49.7)^{a}	12.29	**.006**	0.93	.335	1.80	.615
	Post-	4 (44.4)	79 (62.2)	17 (73.9)^{a}	83 (55.7)^{a}						
FREQUENCY OF EMPLOYEES AT LOW-RISK											
Physical activity	Pre-(REF)	4 (44.4)	35 (27.6)^{a}	9 (39.1)	78 (52.3)^{a}	18.58	**<.001**	0.19	.666	4.75	.191
	Post-	6 (66.7)	37 (29.1)^{a}	12 (52.2)	67 (45.0)^{a}						
Eating habits	Pre-(REF)	3 (33.3)	15 (11.8)	5 (21.7)	32 (21.5)	5.32	.150	0.02	.891	2.46	.483
	Post-	4 (44.4)	19 (15.0)	5 (21.7)	26 (17.4)						
Sleep	Pre-(REF)	8 (88.9)	89 (70.1)	17 (73.9)	105 (70.5)	3.57	.312	0.13	.714	6.20	.102
	Post-	6 (66.7)	86 (67.7)	21 (91.3)	103 (69.1)						
Alcohol	Pre-(REF)	8 (88.9)	123 (96.9)	19 (82.6)	142 (95.3)	3.70	.295	0.07	.796	5.57	.135
	Post-	8 (88.9)	123 (96.9)	22 (95.7)	138 (92.6)						
Tobacco[1]	Pre-(REF)	9 (100.0)	110 (86.6)^{a}	20 (87.0)	143 (96.0)^{a}	7.99	**.018**	3.77	.052	1.39	.498
	Post-	9 (100.0)	114 (89.8)^{a}	22 (95.7)	144 (96.6)^{a}						
FREQUENCY OF REPORTED MENTAL HEALTH ISSUE (PRESENCE)											
Pleasure	Pre-(REF)	1 (11.1)	34 (26.8)^{a}	5 (21.7)	19 (12.8)^{a}	13.37	**.004**	0.06	.811	0.10	.992
	Post-	1 (11.1)	33 (26.0)^{a}	4 (17.4)	19 (12.8)^{a}						
Anxiety[1]	Pre-(REF)	1 (11.1)	21 (16.5)	3 (13.0)	8 (5.4)	5.68	.058	0.36	.549	4.66	.097
	Post-	0 (0.0)	16 (12.6)	1 (4.3)	12 (8.1)						
Depression[2]	Pre-(REF)	3 (33.3)^{a}	22 (17.3)^{b}	1 (4.3)	16 (10.7)^{ab}	8.82	**.012**	0.44	.505	2.64	.268
	Post-	3 (33.3)^{a}	24 (18.9)^{b}	0 (0.0)	10 (6.7)^{ab}						

Df: Degree of freedom. Results of analyses using generalized estimating equations models. Main effects were estimated without the interaction effect in the model except for [§]: main effects were estimated with interaction effect in the model. Significant results are in **bold**. $^{a, b, c}$: Significantly different from the other option with the same letter in a given row based on Post-Hoc tests (≤ .05). †: Significantly different from the first time point (≤ .05). [1]: *Control* not included in the analysis (n=299, Df of option and interaction are 2). [2]: *Moderate* not included in the analysis (n=285, Df of option and interaction are 2).

Supplementary material 6

Table: Changes in outcomes related to health and lifestyle, and various perceptions between baseline and post-intervention in each option in men (n=216)

		OPTIONS				EFFECTS					
		Control (n=9)	*Light* (n=36)	*Moderate* (n=8)	*High* (n=163)	Option		Time		Option*Time	
OUTCOMES		***Mean (Standard deviation)***				***F* (3, 419)**	***P***	***F* (1, 419)**	***P***	***F* (3, 419)**	***P***
Body weight (kg)	Pre- Post-	82.27 (11.21) 84.85 (12.39)[†]	92.76 (14.22)[a] 93.66 (14.86)[a]	89.64 (13.83) 89.53 (13.57)	81.09 (12.16)[a] 80.51 (11.89)[a†]	3.59	.014	3.07	.081	5.38	**.001**
Body mass index (kg/m^2)	Pre- Post-	26.81 (3.31) 27.60 (3.44)[†]	28.65 (3.92)[a] 28.94 (3.93)[a]	28.25 (3.98) 28.39 (4.31)	25.23 (3.35)[a] 25.00 (3.28)[a†]	11.18	<.001	3.60	.058	4.91	**.002**
Number of current health problems	Pre- Post-	0.44 (0.73) 0.89 (0.60)	1.06 (1.71) 1.06 (1.43)	1.13 (1.25) 1.38 (1.60)	0.53 (0.95) 0.55 (0.94)	0.64	.591	3.12	.078	1.13	.338
Physical activity days	Pre- Post-	4.22 (2.05) 4.22 (1.86)	2.31 (1.85)[a] 3.19 (2.01)[a]	4.00 (2.07) 3.88 (2.17)	4.37 (1.93)[a] 4.33 (1.84)[a]	9.46	**<.001**	0.50	.482	2.31	.076
Limit_fat[1] (/2)	Pre- Post-	1.44 (0.53) 1.33 (0.50)	1.25 (0.65) 1.25 (0.69)	0.88 (0.84) 0.75 (0.71)	1.40 (0.66) 1.45 (0.66)	6.21	.102	0.34	.558	2.05	.563
Limit_sugar (/2)	Pre- Post-	1.22 (0.83) 1.11 (0.78)	1.36 (0.68) 1.39 (0.73)	1.25 (0.46) 1.38 (0.52)	1.51 (0.63) 1.53 (0.62)	0.59	.622	0.05	.825	0.30	.825
Limit_salt (/2)	Pre- Post-	1.33 (0.71) 1.11 (0.78)	1.14 (0.76) 1.22 (0.76)	1.13 (0.64) 0.75 (0.71)	1.31 (0.77) 1.37 (0.70)	0.64	.592	1.90	.169	1.87	.133
Perceived life satisfaction (/4)	Pre- Post-	2.78 (1.20) 2.89 (0.78)	3.06 (0.63) 3.06 (0.83)	2.75 (0.89) 3.00 (0.76)	3.12 (0.72) 3.09 (0.72)	0.75	.520	0.92	.339	0.62	.603
Perceived general health[2] (/4)	Pre- Post-	2.44 (0.73) 2.11 (1.17)	2.53 (0.88) 2.53 (0.91)	2.38 (0.74) 2.50 (0.93)	2.88 (0.89) 2.86 (0.91)	9.83	**.020**	0.30	.584	1.62	.656
Perceived stress level at work[3] (/4)	Pre- Post-	1.67 (0.50) 1.44 (1.01)	2.17 (0.94) 2.22 (0.93)	2.38 (0.52) 2.25 (0.89)	2.19 (0.81) 2.12 (0.86)	6.48	.090	1.33	.249	1.29	.731
Perceived stress level in general (/4)	Pre- Post-	1.11 (0.78) 1.56 (0.73)	0.97 (0.97)[a] 1.17 (0.78)[a]	2.13 (0.99)[a] 1.88 (0.84)[a]	1.50 (0.83) 1.55 (0.82)	3.74	**.011**	1.13	.289	1.50	.215
Perceived stress management (/4)	Pre- Post-	3.00 (0.71) 3.00 (0.87)	3.03 (0.70) 2.86 (0.83)	3.00 (0.76) 3.12 (0.84)	2.85 (0.76) 2.77 (0.79)	0.77	.509	0.12	.732	0.53	.660

Results of analyses using mixed effect models except [1, 2] and [3]: generalised estimating equations models (main effects of time and option were estimated without the interaction term in the model, and degrees of freedom of χ^2 value are 1 and 3 respectively). Significant results are in **bold**. [a, b, c]: Significantly different from the other option with the same letter based on Tukey-Kramer p-value adjusted for multiple tests for a given row (≤ .05). [†]: Significantly different from the first time point (≤ .05).

(/2): 0 being never limiting intake

(/4): 0 being very poor/very low

Supplementary material 7

Table: Changes in intention, risk level, and mental health status between baseline and post-intervention in each option in men (n=216)

		OPTIONS				EFFECTS					
		Control (n=9)	*Light* (n=36)	*Moderate* (n=8)	*High* (REF; n=163)	Option		Time		Option*Time	
		n (%)				**χ^2 (Df=3)**	***P***	**χ^2 (Df=1)**	***P***	**χ^2 (Df=3)**	***P***
INTENTION TO IMPROVE (YES)											
Physical activity	Pre-(REF)	4 (44.4)	29 (80.6)	5 (62.5)	99 (60.7)	5.06	.168	0.02	.900	2.91	.406
	Post-	4 (44.4)	25 (69.4)	6 (75.0)	103 (63.2)						
Eating habits	Pre-(REF)	3 (33.3)	28 (77.8)[a]	6 (75.0)	93 (57.1)[a]	11.64	**.009**	0.02	.893	3.38	.337
	Post-	6 (66.7)	29 (80.6)[a]	6 (75.0)	90 (55.2)[a]						
Sleeping habits	Pre-(REF)	2 (22.2)	7 (19.4)	3 (37.5)	64 (39.3)	3.71	.295	1.67	.197	5.62	.132
	Post-	2 (22.2)	14 (38.9)	4 (50.0)	66 (40.5)						
Alcohol consumption	Pre-(REF)	2 (22.2)	4 (11.1)	3 (37.5)	30 (18.4)	2.31	.510	5.16	**.023**	3.15	.369
	Post-	1 (11.1)	7 (19.4)	2 (25.0)	43 (26.4)						
Tobacco consumption[1]	Pre-(REF)	3 (33.3)	2 (5.6)	0 (0.0)	12 (7.4)	2.71	.258	1.32	.251	0.87	.649
	Post-	2 (22.2)	3 (8.3)	0 (0.0)	7 (4.3)						
Stress management	Pre-(REF)	3 (33.3)	9 (25.0)	5 (62.5)	71 (43.6)	3.00	.391	0.44	.508	4.45	.217
	Post-	3 (33.3)	14 (38.9)	4 (50.0)	62 (38.0)						
FREQUENCY OF EMPLOYEES AT LOW-RISK											
Physical activity	Pre-(REF)	5 (55.6)	11 (30.6)[a]	4 (50.0)	96 (58.9)[a]	10.65	**.014**	0.24	.623	2.51	.473
	Post-	4 (44.4)	13 (36.1)[a]	6 (75.0)	97 (59.5)[a]						
Eating habits[2]	Pre-(REF)	1 (11.1)	3 (8.3)	2 (25.0)	20 (12.3)	2.04	.360	0.13	.715	1.12	.572
	Post-	0 (0.0)	2 (5.6)	1 (12.5)	20 (12.3)						
Sleep	Pre-(REF)	7 (77.8)	27 (75.0)	4 (50.0)	140 (85.9)	4.27	.234	2.61	.106	3.21	.361
	Post-	6 (66.7)	27 (75.0)	4 (50.0)	132 (81.0)						
Alcohol[3]	Pre-(REF)	8 (88.9)	35 (97.2)	7 (87.5)	154 (94.5)	0.66	.721	0.11	.739	0.11	.947
	Post-	8 (88.9)	36 (100.0)	7 (87.5)	155 (95.1)						
Tobacco[§]	Pre-(REF)	6 (66.7)	34 (94.4)	8 (100.0)	153 (93.9)	-	-	-	-	-	-
	Post-	5 (55.6)	36 (100.0)	8 (100.0)	156 (95.7)						
FREQUENCY OF REPORTED MENTAL HEALTH ISSUE (PRESENCE)											
Pleasure[2]	Pre-(REF)	0 (0.0)	6 (16.7)	3 (37.5)	12 (7.4)	5.47	.065	0.04	.835	1.90	.386
	Post-	2 (22.2)	8 (22.2)	2 (25.0)	12 (7.4)						
Anxiety[4]	Pre-(REF)	0 (0.0)	2 (5.6)	0 (0.0)	6 (3.7)	0.72	.395	0.00	1.00	0.88	.347
	Post-	1 (11.1)	3 (8.3)	1 (12.5)	5 (3.1)						
Depression[1]	Pre-(REF)	1 (11.1)	3 (8.3)	3 (37.5)	13 (8.0)	0.18	.914	2.00	.157	1.46	.481
	Post-	1 (11.1)	5 (13.9)	0 (0.0)	17 (10.4)						

Df: Degree of freedom. Results of analyses using generalized estimating equations models. Main effects were estimated without the interaction effect in the model. Significant results are in **bold**. [a, b, c]: Significantly different from the other option with the same letter in a given row based on Post-Hoc tests (≤ .05). [§]: Analysis was not performed. [1]: *Moderate* not included in the analysis (n=208, Df of option and interaction are 2). [2]: *Control* not included in the analysis (n=207, Df of option and interaction are 2). [3]: *Light* not included in the analysis (n=180, Df of option and interaction are 2). [4]: *Control and Moderate* not included in the analysis (n=199, Df of option and interaction are 1)

Chapter 4 – Article 3

Health-Related and Lifestyle Factors as Predictors of Intentions to Improve Lifestyle Habits in Employees Participating in a Workplace Health Promotion Program

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<u>Introductory statement:</u> This chapter begins the standard sections of an article: abstract, background, methods, results, discussion and conclusion. This is followed by the declaration section (e.g., funding, conflict of interest, etc.). The references, Figures 1 and 2, Tables 1 to 5, and supplementary tables are then presented.

ABSTRACT

Objectives: To explore employees' intentions to improve lifestyle habits, investigate the health and lifestyle-related predictors of these intentions, and how it translated into behavioral improvement. Methods: Employees participating in the *Activate Your Health* WHPP completed a questionnaire of their demographics, health-related variables, as well as six lifestyle habits and intention to improve them. Results: At baseline (n=2729), most employees wanted to focus on physical activity and eating habits. Many predictors were identified for each intention. Majority of intentions were associated with behavioral improvement post-program (n=525), especially in *High*. Conclusions: In the context of WHPPs, intention to improve may lead to actual behavioral improvement. Exploring employees' intentions to improve various lifestyle habits at the start of the program could improve the effectiveness of these programs.

Keywords: Health promotion; Program planning; Obesity; Behavioral improvement; Workers

Companies offer workplace health promotion programs (WHPPs) to improve employees' health and work-related outcomes.[1,2] WHPPs can reach a large number of individuals and create a culture of health within the organization.[3,4] Moreover, because employees spend more than eight hours of their day at work,[5] WHPPs allow them to allocate time towards adopting and maintaining healthy lifestyle habits at their workplace.[6] Adopting healthy lifestyle habits is essential due to numerous health benefits such as reduced risk of chronic diseases including certain types of cancers.[7,8]

Although WHPPs offer potential benefits for employees and their organizations,[2] systematic reviews and meta-analyses report inconclusive results or small effect sizes regarding the effectiveness of these programs on certain health-related outcomes and lifestyle habits.[1,9-12] Also, a fairly small percentage seem to improve their habits. A 1-year program called *The Prevention Plan* was offered to decrease health risks of employees by supporting and encouraging them to adopt healthy behaviors and lifestyle habits.[13] There was decrease of 14.7 %, 18.5%, and 24.2% in the proportion of high-risk employees for frequency of high-fat food consumption, physical activity (PA), and alcohol consumption respectively.[13] In a seven-year WHPP targeting multiple lifestyle habits, 15.5% of university employees became physically active at least once weekly.[14] In addition, 11.9% and 3.5% of employees improved their eating habits (at least 5 servings of fruits and vegetables daily) and smoking habits respectively.[14] More recently, in a WHPP including multiple lifestyle habits interventions, there was a non-significant decrease in the percentage of employees who were physically inactive based on their classification between 2010 and 2017 (16.6% to 14.4%).[15]

Knowing that theories such as the theory of planned behavior and the transtheoretical model emphasize that intention is associated with behavior, intention needs to be examined.[16,17] To our knowledge, very few studies have examined the intentions to improve various lifestyle habits when employees enroll in WHPPs. Previous studies have reported the proportion of employees intending to make changes in some health habits using different questions to document these outcomes.[18,19] Moreover, to our knowledge, the characteristics of employees intending to improve each lifestyle habits have not been extensively investigated in the context of WHPPs. By identifying the characteristics of employees intending to improve each lifestyle habit, program practitioners may be able to offer the appropriate intervention at the start of the program to the right sub-group of employees. This will result in a targeted approach that may improve the number of employees achieving a behavioral improvement following the program.

Moreover, intention was identified as one of two predictors of overall PA change[20] and as a moderate predictor of exercising.[21] In health promotion clinics, intention was associated to healthy eating[22] and smoking cessation attempt[23]. Intention was also identified as one of the predictor of consuming two or more servings of fruits daily.[24] Furthermore, changing behavioral intention has been suggested to be an option in the aim of preventing alcohol consumption.[25] A meta-analysis stated that, in general, a medium-to-large intention change results in a small-to-moderate behavior change.[26] However, to our knowledge, very few studies have explored whether positive intention leads to an improvement in its habit in the context of WHPPs. An association between these variables would suggest that offering interventions targeted to employees' initial intentions to improve would increase the probability of achieving an actual behavioral improvement. As a result, initial intention could be used to screen participants, which represents a proper allocation of resources to the right sub-group. It would justify offering coaching sessions on intention changes before implementing costly behavioral programs to all employees. All of these may consequently lead to better effectiveness of WHPPs.

The primary aim of the current study is to examine the proportion of employees who intended to improve each lifestyle habit in a WHPP and explore what health- and lifestyle-related factors predicted these intentions in all employees who enrolled at baseline. The secondary aim is to verify whether these intentions were associated to an improvement in behavior after participating in the program among employees also enrolled at post-program, and what option of the program (*Control*, *Light*, *Moderate* or *High*) leads to intention-to-behavioral improvement in the greatest number of habits.

METHODS

Study Design and Participants

Activate Your Health is a WHPP created by Capsana.[27] It includes a research component and is evaluated in eight companies in Quebec, Canada with the partnership of the Public Health Agency of Canada.[28] Participating companies are located in a variety of sectors ranging from bank-related organizations to graveyard administration. Participating companies picked the following options of this WHPP: *Control*, *Light*, *Moderate*, and *High*. Companies selected one option except for one company, which gave the choice of two options to their employees (*Control and Moderate*). The options vary by the number and type of included interventions. *Control* does not include any additional interventions other than an optional informational/motivational session, which was offered to all the options. *Light* contains personalized online menus, support in fostering a healthy environment, participation in the national *Health challenge*, conferences on health and lifestyle habits, individualized coaching session by a nurse, and closing event (recreational activity to celebrate participation in the program). In *Moderate*, in addition to including all the interventions offered in *Light*, it also contained the following interventions: health screening and flexibility assessment, CANRISK questionnaire (determines the risk of developing pre-diabetes and diabetes), distribution of publications/handouts, and a social health platform that allows employees to set goals and challenge their colleagues. *High*, the most extensive package, comprises of interventions contained in *Moderate*, and a draw of activity trackers. In *Moderate* and *High*, an optional intervention targeting smoking cessation called *Quit to Win! Challenge* was available. Details of each option and intervention have been previously described.[28]

Participation was voluntary and only pregnant women were excluded from the research component. Employees completed an online consent form (written). They were informed that their data would be used to evaluate the *Activate Your Health* program and that their employers would not have access to their personal data. This study was approved by the Health Research Ethics Committee of Université de Montréal [16-063-CERES-D(1)] and registered on Clinicaltrials.gov on October 16, 2016 and updated on March 26, 2019 (NCT02933385).

Data Collection

Capsana collected the data and gave access to the data to the research team. Employees consented to participate in the *Activate Your Health* program and were aware that their anonymized data would be analyzed. Then, they completed an online health-risk assessment (HRA) regarding their health, lifestyle habits and the intention to improve them. The current study used the baseline data gathered between December 2016 and July 2018 and the post-intervention data collected between April 2018 and January 2020 [1.35 (min 1.05–max 2.46 years) years elapsed per company]. At the completion of the HRA, employees were unaware of in which option they would be placed. Participants reported their age, sex, weight, and height [Body mass index (BMI) = weight (kg)/height^2 (m)].

Lifestyle Habits

Participants were asked, "How many days per week (0, 1, 2, 3, 4, 5, 6, or 7) are you physically active (e.g., by walking instead of driving to your destination, or by doing recreational activities, such as bicycling, playing tennis, dancing, swimming, etc.)?" If they answered one day or more, two follow-up questions were asked: 1) "On your physically active days (including when you walk), how many minutes (<10, 10, 20, 30, 40, 50, 60, 75, 90 or >90 minutes) on average do you spend on PA?" 2) "What is your level of shortness of breath (none, slight, or enough to make conversation difficult) during your periods of PA?" Total PA was computed by multiplying weekly days of PA and minutes per session. Based on the Canadian Society for Exercise Physiology guidelines,[29] "slight shortness of breath" was considered moderate intensity, and "enough shortness of breath" was considered vigorous intensity. Performing less than 150 minutes of weekly PA or not reaching moderate-vigorous intensity was considered high risk due to an insufficient amount of PA.

Frequency of fruit and vegetable consumption is a good approximation of diet quality.[30] Moreover, fruit and vegetable consumption is associated with the prevention of various diseases such as cardiovascular disease and cancer.[31,32] Employees selected their daily number of fruit (0, 1, 2, 3, 4, 5, or ≥6) and vegetable (0, 1, 2, 3, 4, 5, or ≥6) servings as defined by the 2007 Canadian Food Guide.[33] This guide recommends daily servings of fruits and vegetables based on sex and age: women aged ≥18 years and men aged >50 years should eat at least seven servings, and men aged 18-50 years should eat at least eight servings. Participants who did not meet the recommended level were considered to be at high risk due to unhealthy eating habits.

To assess sleep habits, employees had to report the presence of sleep disorder such as insomnia and sleep apnea. Those who reported "yes, but I have never received treatment prescribed by a doctor/specialist" or "yes, and I am currently receiving treatment prescribed by a doctor/specialist" were categorized as being at high risk due to suboptimal sleep habits. Moreover, participants were asked, “How often (rarely/never, sometimes, or often) do sleep problems interfere with your daily activities and well-being?” Those who reported “often” were also categorized as being at high risk. Employees who selected sleep disturbance for the following question were also classified as being at high risk: “Of the following signs, which have you experienced in a significant, continuous way for at least two weeks?”

Employees who did not smoke were classified as being at low risk, whereas those who smoked occasionally/regularly were considered to be at high risk. As for alcohol consumption, participants indicated their weekly number (<1, 1-3, 4-10, 11-15, 16-21, or >21) of drinks (1 drink = 12 oz./340 mL of beer, 5 oz./150 mL of wine or 1.5 oz./45 mL of spirits).[34] Women who drank >10 drinks and men who drank >15 drinks weekly were considered high risk due to high alcohol consumption.

General Health

General health was studied by asking, “Considering your age, how (excellent, very good, good, fair, or poor) would you describe your general health?” For this variable, responses were categorized as excellent, very good/good, and fair/poor. The number of current health problems was calculated by summing the total number of health issues selected from a list [high blood pressure, high or abnormal cholesterol or triglyceride levels, diabetes, heart disease, stroke, cancer, osteoarthritis or another type of arthritis, osteoporosis, asthma or chronic lung disease, chronic back or neck pain, migraines or chronic headaches, depression, anxiety disorder or any other mental health problem, neurodegenerative disease, attention deficit disorder with or without hyperactivity, and sleep disorders (eg, insomnia, sleep apnea)].

Stress

Level of stress at work was measured with the question: “What is your stress level (very low, low, moderate, high, very high, or does not apply, I don’t work) at work?” Responses were categorized as either very low, low/moderate, and high/very high. Stress management was also studied by asking: “How good (very poor, poor, average, good, or very good) are your stress coping skills?” This variable was categorized as very poor/poor, average/good, and very good.

Intentions to improve each lifestyle habit

Participants were required to indicate whether they intended positive (yes) or negative (no) intention to do more PA, improve their eating habits, improve their sleep habits, stop smoking, reduce their consumption of alcohol, and better manage their stress in the following six months.

Improvement

Employees were considered "improved" if they were initially at risk due to a poor habit and became not at risk after participating in the current WHPP. Those who had a higher rating of stress management following the program compared to baseline were also considered "improved." Behavioral improvement was computed for participants who were properly allocated into an option and who completed the HRA at baseline and at post-intervention.

Statistical Analyses

Frequency distributions were used to obtain the number of employees who intended to improve each lifestyle habit. From this, employees were categorized according to their number of positive intention(s) (0 to 6). Then, within each category, the most common combination of intentions were noted.

Binary logistic regression was performed with each predictor variable and dependent variable. Age, BMI, and number of current health problems were used as continuous predictor variables and the linearity between each of them and each dependent variable were tested. When linearity was not respected, predictor variables were categorized [median age (< 40 years old) and 25 kg/m^2 as cut-offs for age and BMI]. Sex, perceived general health, perceived stress at work, perceived stress management, as well as all the risk factors were considered categorical predictor variables and were assigned a reference category. The dependent variables were the intentions to improve PA, eating habits, sleep habits, smoking behavior, alcohol consumption, and stress management. To determine which factors were the best predictors of each dependent variable, forward stepwise logistic regression was used. Non-smokers were removed from the logistic regression analyses regarding intention to stop smoking because these employees were less likely to improve this habit. Likewise, those who reported consuming less than one alcohol consumption weekly were excluded from the analyses of intention to reduce alcohol consumption.

The discriminative ability of the final regression model of each dependent variable was obtained using the area under the receiver operating characteristic curve (ROC).[35] An area under the ROC curve close to a value of “1” indicates that the predictive model has high discriminatory power.[35]

Pearson Chi-square tests with Cramer’s V were used to examine the association between each intention and its behavioral improvement. The analyses were then stratified by option. The analyses were performed using SPSS Statistics (IBM, Armonk Corp., NY) version 26.0. Odds ratios (ORs), p-values, and 95% confidence interval (95% CI) were obtained. P-values ≤ 0.05 were considered statistically significant.

RESULTS

Table 1 shows the descriptive data of employees with complete data at baseline (n = 2729). A minority of employees (n=205) did not intend to improve any of the lifestyle habits (Figure 1). Figure 2 shows the lifestyle habits that the remaining employees (n = 2524) intended to improve. Among all the employees, 353 (13%) reported being smokers, and 242 (69%) of these intended to stop smoking. Among the 1907 (70%) employees who drank alcohol at least once a week, 479 (25%) intended to reduce their consumption. More than half of the employees (64%) intended to improve ≤3 lifestyle habits (Figure 1). Table 2 presents the most common combinations of lifestyle habits according to each number of positive intentions (1 to 6). One interpretation from these data is that among the employees who had the intention to improve three lifestyle habits, 46% intended to improve their PA level, eating habits, and stress management (Table 2).

In the binary logistic regression analyses, among smokers, no predictor was associated with the intention to stop smoking (See Table, Supplemental Digital Content 1, which shows all ORs). Only the statistically significant associations between predictors and intentions to improve (OR_{BI}) are presented in Table 3. The ORs for age, BMI, and number of current health problems are expressed on a per unit increase basis unless otherwise specified. For example, 28-year-old employees were nearly 18% less likely to intend to improve their PA than the 18-year-old employees ($OR^{\text{number of unit difference}} = 0.98^{10}$).

Table 3 also shows the ORs for the statistically significant predictors retained in the final model from the multivariate logistic regression analyses of each intention (OR_{MULTI}). The area under the ROC of intention to increase PA, improve eating habits, improve sleep habits, reduce alcohol consumption, and improve stress management were respectively 0.78 (CI: 0.76-0.80), 0.70 (CI: 0.68-0.72), 0.73 (CI: 0.71-0.75), 0.64 (CI: 0.61-0.67), and 0.75 (CI: 0.73-0.77).

Overall, in the 525 employees who completed the baseline and post-program HRA, each intention at baseline and its behavioral improvement post-intervention were dependent except for the intention to improve eating habits (Table 4). When stratified by option, in *High*, each intention and its behavioral improvement were dependent (Table 5), except for the intention to improve eating habits. In *Light*, each behavioral improvement was dependent on its intention (all $P \leq 0.05$; Table 5), except for PA and eating habits. In *Moderate*, only intention to stop smoking and its habit were dependent ($P = 0.01$; Table 5). In *Control*, intention and behavioral improvement were dependent for stress management and eating habits (both $P \leq 0.05$; Table 5).

DISCUSSION

The current study aimed to complement the scientific literature by firstly studying employees' intentions to improve various lifestyle habits when starting a WHPP and examining the factors that predicted each intention at baseline. Secondly, it aimed to investigate the association between baseline intention and behavioral improvement following the program for each habit and exploring which option led to the largest number of intentions to behavioral conversions. Most employees intended to increase their PA or improve their eating habits. At least four predictors were identified for each intention. Overall, most intentions, except intention to improve eating habits, translated into improvement in their respective habit, and *High* appears to be the most beneficial in doing so, followed by *Light*. Employees have various combinations of intentions regarding their lifestyle habits. In the context of WHPPs, documenting employees' intention to improve at the start of the program and targeting those individuals with positive intentions may be beneficial at improving the effectiveness of these programs.

In a nationally representative sample US workers were mostly interested in on-site fitness center (80.6%) as a health promotion service and healthy food options in vending machines and cafeterias as a policy (77.5%).[36] However, the participants' intentions to improve these habits were not documented. These are important given their positive association with behavior.[16,17] Nevertheless, the current study found that most employees intended to increase their PA at the start of the WHPP. Employees who did not satisfy PA recommendations were four times more likely to have the intention to improve their PA level. Therefore, WHPP practitioners can identify employees who do not follow PA recommendations as they may be more likely to have the initial intention to improve this behavior. In addition, a larger proportion of those who improved PA following the *Activate Your Health* program intended on improving this habit at baseline, especially in *High*. Meta-analyses have reported a weak relationship between intention and PA and have tried to quantify the gap between intention and PA improvement.[37,38] However, in the current WHPP, intention was associated to an actual improvement. This suggests that documenting employees' initial intention to improve PA may lead to positive results in the context of WHPPs. Therefore, employees with positive intentions can be screened and targeted to improve the effectiveness of WHPPs. Moreover, to increase the chances of converting initial intention into behavioral improvement, WHPP practitioners could use technics such as implementation intentions[21,39] or even distribute self-help material, which have been shown to be beneficial. An one-shot workplace intervention offering self-help exercise booklets matched to individuals' stage of motivational readiness was shown to be as effective as a booklet derived from social-cognitive theory not stage-matched at moving employees to higher motivational readiness for regular PA one month later.[40] In addition, an improvement in regular PA participation was observed following the intervention.

In the current study, employees had different number of positive intentions and varying combination of lifestyle habits that they intended on improving. This is in agreement with another study that showed that healthcare workers taking part in a WHPP were at different levels of readiness to change their lifestyle habits.[41] Intentions seem to vary from one individual to another, WHPPs could be more flexible and adapt their interventions to each participant's current needs.[41] Interestingly, our results indicated that participants who were at high risk due to poor lifestyle habits had the intention to improve that specific habit (except for smoking). This is a positive finding since this sub-group of employees are the ones to benefit the most of such programs and they were more likely to have a positive intention. It may be thought that individuals who do not adhere to a certain lifestyle habit recommendation will automatically be more likely to have the intention to improve that habit. However, individuals may not be aware that they do not comply with a certain recommendation. For example, among individuals who do not meet the recommended vegetable consumption, 88% thought that they met the guidelines.[42] This was also seen in those for fruit consumption; individuals (65%) who did not eat enough fruit indicated that they had enough intake.[42] Moreover, it is not certain that someone who does not respect a certain lifestyle habit and who is aware of it will necessarily have the intention to improve that habit. For example, an individual who smokes daily may not have the intention to stop smoking or those who have high alcohol consumption to forget about their problems may not necessarily have the intention to focus on this habit in the next six months. Therefore, in the context of WHPPs, employees not complying with healthy lifestyle habits could be targeted as they seem to have positive intentions. Two common barriers reported by employees who were offered a WHPP targeting eating habits were a lack of interest in the topic presented and the program itself.[43] Understanding the lifestyle habits that participants intend to improve will allow health professionals to provide better support.[41]

Moreover, most intentions and their behavioral improvement were dependent after participating in the current program. Perceived behavioral control can influence intention and behavior.[16,26] By implementing the *Activate Your Health* program employees may have felt a greater perceived behavioral control thereby leading to behavioral improvement. It is also possible that the program changed other variables such as attitude and subjective norm, which can predict intention.[16] In blue-collar workers perceived behavioral control and attitude explained intention to exercise, and intention and perceived behavioral control explained the variance of exercise behavior.[44] However, this was not after offering a WHPP. Therefore, future studies should document these measures following the implementation of a similar program as *Activate Your Health* and regarding different lifestyle habits to get a better understanding in the context of WHPPs. Nevertheless, developing interventions targeting intentions could be potential solution to increase behavioral improvement in these programs.

Initial intention to improve eating habits was not associated with a behavioral improvement following the program even in *High* and *Moderate*, which contained the largest number of interventions. A meta-analysis reported that encouraging individuals to pursue a moderate number of recommendations (2-3 behaviors) may lead to the greatest improvement in behavior.[45] Following multiple goals at the same time can decrease the chances of adopting a habit.[46] The current WHPP targeted six lifestyle habits and 80% of employees intended to improve more than two lifestyle habits without counting other behaviors that they might have intended to improve. It is possible that throughout the program, employees who initially had the intention to improve eating habits decided to not purse this habit. In health promotion clinics, intention reported 6-month after the program predicted healthy eating behavior six years later.[22] Also, as intention stability increased, intention became a stronger predictor of this behavior.[22] Eating habits may require more cognitive effort to convert intention to improvement. More information is necessary to properly interpret this result in the context of WHPPs.

Certain characteristics stood out across many lifestyle habits: sex and age. A meta-analysis confirmed that, compared to men, women have greater participation in WHPPs.[47] Our results supplement these data by showing that women were more likely to have the intention to increase their PA, improve their eating habits, and better manage their stress compared to men when they started the program. This may explain why men participate less in WHPPs: they are already less likely to have the intention to improve those habits when they start the program. In WHPP offered to men, most of them were at least moderately interested in screening and early detection of cancer than healthy lifestyle habits.[48] It has been previously suggested that men engage less in health promotion as this may be against masculine ideas and health promoting practices are not man-like.[49,50] This may explain as to why men were less likely to have the intention to improve those habits compared to women. Interestingly, compared to men at a lower stage of change, those in a higher stage were more likely to be interested in PA and healthy eating health promotion topics.[48] Therefore, WHPP practitioners can identify this sub-group and provide appropriate support to improve their intentions toward healthy lifestyle habits in order to improve the effectiveness of their program. Moreover, the current findings indicate that older employees were less likely to have the intention to improve PA, eating habits, sleep habits, and stress management. A cross-sectional study reported that compared to inactive young adults (25%), a larger proportion of inactive older adults (60%) did not intend to engage in regular PA in the next six months.[51] Similarly, a case study reported that younger employees were more interested in exercising and improving stress management compared to older employees.[52] Individuals with prediabetes were offered to enroll in a lifestyle habit modification program; those ≥60 years old had lesser intention to increase PA level and to eat heathier than individuals <60 years old.[53] Thus, older individuals seem to be less likely than younger ones to initiate changes in their lifestyle habits. This may be because the older an individual get, the more they are accustomed to their unhealthy lifestyle habits thereby being less willing to change their behaviors.[53] Consequently, an individualized consultation to determine the specific mind-set and needs of these subgroups may represent a better approach to boost effectiveness.[48]

In the current study, participants with higher BMI were more likely to have the intention to increase PA, improve eating habits, and reduce alcohol consumption. According to a meta-analysis, a medium-to-large intention change produces a small-to-medium behavior change.[26] Moreover, a well-designed WHPP combining PA sessions and nutritional counseling can reduce body weight and change eating habits in employees with overweight/obesity to an even greater extent than in workers with a healthy body weight.[54] Participants with overweight or obesity showed a greater increase in stair climbing at work than employees with normal weight status following a WHPP promoting this behavior.[55] These results suggest that participants with overweight or obesity may already be willing to improve these habits when starting WHPPs, which may translate into improved outcomes with the proper guidance. In the context of a WHPPs, relative weight was associated with the intention to change it.[19] Individuals with higher BMI may be more concerned about their weight status thereby having the intention to improve it via the adoption of healthy lifestyle habits, which may explain why they were more likely to have those positive intentions.

In the current study, perceived general health had an important role in the intention to improve multiple lifestyle habits. Participants with a perceived general health below excellent were more likely to increase their PA, improve their eating habits, and better manage their stress. In addition, the ORs showed a gradient effect. For example, compared to employees who reported having excellent perceived general health, those with poor/fair perceived general health were 4.57 times more likely to have the intention to increase their PA. In contrast, employees who had good/very good perceived general health were only 2.89 times more likely to have this intention compared to those with an excellent perceived general health. Poor perceived health status was reported to be associated with intention to participate in a WHPP.[3] Individuals with less than excellent perception of general health may feel that they are more susceptible to health consequences thereby holding a positive attitude toward healthy lifestyle habits, which led to this increased odds of having the intention to improve different lifestyle habits. Therefore, employees with lower perception of general health could be identified at the start of the program because they seem to hold positive intentions, which could be translated to behavior with proper guidance and improve the effectiveness of WHPPs.

Occupational stress is a main preoccupation at work.[56] In the context of WHPPs, and more precisely in a health risk appraisal, a high stress level was associated with a higher score for intention to change behavior.[57] However, in general, stress was reported to be an impediment to successful changes in PA, overeating, tobacco use, and alcohol consumption.[57,58] Along these lines, in the context of the current WHPP study, perceived stress level at work was not associated with the intention to improve PA, eating habits, or consumption of tobacco or alcohol. Nevertheless, participants who had a higher perceived stress level at work and those who had lower perceived stress management were more likely to have the intention to improve their stress management. This is a positive finding as those who needed the most intended to improve stress management. Moreover, intention to improve stress management was associated with stress management improvement following the current WHPP even in the control group. Work-related stress has been previously reported to predict intent to change it.[19] There seems to be a lack of studies on the association between intention and improvement regarding stress management in employees. Taking these results together, WHPP practitioners could screen employees with high levels of stress at work and poor stress management at the start of the program as they may be intending to improve their stress management. Then, providing appropriate interventions to this group may lead to behavioral improvement thereby improving the effectiveness of WHPPs in addition to employees' mental health. Also, participants with a higher stress level rating at work and those with average-to-good perceived stress management were more likely to have the intention to improve their sleep habits, suggesting a specific combination of lifestyle habits to target for this sub-group. In white-collar workers, occupational stress was associated with poor sleep quality.[59] Independently of working hours and lifestyle habits, job stressors were associated with sleep disorders among middle-aged male employees.[60] Employees with stress-related problems were maybe aware that it had negative consequences on their sleep habits and consequently intended to improve this habit. Employees may benefit from educational sessions presenting strategies for improving stress management such as doing PA or interventions including cognitive behavioral therapy.[1,61]

In the current study, less than half of the employees intended to improve their sleep habits. However, a large proportion of those who improved this habit at post-intervention intended to improve sleep habits at baseline. In students (mean age of 20.3 years old), perceived behavioral control, subjective norm, and attitude towards sleep habits were strong predictors of intention to obtain adequate sleep in the next 24h.[62] It is possible that in the current study, one of these factors may have been positively affected which in turn led to a positive intention and behavioral change. Future studies should explore attitudes, perceived behavioral control, and intention of employees in the context of WHPPs to effectively focus intervention efforts aiming at this habit. Regarding tobacco use, among smokers, none of the predictors were associated with the intention to stop smoking in the univariate and multivariate analyses. A Canadian study reported that 14% of men were smokers.[48] In the current study, a similar percentage of employees were smokers (13%), and 69% of these intended to stop smoking. Only a small number of employees consider seeking help from their workplace regarding smoking and excess alcohol consumption.[63] Interestingly, in the current study, a larger proportion of those who intended to stop smoking at baseline quitted smoking at post-intervention. When stratified by option, this association was significant in the intervention groups only (*High*, *Moderate* and *Light*). This is a positive finding because offering the *Activate Your Health* program was enough to lead to smoking cessation. It is possible that simply implementing such program motivated employees who were on the verge of quitting to do so. In health promotion clinics, perceived behavioral control and perceived susceptibility were predictors of intention to quit smoking.[23] Thus, in the current study, offering a program may have created awareness and gave a sense of behavioral control to employees which translated into a positive intention and consequently to an improvement. Moreover, a WHPP targeting smoking cessation reported that there was a positive association between social support from colleagues and quitting successfully at 12 months.[64] Workplace seems to be a good setting for promoting smoking cessation. Employers who want to increase efforts to reduce tobacco consumption may implement a WHPP which specifically targets employees intending to improve smoking habits in the next six months. Regarding alcohol consumption, intention to improve this habit and improvement in alcohol consumption were not independent after participating in the program. Blue-collar men who often drank alcohol were more interested in WHPPs focusing on improving this habit.[48] Employees may be more open to seek help regarding drinking and smoking habits, and employees may benefit if they intend to improve these habits as they enroll in a WHPP. Before offering interventions regarding sleep habits, tabaco use and alcohol consumption, program practitioners may want to identify employees with positive intentions as this may save time and effort in the context of WHPPs especially for this habit as a large proportion do not initially intend to improve this habit.

One of the strengths of the current study is its large sample size comprising employees in various occupations and workplaces (banks, marketing firms, graveyard administration, etc.) as well as a broad age range (18-70 years). Our primary results may be generalizable to most Canadian workplaces, to a certain extent. Another advantage of the study is its documentation of intentions regarding many lifestyle habits in an effort to understand the participants' overall mind-set, which was rarely conducted in previous studies on WHPPs.[41,65] Finally, another strength is examining the proportional changes between intention to improve and improvement following the program by habit and by option. One of the limitations of the present study is the self-reported data, which might carry a social desirability bias.[66] Also, while our sample represents active workers, specific predictors related to socioeconomic status should be considered in future studies as these data were not gathered in the current program. Moreover, some of the 95% CIs were quite large (Table 3), thereby decreasing the precision of the ORs.[67] This was probably due to the small number of participants in that specific category. These must be interpreted with caution. Also, a small number of individuals (n=8) were classified to be at high risk due to eating habits because of the provided choices of answers to the questions regarding daily fruit and vegetable consumption. However, analyses excluding these participants revealed no changes to the initial conclusions. When employees were stratified per option, the sample size was reduced, which may have reduced the power of our analyses especially in *Moderate* and in *Control*.

CONCLUSION

In summary, the employees showed a range of different intentions regarding the lifestyle habits. Most employees intended to focus on PA and eating habits. Many health-related and lifestyle factors influenced the intention to improve each lifestyle habit. Men, older workers, and those not complying with a certain lifestyle recommendation are some of the sub-groups that could be identified at the start of the program. Most intentions at baseline were associated with improvement following the program regarding most lifestyle habits including PA and stress management, especially in *High*. Intention to improve eating habits was not associated with an improvement following the program suggesting that other variables may be more associated with this habit. This study supports the need to examine employee intentions to improve various lifestyle habits before the start of the program. WHPP practitioners may focus on employees who have an initial intention to improve lifestyle habits, which would allow the organizers to identify sub-groups of interest that seem to lead to positive behavioral changes. Moreover, screening by intention at the start may ensure to properly allocate the time, effort, and resources in the context of WHPPs translating into a better effectiveness of such programs.

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CONFLICTS OF INTEREST:

All the authors (TAK, FL, SL, JT, MEM) declare a potential conflict of interest as the program is co-financed by the Public Health Agency of Canada and Capsana. However, none of the authors work for the Public Health Agency of Canada or Capsana.

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ETHICAL APPROVAL OF STUDIES/INFORMED CONSENT:

Employees completed an online consent form (written). This study was approved by the Health Research Ethics Committee of Université de Montréal [16-063-CERES-D(1)] and registered on Clinicaltrials.gov on October 16, 2016 (NCT02933385).

List of Supplemental Digital Content:

Supplemental Digital Content 1.doc

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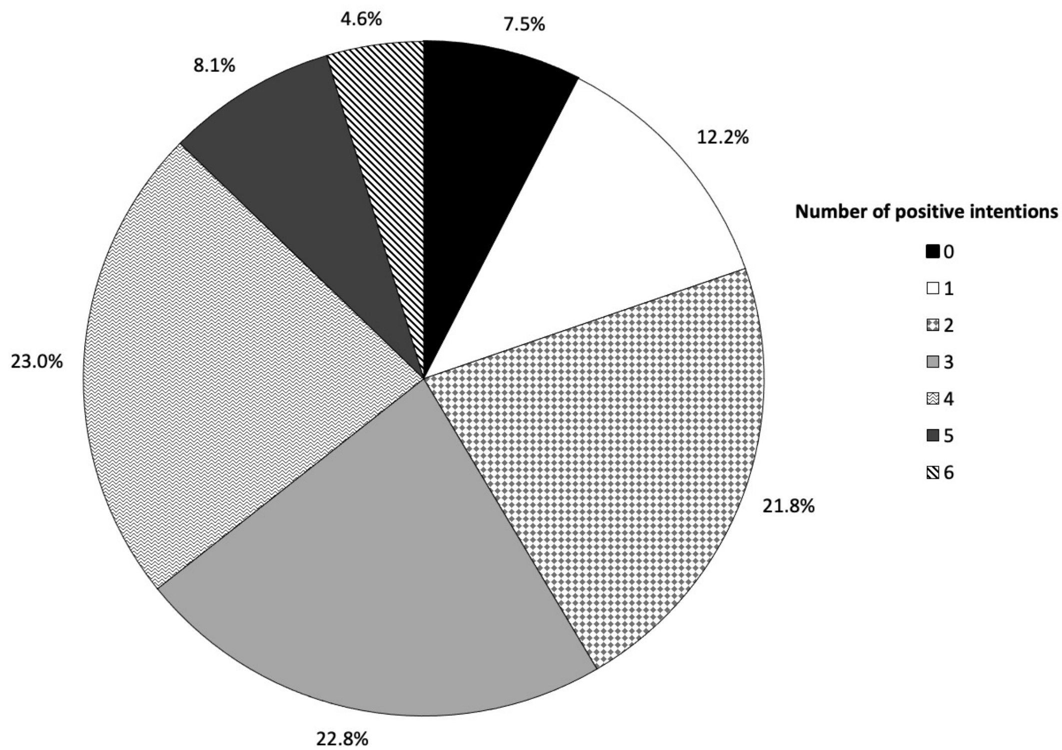

Fig.1. Number of habits that employees intended to improve in the following six months at baseline, expressed as relative frequency percentages (n=2729)

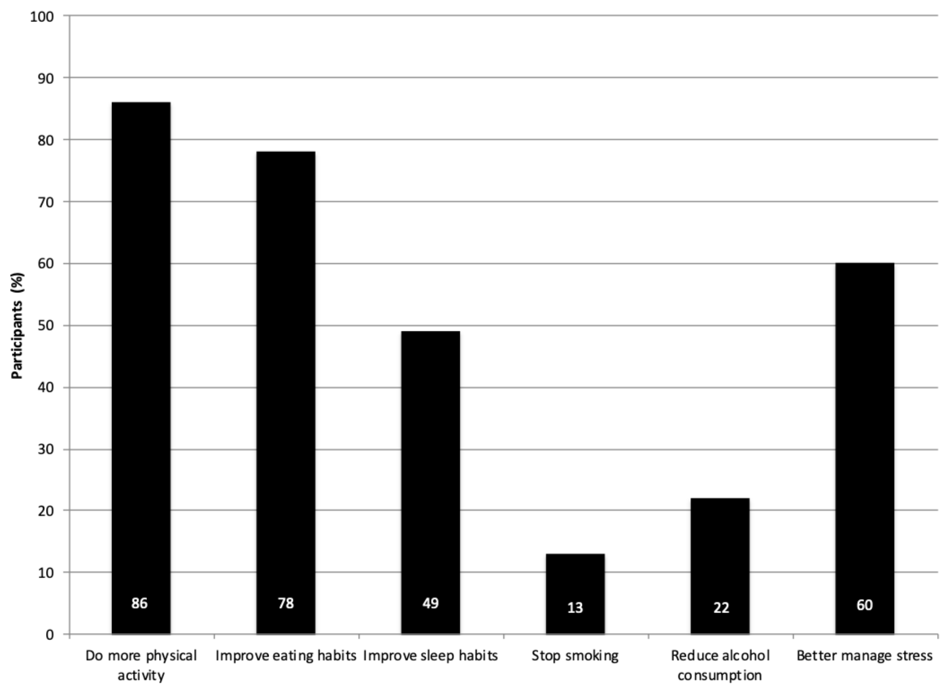

Fig.2. Percentage of employees who intended to improve each lifestyle habit in the following six months at baseline (n=2524)

Table 1. Descriptive data of the study population at baseline (n = 2729)

Variables	Mean (standard deviation) or n (%)
Age (years)	41.1 (10.4)
Sex	
Female	1724 (63.2)
Body mass index (kg/m^2)	26.4 (6.1)
Number of current health problems	1.0 (1.3)
At high risk due to poor lifestyle habits	
Physical activity	1674 (61.3)
Eating habits	2350 (86.1)
Sleep	794 (29.1)
Smoking	353 (12.9)
Alcohol	156 (5.7)
Perceived general health	
Excellent	334 (12.2)
Good/Very good	2090 (76.6)
Poor/Fair	305 (11.2)
Perceived stress at work	
Very low	93 (3.4)
Low/Moderate	1884 (69.0)
High/Very high	752 (27.6)
Perceived stress management	
Very good	420 (15.4)
Average/Good	2114 (77.5)
Very poor/Poor	195 (7.1)

Table 2. Most common combinations of lifestyle habits according to number of positive intentions (n=2524)

Intention to improve	**Number of positive intentions**					
	1 (n=333)	**2** (n=595)	**3** (n=622)	**4** (n=629)	**5** (n=220)	**6** (n=125)
Physical activity	X	X	X	X	X	X
Eating habits		X	X	X	X	X
Stress management			X	X	X	X
Sleep habits				X	X	X
Alcohol consumption					X	X
Smoking (quit)						X
Participants with this combination (%)	48	61	46	74	70	100

Table 3. Odds ratio for each significant predictor and intention to improve (n=2729)

Characteristics	**OR_{BI} (95% CI)**	**OR_{MULTI} (95% CI)**
INTENTION TO INCREASE PA		
Age	0.99 (0.98-0.99)	0.98 (0.97-0.99)
Sex	1.91 (1.58-2.30)	2.25 (1.81- 2.79)
BMI	1.09 (1.06-1.11)	1.08 (1.05-1.11)
# of current health problems	1.26 (1.16-1.37)	
Risk-PA	4.44 (3.64-5.41)	3.58 (2.90-4.42)
Risk-eating habits	1.86 (1.46-2.37)	1.42 (1.08-1.87)
Risk-sleep	1.69 (1.35-2.12)	
Risk-smoking	1.77 (1.28-2.44)	
Perceived general health		
Excellent	Reference	
Good/Very good	4.42 (3.47-5.63)	2.89 (2.22-3.76)
Poor/Fair	12.89 (7.88-21.09)	4.57 (2.68-7.77)
Perceived stress management		
Very good	Reference	
Very poor/Poor	2.06 (1.29-3.29)	
INTENTION TO IMPROVE EATING HABITS		
Age[1]	0.76 (0.64-0.90)	0.67 (0.56-0.80)
Sex	1.36 (1.15-1.62)	1.86 (1.53-2.24)
BMI[1]	2.53 (2.13-3.01)	2.47 (2.04-2.99)
# of current health problems	1.14 (1.06-1.22)	
Risk-PA	1.50 (1.26-1.77)	
Risk-eating habits	2.30 (1.84-2.88)	2.08 (1.64-2.65)
Risk-sleep	1.49 (1.23-1.81)	
Risk-smoking	1.56 (1.19-2.05)	
Risk-alcohol	0.65 (0.47-0.92)	0.63 (0.44-0.90)
Perceived general health		
Excellent	Reference	
Good/Very good	2.70 (2.13-3.42)	2.04 (1.59-2.61)
Poor/Fair	7.88 (5.20-11.94)	4.42 (2.86-6.83)
Perceived stress management		
Very good	Reference	
Average/Good	1.35 (1.08-1.69)	
Very poor/Poor	1.49 (1.02-2.18)	
INTENTION TO IMPROVE SLEEP HABITS		
Age	0.98 (0.97-0.99)	0.97 (0.97-0.98)
Sex	1.25 (1.06-1.46)	
# of current health problems	1.24 (1.16-1.31)	
Risk-sleep	6.32 (5.24-7.62)	6.27 (5.16-7.61)
Perceived general health		
Excellent	Reference	
Good/Very good	1.61 (1.26-2.05)	
Poor/Fair	2.56 (1.86-3.53)	
Perceived stress at work		
Very low	Reference	

Very low	Reference	
Low/Moderate	2.09 (1.30-3.36)	
High/Very high	3.45 (2.12-5.60)	2.01 (1.19-3.40)
Perceived stress management		
Very good	Reference	
Average/Good	1.79 (1.44-2.23)	1.55 (1.22-1.98)
Very poor/Poor	2.29 (1.62-3.24)	
INTENTION TO REDUCE ALCOHOL CONSUMPTION†		
BMI	1.02 (1.01-1.04)	1.02 (1.01-1.04)
# of current health problems	1.16 (1.07-1.26)	1.12 (1.03-1.21)
Risk-PA		0.77 (0.62-0.96)
Risk-sleep	1.42 (1.14-1.79)	
Risk-smoking	1.90 (1.43-2.51)	1.76 (1.31-2.36)
Risk-alcohol	5.22 (3.72-7.33)	5.04 (3.58-7.11)
Perceived general health		
Excellent	Reference	
Good/Very good	1.41 (1.01-1.97)	
Poor/Fair	2.10 (1.35-3.27)	
INTENTION TO IMPROVE STRESS MANAGEMENT		
Age	0.98 (0.98-0.99)	0.97 (0.97-0.98)
Sex	1.74 (1.49-2.04)	1.63 (1.37-1.95)
# of current health problems	1.28 (1.21-1.37)	1.09 (1.01-1.17)
Risk-PA	1.28 (1.10-1.50)	
Risk-sleep	2.99 (2.49-3.58)	2.05 (1.66-2.53)
Risk-smoking	1.41 (1.12-1.77)	
Perceived general health		
Excellent	Reference	
Good/Very good	1.97 (1.55-2.49)	1.36 (1.05-1.77)
Poor/Fair	4.13 (2.96-5.77)	2.06 (1.41-3.00)
Perceived stress at work		
Very low	Reference	
Low/Moderate	5.94 (3.28-10.74)	4.18 (2.23-7.83)
High/Very high	19.99 (10.86-36.79)	13.34 (6.99-25.45)
Perceived stress management		
Very good	Reference	
Average/Good	3.47 (2.76-4.36)	2.88 (2.24-3.71)
Very poor/Poor	10.21 (6.76-15.42)	6.16 (3.95-9.62)

BMI: Body mass index; CI: Confidence interval; OR_{BI}: Odds ratio of binary logistic regression analyses; OR_{MULTI}: Odds ratio for multivariate logistic regression analyses; PA: physical activity. [1]: Categorical variable; reference categories for age and BMI were <40 years old and <25 kg/m^2, respectively. †: Only employees who drank ≥1 alcohol consumption/week were considered in this analysis; n=1907. The reference categories in logistic regression analyses for sex and risk profile were being a man and not being at risk, respectively.

Table 4. Chi-Square analyses between each habit's intention to improve and its behavioral improvement after the program (n=525)

Intention to improve		**Improvement** No (%)	Yes (%)	**P-value**	**Effect size**
Physical activity	No	93.0	7.0	**0.003**	0.129
	Yes	82.8	17.2		
Eating habits	No	90.8	9.2	0.317	0.044
	Yes	93.2	6.8		
Sleep habits	No	95.5	4.5	**<0.001**	0.158
	Yes	86.6	13.4		
Smoking (quit)	No	99.2	0.8	**<0.001**	0.444
	Yes	70.7	29.3		
Alcohol consumption	No	98.9	1.1	**<0.001**	0.218
	Yes	89.3	10.7		
Stress management	No	87.8	12.2	**0.001**	0.144
	Yes	76.8	23.2		

The results are reported as row %. The effect size (Cramer's V) of each variable is also provided. Statistically significant results are in boldface (P-value ≤0.05).

Table 5. Chi-Square analyses between each habit's intention to improve and its behavioral improvement after the program per option

Intention to improve		Improvement No (%)	Improvement Yes (%)	P-value	Effect size
CONTROL (n=18)					
Physical activity	No	87.5	12.5	0.375	0.209
	Yes	70.0	30.0		
Eating habits	No	100.0	0.0	**0.034**	0.500
	Yes	66.7	33.3		
Sleep habits	No	100.0	0.0	-	-
	Yes	100.0	0.0		
Smoking (quit)	No	100.0	0.0	-	-
	Yes	100.0	0.0		
Alcohol consumption	No	100.0	0.0	-	-
	Yes	100.0	0.0		
Stress management	No	91.7	8.3	**0.045**	0.472
	Yes	50.0	50.0		
LIGHT (n=163)					
Physical activity	No	100.0	0.0	0.053	0.152
	Yes	85.7	14.3		
Eating habits	No	90.0	10.0	0.432	0.062
	Yes	94.0	6.0		
Sleep habits	No	95.2	4.8	**0.010**	0.202
	Yes	83.1	16.9		
Smoking (quit)	No	98.6	1.4	**<0.001**	0.456
	Yes	66.7	33.3		
Alcohol consumption	No	99.3	0.7	**<0.001**	0.361
	Yes	80.0	20.0		
Stress management	No	86.8	13.2	**0.035**	0.165
	Yes	73.6	26.4		
MODERATE (n=31)					
Physical activity	No	100.0	0.0	0.187	0.237
	Yes	73.1	26.9		
Eating habits	No	100.0	0.0	0.618	0.089
	Yes	96.0	4.0		
Sleep habits	No	100.0	0.0	0.112	0.285
	Yes	80.0	20.0		
Smoking (quit)	No	96.6	3.4	**0.010**	0.466
	Yes	50.0	50.0		
Alcohol consumption	No	95.0	5.0	0.235	0.213
	Yes	81.8	18.2		
Stress management	No	85.7	14.3	0.639	0.084
	Yes	91.7	8.3		

HIGH (n=312)					
Physical activity	No	91.5	8.5	**0.032**	0.121
	Yes	82.5	17.5		
Eating habits	No	89.8	10.2	0.286	0.060
	Yes	93.1	6.9		
Sleep habits	No	95.0	5.0	**0.037**	0.118
	Yes	88.6	11.4		
Smoking (quit)	No	99.7	0.3	**<0.001**	0.478
	Yes	71.4	28.6		
Alcohol consumption	No	98.8	1.2	**0.030**	0.123
	Yes	94.3	5.7		
Stress management	No	88.0	12.0	**0.017**	0.135
	Yes	77.9	22.1		

The results are reported as row %. One participant was removed from these analyses due to unknown option allocation. The effect size (Cramer's V) of each variable is also provided. Statistically significant results are in boldface (P-value ≤0.05).

Supplemental Digital Content 1.Table

Annex 1: Details regarding Table 3

Odds ratio for each predictor and intention to improve (n=2729)

Characteristics	OR_{BI} (95% CI)	OR_{MULTI} (95% CI)
INTENTION TO INCREASE PA		
Age	0.99 (0.98-0.99)*	0.98 (0.97-0.99)*
Sex	1.91 (1.58-2.30)*	2.25 (1.81- 2.79)*
BMI	1.09 (1.06-1.11)*	1.08 (1.05-1.11)*
# of current health problems	1.26 (1.16-1.37)*	
Risk-PA	4.44 (3.64-5.41)*	3.58 (2.90-4.42)*
Risk-eating habits	1.86 (1.46-2.37)*	1.42 (1.08-1.87)*
Risk-sleep	1.69 (1.35-2.12)*	
Risk-smoking	1.77 (1.28-2.44)*	
Risk-alcohol	0.75 (0.52-1.10)	
Perceived general health		
Excellent	Reference	
Good/Very good	4.42 (3.47-5.63)*	2.89 (2.22-3.76)*
Poor/Fair	12.89 (7.88-21.09)*	4.57 (2.68-7.77)*
Perceived stress at work		
Very low	Reference	
Low/Moderate	1.21 (0.75-1.97)	
High/Very high	1.57 (0.95-2.61)	
Perceived stress management		
Very good	Reference	
Average/Good	1.25 (0.97-1.60)	
Very poor/Poor	2.06 (1.29-3.29)*	
INTENTION TO IMPROVE EATING HABITS		
Age[1]	0.76 (0.64-0.90)*	0.67 (0.56-0.80)*
Sex	1.36 (1.15-1.62)*	1.86 (1.53-2.24)*
BMI[1]	2.53 (2.13-3.01)*	2.47 (2.04-2.99)*
# of current health problems	1.14 (1.06-1.22)*	
Risk-PA	1.50 (1.26-1.77)*	
Risk-eating habits	2.30 (1.84-2.88)*	2.08 (1.64-2.65)*
Risk-sleep	1.49 (1.23-1.81)*	
Risk-smoking	1.56 (1.19-2.05)*	
Risk-alcohol	0.65 (0.47-0.92)*	0.63 (0.44-0.90)*
Perceived general health		
Excellent	Reference	
Good/Very good	2.70 (2.13-3.42)*	2.04 (1.59-2.61)*
Poor/Fair	7.88 (5.20-11.94)*	4.42 (2.86-6.83)*
Perceived stress at work		
Very low	Reference	
Low/Moderate	0.92 (0.58-1.47)	
High/Very high	1.03 (0.63-1.67)	
Perceived stress management		
Very good	Reference	
Average/Good	1.35 (1.08-1.69)*	
Very poor/Poor	1.49 (1.02-2.18)*	

INTENTION TO IMPROVE SLEEP HABITS		
Age	0.98 (0.97-0.99)*	0.97 (0.97-0.98)*
Sex	1.25 (1.06-1.46)*	
BMI	1.00 (0.99-1.01)	
# of current health problems	1.24 (1.16-1.31)*	
Risk-PA	1.08 (0.93-1.26)	
Risk-eating habits	0.95 (0.76-1.18)	
Risk-sleep	6.32 (5.24-7.62)*	6.27 (5.16-7.61)*
Risk-smoking	1.24 (0.99-1.55)	
Risk-alcohol	0.94 (0.68-1.30)	
Perceived general health		
Excellent	Reference	
Good/Very good	1.61 (1.26-2.05)*	
Poor/Fair	2.56 (1.86-3.53)*	
Perceived stress at work		
Very low	Reference	
Low/Moderate	2.09 (1.30-3.36)*	1.54 (0.92-2.56)
High/Very high	3.45 (2.12-5.60)*	2.01 (1.19-3.40)*
Perceived stress management		
Very good	Reference	
Average/Good	1.79 (1.44-2.23)*	1.55 (1.22-1.98)*
Very poor/Poor	2.29 (1.62-3.24)*	1.29 (0.87-1.90)
INTENTION TO STOP SMOKING[a]		
Age	1.01 (0.99-1.03)	
Sex	1.17 (0.73-1.86)	
BMI	0.97 (0.94-1.01)	
# of current health problems	1.02 (0.89-1.16)	
Risk-PA	0.81 (0.49-1.33)	
Risk-eating habits	0.93 (0.41-2.10)	
Risk-sleep	0.94 (0.59-1.51)	
Risk-smoking	-	
Risk-alcohol	0.86 (0.40-1.86)	
Perceived general health		
Excellent	Reference	
Good/Very good	0.80 (0.31-2.12)	
Poor/Fair	0.63 (0.23-1.78)	
Perceived stress at work		
Very low	Reference	
Low/Moderate	1.95 (0.58-6.59)	
High/Very high	1.67 (0.48-5.84)	
Perceived stress management		
Very good	Reference	
Average/Good	0.94 (0.49-1.80)	
Very poor/Poor	0.81 (0.30-2.22)	

INTENTION TO REDUCE ALCOHOL CONSUMPTION[b]		
Age	1.00 (0.99-1.01)	
Sex	1.05 (0.85-1.30)	
BMI	1.02 (1.01-1.04)*	1.02 (1.01-1.04)*
# of current health problems	1.16 (1.07-1.26)*	1.12 (1.03-1.21)*
Risk-PA	0.84 (0.68-1.03)	0.77 (0.62-0.96)*
Risk-eating habits	1.00 (0.75-1.34)	
Risk-sleep	1.42 (1.14-1.79)*	
Risk-smoking	1.90 (1.43-2.51)*	1.76 (1.31-2.36)*
Risk-alcohol	5.22 (3.72-7.33)*	5.04 (3.58-7.11)*
Perceived general health		
Excellent	Reference	
Good/Very good	1.41 (1.01-1.97)*	
Poor/Fair	2.10 (1.35-3.27)*	
Perceived stress at work		
Very low	Reference	
Low/Moderate	0.72 (0.40-1.29)	
High/Very high	0.81 (0.44-1.49)	
Perceived stress management		
Very good	Reference	
Average/Good	1.11 (0.83-1.48)	
Very poor/Poor	1.22 (0.75-1.98)	
INTENTION TO IMPROVE STRESS MANAGEMENT		
Age	0.98 (0.98-0.99)*	0.97 (0.97-0.98)*
Sex	1.74 (1.49-2.04)*	1.63 (1.37-1.95)*
BMI	1.01 (1.00-1.03)	
# of current health problems	1.28 (1.21-1.37)*	1.09 (1.01-1.17)*
Risk-PA	1.28 (1.10-1.50)*	
Risk-eating habits	1.24 (0.99-1.54)	
Risk-sleep	2.99 (2.49-3.58)*	2.05 (1.66-2.53)*
Risk-smoking	1.41 (1.12-1.77)*	
Risk-alcohol	0.84 (0.61-1.16)	
Perceived general health		
Excellent	Reference	
Good/Very good	1.97 (1.55-2.49)*	1.36 (1.05-1.77)*
Poor/Fair	4.13 (2.96-5.77)*	2.06 (1.41-3.00)*
Perceived stress at work		
Very low	Reference	
Low/Moderate	5.94 (3.28-10.74)*	4.18 (2.23-7.83)*
High/Very high	19.99 (10.86-36.79)*	13.34 (6.99-25.45)*
Perceived stress management		
Very good	Reference	
Average/Good	3.47 (2.76-4.36)*	2.88 (2.24-3.71)*
Very poor/Poor	10.21 (6.76-15.42)*	6.16 (3.95-9.62)*

BMI: Body mass index; CI: Confidence interval; OR_{BI}: Odds ratio of binary logistic regression analyses; OR_{MULTI}: Odds ratio for multivariate logistic regression analyses; PA: physical activity. [1:] Categorical variable; reference categories for age and BMI were <40 years old and <25 kg/m^2. [a]: Results for employees who reported smoking; n = 353. [b]: Only employees who drank ≥1 alcohol consumption/week were considered in this analysis; n=1907. The reference categories in logistic regression analyses for sex and risk profile were being a man and not being at risk, respectively. *Statistically significant (*P*-value ≤0.05).

Chapter 5 – Article 4

Improvement Predictors in a Workplace Program Promoting Healthy Lifestyle Habits

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<u>Introductory statement:</u> This chapter begins with some details that were requested by the journal such as key words and word count. This is followed by the standard sections of an article: abstract, background, methods, results, discussion and conclusion. Then, the declaration sections are presented followed by references. Figure 1 and Tables 1 to 4 are presented. Finally, the supplementary document can be found. We explored in the most extensive options.

A brief running head: Improvement Predictors Post-Workplace Program

Manuscript type: Original Research

Three to five key words: Mental health, Health promotion, Health behavior

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ABSTRACT

Background: The baseline characteristics of employees to predict improvements in healthy lifestyle habits (LHs) following workplace health promotion programs are underexplored. This study sought to identify predictors of improvements in physical activity (PA), eating habits, sleep habits, and stress management, and health risk factors resulting from healthy LHs. **Methods:** The *Activate Your Health* program included three packages of increasing number of interventions: *Light*, *Moderate*, and *High*. Participating employees (n=506) completed baseline and post-intervention questionnaires that collected sociodemographic data, health- and lifestyle habit-related variables, stress-related variables, and perceptions of general health and life satisfaction. Only those with the potential to improve were included in each improvement outcome analyses. **Results:** Being in *High* and intending to reduce alcohol consumption increased the odds of improving PA. Very good/excellent perceived general health, poor sleep habits, high alcohol consumption, and intending to improve stress management increased the odds of improving stress levels at work. Depression and intending to improve sleep habits increased the odds of improving stress management. Reporting feelings of pleasure increased the odds of improving body mass index. **Conclusions:** Baseline characteristics predicting improvements differed for each LH. A targeted approach may be needed to help employees improve LHs and related outcomes.

BACKGROUND

Worldwide, chronic conditions such as cardiovascular disease, stroke, diabetes, and many types of cancer account for nearly 71% of all deaths annually.[1] Most chronic conditions can be prevented by targeting modifiable risk factors, including lifestyle habits such as physical activity (PA), healthy eating, and tobacco consumption.[2,3] Adherence to healthy lifestyle habit recommendations is a challenge in Canada, where only 16% of adults meet the national recommendation of 150 minutes of moderate-to-vigorous PA in bouts of 10 minutes or more,[4] and 29% of Canadians aged 12 years and older consume fruits and vegetables ≥5 times per day.[5]

To help adults improve their lifestyle habits, the World Health Organization stated that health promotion efforts should be more stimulated at the worksite.[6] This is an appropriate setting since more than 50% of awake hours per day are spent at the workplace by most adults and a large proportion of the population can be reached at once.[7,8]

Systematic reviews and meta-analyses have assessed the effectiveness of workplace health promotion programs (WHPPs) aimed at improving health and/or lifestyle habits. They report small effect sizes and inconclusive results.[8-14] More recently, a systematic review of reviews specified that WHPPs can be effective in the prevention of outcomes related to body weight, mental health, and musculoskeletal disorders.[15] Furthermore, based on a WHPP data from 2010 to 2017 targeting multiple lifestyle habits, the percentage of employees classified as being physically inactive changed non-significantly from 16.6% to 14.4%.[16]

To date, very few studies have explored the predictors of health behavior change.[17] It is important to identify the characteristics of those who respond positively to WHPP as this allows program practitioners to adapt WHPPs based on participant characteristics, thus improving the lifestyle habits of a larger proportion of employees. Recently, Muir et al. (2019) carried out a systematic review of WHPP studies that targeted at least PA (15 studies).[17] They identified some predictors of health behavior improvements among participants. Each behavioral-change predictor related to health, lifestyle habits, and work was identified only in one study, most of the time. Predictors such as age and gender were tested in multiple studies, but their influences on health behavior change were inconclusive.[17] Interestingly, some potential predictors, such as stress levels at work, perceived general health, life satisfaction, and intention to improve lifestyle habits, were not tested in the studies reviewed.[17] In addition, the behavioral changes examined in the studies were numerous (PA, diet, smoking, and alcohol consumption) but incomplete. Studies also reported predictors of outcomes resulting from healthy lifestyle habits such as waist circumference and body weight changes, perceptions of well-being, and self-reported health-related quality of life.[17]

The primary objective of the current study was to identify predictors of improvements in healthy lifestyle habits (PA, eating habits, sleep habits, smoking, alcohol consumption, and stress management) in employees who took part in a WHPP targeting multiple lifestyle habits and who had the potential to improve at baseline. The secondary objective was to identify predictors of improvement in certain health risk factors, such as stress levels at work and body mass index (BMI).

METHODS

Study design and population

The current study analyzed the data of a WHPP called *Activate Your Health*. The evaluation of this WHPP used a quasi-experimental design. The *Activate Your Health* program was created by Capsana, an organization committed to promoting healthy lifestyle habits and preventing chronic conditions.[18] During the evaluation period (from 2016 to 2021), Capsana offered the program to eight companies in the province of Quebec, Canada. Employees were invited to voluntarily take part in the program. Pregnant women were excluded from the research component.

A detailed description of this program has been previously published.[19] This study was approved by the Comité d'éthique de la recherche en santé of Université de Montréal [16-063-CERES-D(1)].

Description of the program

The current study included three intervention packages, called options, of the *Activate Your Health* program: *Light*, *Moderate*, and *High*. These options vary by number of interventions, which were offered either in-person or online. *High* had the greatest number of interventions, which included personalized online menus, assistance in fostering a health-supporting environment, health challenges, conferences on various topics, personalized coaching, closing events, health screening and flexibility assessment, distribution of publications, a social health platform, and an activity tracker draw (lottery). *Moderate* had the same interventions as *High* apart from the activity tracker draw. *Light* consisted of a smaller number of interventions that included personalized online menus, assistance in fostering a health-supporting environment, health challenges, conferences on various topics, personalized coaching, and closing events. All options had an optional information/motivation session. *High* and *Moderate* also had an optional smoking cessation intervention. All three options were composed of interventions that targeted multiple lifestyle habits. Further details regarding option allocation and interventions can be found elsewhere.[19]

Data collection

Once employees consented to participation in the program, they completed a health risk assessment (HRA), which was the data collection tool. The HRA was adapted from validated questionnaires, national/provincial recommendations, and health experts' opinions, and baseline data were gathered between December 2016 and July 2018. Participants completed the HRA again following completion of the program. Post-intervention data collection took place between April 2018 and January 2020. Depending on the company, an average of 1.35 (min 1.05–max 2.46) years elapsed between the two data collection periods.

Upon completion of the HRA, employees received immediate feedback on their lifestyle habits. To boost participation, a draw was organized in certain companies and employees who completed the HRA were eligible to win gift cards worth CAD$25 and CAD$100 or books on topics related to healthy lifestyle habits. Capsana was responsible for data collection and provided the research group with access to the anonymous data for external analysis. Participants were aware that their anonymous data would be used to perform statistical analyses and would otherwise remain confidential.

Measures

Sociodemographic and anthropometric variables

Age, sex, weight, and height were obtained from the HRA, and BMI was calculated as weight (kg)/height (m)^2.

Current health problems

Employees reported their current health problems from a provided list (Supplementary material 1). These were summed up to obtain the number of current health problems.

Assessment of healthy lifestyle habits

PA: Participants were asked three questions to assess their PA level: 1) “How many days per week (0 to 7) are you physically active (e.g., by walking instead of driving to your destination, or by doing recreational activities, such as bicycling, playing tennis, dancing, swimming, etc.)?” 2) “On your physically active days (including when you walk), how many minutes (<10, 10, 20, 30, 40, 50, 60, 75, 90, or >90 minutes) on average do you spend on PA?” 3) “What is your level of shortness of breath (none, slight, or enough to make conversation difficult) during your periods of PA?” Based on participant responses, weekly minutes of PA were calculated by multiplying number of days of PA per week and number of minutes of PA per day.

Eating habits: Employees reported their daily servings of fruit (0, 1, 2, 3, 4, 5, or ≥6) and vegetable (0, 1, 2, 3, 4, 5, or ≥6). The size of each serving of food was inspired by the 2007 Canada’s Food Guide.[20] A Canadian study showed that frequency of fruit and vegetable consumption was a good proxy of diet quality.[21] The number of servings of fruits was added to the number of servings of vegetables.

Sleep habits: Participants were asked, “How often (often, sometimes, or rarely/never) do sleep problems interfere with your daily activities and well-being?” Employees were asked, “Of the following signs, which have you experienced in a significant, continuous way for at least two weeks?” If participants selected “yes” for sleep disturbance, they were considered to have sleep disturbance. Employees were considered to have sleep disorder if they reported having a sleep disorder, such as insomnia and sleep apnea, and specified one of the following answers: “yes, but

I have never received treatment prescribed by a doctor/specialist" or "yes, and I am currently receiving treatment prescribed by a doctor/specialist."

Tobacco use: To assess the consumption of tobacco products, excluding electronic cigarettes, participants were asked how often they smoked. They were provided with the following choices of answer: do not smoke, occasionally, and every day.

Alcohol consumption: Participants were asked, "How much alcohol do you drink in a week (<1, 1-3, 4-10, 11-15, 16-21, or >21 drinks)?" According to national/provincial recommendations, one drink was defined as 12 oz./340 ml of beer, 5 oz./150 ml of wine, or 1.5 oz./45 ml of spirits.[22]

Stress-related measures

Employees were asked, "What is your stress level at work?" They selected one of the following options: very low, low, moderate, high, very high, or does not apply, I don't work. Employees were classified as suboptimal (high/very high) or optimal (very low/low/moderate). Stress levels in general were assessed by asking: "What is your stress level away from work (in your relationships, parenting, caring for aging parents, lack of time for self, isolation, health issues, financial strains, etc.)?" Employees were categorized as suboptimal (moderate/high/very high) or optimal (very low/low). To measure stress management, they were asked, "How good are your stress coping skills?" Answers were categorized as suboptimal (very poor/poor/average) or optimal (good/very good).

High-risk classification

Table 1 shows the high-risk classification for lifestyle habits and health risk factors based on national/provincial recommendations.[20,22,23]

Intention to improve each lifestyle habit

For each habit, participants were classified as having the intention (yes) or not (no or doesn't apply to me) in the next six months to: do more PA, improve eating habits, improve sleep habits, stop smoking, reduce alcohol consumption, and manage stress better.

General health and life satisfaction

To capture general health, employees were asked, "Considering your age, how would you describe your general health?" Answers were then classified as suboptimal (poor/fair/good) or optimal (very good/excellent). To assess overall life satisfaction, they were asked, "In general, what is your level of satisfaction with your life, including personal and professional aspects?" Responses were categorized as suboptimal (very unsatisfied/unsatisfied/neither satisfied nor unsatisfied) or optimal (satisfied/very satisfied).

*Mental health measure*s

Employees were classified as having depression or loss of pleasure if they reported "yes" to the following question: "Of the following signs, which have you experienced in a significant, continuous way for at least two weeks?: Depressed mood, and pronounced decreased interest or pleasure in activities." Employees who selected "depression" in the current health problem list were also categorized as "yes" for this mental illness.

Primary improvement outcomes

For each lifestyle habit, employees were classified as "improved" if they were at high risk at baseline and were at low risk after the intervention. Given the absence of guidelines for stress management, employees were classified as "improved" if they reported higher stress management after the intervention compared to their baseline rating. Otherwise, employees were classified as "not improved."

Secondary improvement outcomes

For health risk factors, a lower BMI and a lower rating of perceived stress levels at work at post-intervention compared to baseline were considered as "improved," otherwise as "not improved."

Statistical analyses

Descriptive analyses were performed to determine the proportion of employees who improved each outcome and to calculate the relative frequency of the number of lifestyle habit improvements (0 to 6). Using descriptive analyses (frequency), the most common combination of lifestyle habit changes was identified.

For each outcome, data from high-risk employees at baseline were included in their respective analyses since they had the potential to improve. For example, employees who were at low risk because of their PA at baseline were excluded from analyses of PA improvement. Binary logistic regression was first performed to test the association between each potential predictor at baseline and outcome variable. Next, forward stepwise logistic regression was used to determine the best predictors of each outcome. Age, BMI, and number of current health problems were used as continuous predictor variables, and linearity was verified between each of these and the outcomes. Sex, the *Activate Your Health* program's option, lifestyle habit risks, depression, loss of pleasure, intention to improve each lifestyle habit, and all perceptions (general health, stress levels at work, stress levels in general, life satisfaction, and stress management) were considered categorical predictors and were assigned a reference category. For these perceptions, only optimal responses were grouped together except when the number of observations was very small. The dependent variables consisted of all the improvement outcomes. The variable used to identify high-risk employees was not included as a predictor in their respective analyses. The area under the receiver operating characteristic (ROC) curve was obtained to measure outcome discrimination in the final regression model, with high discriminatory power representing an area close to "1".[24] SPSS version 26.0 (IBM, Armonk Corp., NY) was used and p-values ≤ 0.05 were considered statistically significant.

RESULTS

Five hundred and six employees who completed the baseline and post-intervention HRA were included in the current study (Table 2). At baseline, employees were, on average, 41.2 (9.7) years old, and the majority were women. Employees were, on average, slightly overweight and reported nearly one health problem. Most employees were at high risk due to insufficient PA levels (54.0%) and poor eating habits (84.8%). At the end of the intervention, 58.7% of employees had not improved any lifestyle habits (Figure 1). Among those who improved one habit, stress management improvement was most common, while among those who improved two habits, the combination of stress management and PA improvements was the most common (Table 3). Among participants who improved three habits, four potential combinations of improvements were equally common (Table 3).

Fewer than four predictors were identified for each improvement in the final models (Table 4). As an example of interpretation, sex was a potential predictor of PA improvement with women being less likely to improve this habit (Table 4). The area under the ROC curve for improvement in PA, eating habits, stress management, and stress levels at work were respectively 0.63 [95% confidence interval (CI): 0.56-0.71], 0.65 (CI: 0.56-0.74), 0.60 (CI: 0.53-0.67), and 0.66 (CI: 0.60-0.71) (only significant results are reported). Predictors were not identified for sleep habits, smoking, and alcohol consumption probably due to the small number of high-risk employees for those habits (Table 2).

DISCUSSION

As intended, the current study succeeded in identifying predictors of improvements in some healthy lifestyle habits, namely, PA, eating habits, and stress management, in response to a WHPP targeting multiple lifestyle habits. It also identified predictors of improvements in stress levels at work and BMI. Employees in *High* and those intending to reduce alcohol consumption were nearly twice as likely to improve PA. Employees reporting depression and those intending to improve sleep habits were more likely to improve stress management. The following predictors increased the odds of decreasing stress levels at work: having optimal perceived general health, having suboptimal sleep habits, excessive alcohol consumption, and intending to improve stress management. Employees who reported feelings of pleasure were more likely to improve their BMI.

Employees in options *Moderate* and *High* were at least twice likely to show improvement in PA compared to those in *Light* based on the bivariate models. Moreover, being in *High* was a predictor in the final model. Previous studies have rarely investigated the number of interventions as a predictor of improvement in PA in the context of WHPPs. Also, most studies on workplace PA programs/interventions have only two groups.[9,25,26] Although our study was not designed to identify specifically which interventions in *High* led to this improvement, similar interventions as *High* could be beneficial for improving PA in employees who do not meet the national recommendations for PA at baseline.

Improvements in certain lifestyle habits were predicted by other habits or by the intention to improve those complementary habits at baseline. Employees intending to improve sleep habits at baseline were three times more likely to improve their eating habits following the *Activate Your Health* program. Poor sleep duration and quality can lead to metabolic and endocrine changes, such as increased ghrelin levels and decreased leptin levels, leading to increased appetite and feelings of hunger.[27] Moreover, satisfying sleep recommendations (7–9h/day) are associated with greater consumption of fruits and vegetables in women.[28] Therefore, it is possible that employees intending to improve sleep habits managed to do so and consequently improved their eating habits. Intention to improve sleep habits was also identified as a predictor of stress management improvement. A prospective study found that police officers who reported sleep problems at baseline were more likely to report high work-related stress levels at five-year follow-up compared to their reference group.[29] Moreover, it was observed that high perceived fitness enabled greater resilience to stress among police officers only when they had good sleep habits.[30] In the *Activate Your Health* program, employees who reported poor stress management at baseline may have had poor sleep habits; by improving their sleep habits, they also improved their stress management. This hypothesis requires further investigation, especially given that employees with suboptimal sleep habits were twice as likely to report reduced stress levels at work following the *Activate Your Health* program.

In the current study, baseline characteristics related to alcohol consumption were significant predictors of improved outcomes, i.e., PA and stress levels at work. Among employees who did not satisfy PA recommendations at baseline, those intending to reduce alcohol consumption were twice as likely to show improvement in PA. This is in opposition with a review article that stated that individuals who drank alcohol were more active than non-drinkers.[31] Among participants of the *Activate Your Health* program who were classified as high risk for stress at work, those who drank alcohol excessively at baseline were three times more likely to improve stress levels at work. Frone found that employees who reported high levels of work-related stress also had high alcohol use (frequency and quantity).[32] Thus, employees who drank more than recommended may have identified work stress as a reason for their consumption and decided to focus on this habit and improved it consequently.

In the current study, perceived general health and life satisfaction were identified as potential predictors of improved stress levels at work and improved eating habits, respectively. Employees reporting suboptimal perceptions of general health were less likely to show a decrease in stress levels at work compared to those reporting optimal perceptions. A cross-sectional study found that stress related to staff issues and patient care was associated with nurses' general health, after controlling for other relevant variables.[33] Thus, WHPP practitioners may want to identify, at baseline, employees with low perceptions of their general health in combination with high levels of work-related stress, as those individuals may require targeted support to improve their stress levels at work. To our knowledge, this is the first study to consider perceived general health as a potential predictor of lifestyle habit and health risk factor improvement outcomes in the context of WHPPs. Regarding life satisfaction, employees with suboptimal ratings at baseline were nearly twice as likely to improve their eating habits after participating in the current program than those with optimal ratings. It is possible that employees improved their life satisfaction, leading to healthy eating. Life satisfaction, adjusted for age, gender, and data clustering, was positively associated with eating fruit and limiting fat intake in individuals aged 17-30 years.[34] However, this association requires further investigation in the context of WHPPs.

Mental health variables were predictors of stress management and BMI improvements. In fact, among employees reporting low ratings for stress management, reporting depression at baseline increased the odds of improving stress management. Other studies have reported a relationship between depression and stress management. A WHPP using a cognitive behavioral approach to improve stress management reported a decrease in depressive symptoms,[35] while a systematic review of reviews stated that WHPPs, especially those using e-health and cognitive behavioral therapy techniques, could have a positive effect on mental health outcomes such as depression, anxiety, and job stress.[15] Therefore, employees who reported depression at baseline may have improved their mental health following the *Activate Your Health* program which, in turn, had an impact on their stress management. Among participants with high BMI, loss of pleasure at baseline, when analyzed individually, decreased the odds of reduced BMI in the current study. Compared to people without depression, patients with depression were observed to be three times less likely to comply with medical treatment recommendations, such as following prescribed diets or exercise regimes.[36] Also, the presence of comorbidities, such as mental health problems (i.e., depression), has been identified as a barrier to obesity treatment.[37] Therefore, employees who present with mental health problems may need to focus on the management of their mental health problems before targeting lifestyle habits to improve BMI.

In the current study, sex, when analyzed individually, was associated with PA and BMI improvements. Men were nearly twice as likely to improve their PA following the *Activate Your Health* program than women. Similarly, a step-based WHPP reported that men were more likely to achieve a 70 000-step-count weekly goal.[38] Another WHPP targeting PA reported greater total metabolic equivalent minutes of moderate-to-vigorous PA in men than in women.[39] In contrast, in a web-based program addressing multiple health behaviors in elderly workers, women improved their self-reported overall PA.[40] More attention could be paid to women, as they may experience greater difficulty improving PA than men in the context of WHPPs. For BMI improvement, sex was not identified as a predictor of waist circumference improvement in a pedometer-based WHPP, which is in agreement with our results.[41] However, in the current program, when sex was analyzed individually, men were more likely to improve BMI than women. Following a web-based program targeting weight loss, men lost more weight than women.[42] It is possible that men more easily improve their body composition when such programs are offered, potentially through the adoption of more active lifestyles.

Although not a significant predictor in the final model, employees intending to improve stress management at baseline were nearly twice as likely to improve their stress levels at work following the current program compared to those not intending to improve. Intention may lead to behavior improvement.[43,44] Therefore, documenting intention to improve this habit at the beginning of the program and providing relevant tools could help employees to improve stress-related outcomes. Further investigation regarding the intention and actual improvement in stress levels among high-risk employees participating in WHPP may provide more insights.

The current study has several strengths. First, unlike previous studies, it documented variables resulting from healthy lifestyle habits in addition to improvements in various lifestyle habits in the same study using the same population. Second, it was innovative in testing predictors other than sociodemographic variables and including stress-related variables, intention to improve a variety of habits, different options of the current WHPP, and perception of life satisfaction. Third, the analyses targeted subgroups of interest for each improvement outcome i.e., high-risk employees at baseline for each respective outcome. However, the study also has limitations, including self-reported data that carry recall bias and social desirability bias.[45,46] Moreover, some improvement outcomes were based on changes in risk categorization, which were dependent on adherence to national or provincial recommendations, when possible. These categorizations could not capture habit changes that would not result in the attainment of a recommendation cut-off point. For instance, this may explain the finding that, despite intending to improve eating habits, employees at high risk due to poor eating habits at baseline were less likely to improve their eating habits. A further limitation of the current study was the sample size. The selection of only high-risk employees for the analyses of each outcome considerably reduced the sample size, particularly for smoking habits and alcohol consumption. As a result, this may have reduced the statistical power required to detect significant difference for other improvement outcomes.

CONCLUSION

No more than four predictors were identified for each improvement following the *Activate Your Health* program among high-risk employees, i.e., those who will benefit most from such program. The baseline characteristics predicting improvement outcomes were different for each lifestyle habit and health risk factors. Intentions to improve and mental health variables were also predictors of certain improvement outcomes. The options with many interventions, especially *High*, were the most beneficial at improving PA among employees who did not meet the PA recommendations at baseline. In the context of WHPP, an approach investigating the profile of workers and taking predictors into account may be warranted in employees with the potential to improve. Further research with longitudinal follow-up to examine how the predictors vary over time for each improvement is needed.

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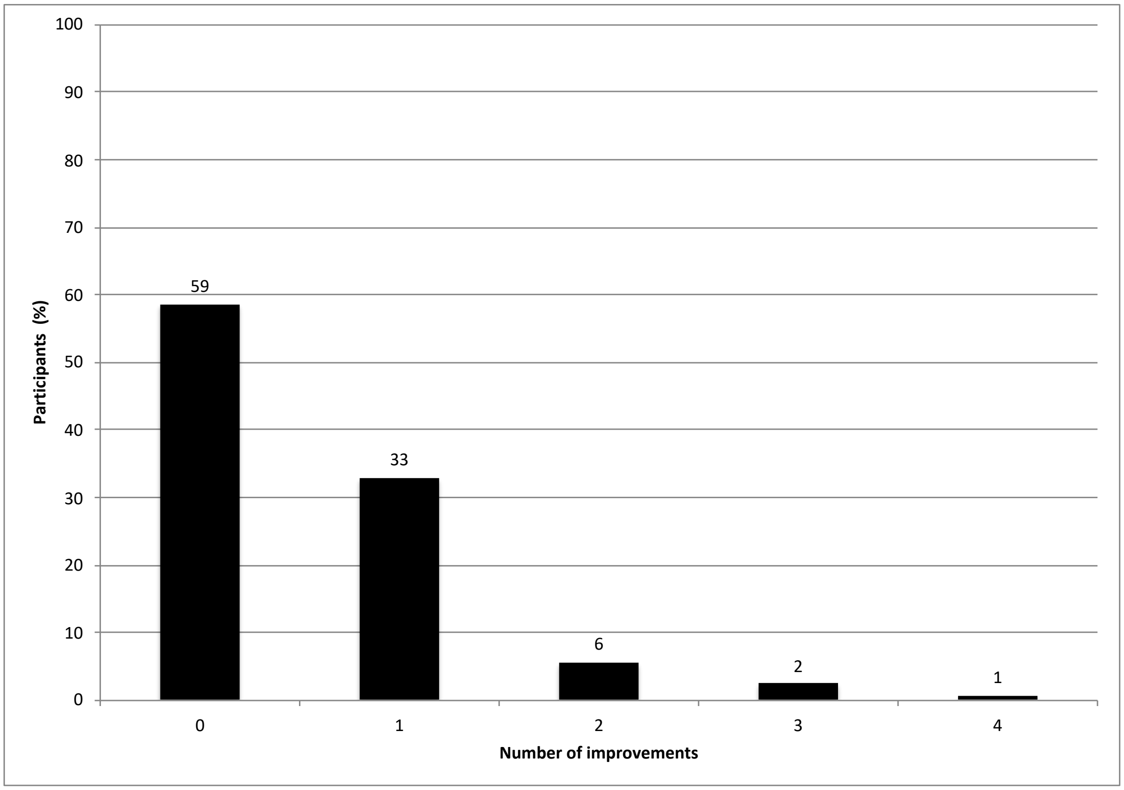

Figure 1. Relative frequency of the number of lifestyle habit improvements between baseline and postintervention (N = 506)

Table 1. High-risk definition

Lifestyle habits and health risk factors	**Definition of high risk**
Physical activity	<150 minutes per week or no shortness of breath
Eating habits	Women aged ≥18 years and men aged >50 years: <7 servings daily Men, 18-50 years old: <8 servings daily
Sleep habits	Answered "often" or "yes" to sleep problems, sleep disturbance, or sleep disorder questions
Smoking	Answered "occasionally" or "every day"
Alcohol consumption	Women: >10 drinks per week Men: >15 drinks per week
Stress management	Answered less than "very good"
Stress levels at work	Answered at least "low"
Body mass index	≥25 kg/m^2

Table 2. Baseline characteristics of employees and improvement outcomes (n = 506)

Variables	**n (%)**
Age (years)[a]	41.2 (9.7)
Women	299 (59.1)
Body mass index (kg/m^2)[a]	25.7 (5.8)
Number of current health problems[a]	0.8 (1.2)
At high risk	
Eating habits	429 (84.8)
Physical activity	273 (54.0)
Sleep habits	124 (24.5)
Smoking	38 (7.5)
Alcohol consumption	26 (5.1)
Suboptimal perceived general health	212 (41.9)
Suboptimal perceived life satisfaction	73 (14.4)
Stress and mental health measures	
Suboptimal perceived stress management	199 (39.3)
Suboptimal perceived stress levels in general	268 (53.0)
Suboptimal perceived stress at work	157 (31.0)
Loss of pleasure	79 (15.6)
Depression	58 (11.5)
Improvements	
Body mass index	189 (37.4)
Perceived stress levels at work	135 (26.7)
Perceived stress management	88 (17.4)

Physical activity	72 (14.2)
Eating habits	38 (7.5)
Sleep habits	43 (8.5)
Smoking	16 (3.2)
Alcohol consumption	13 (2.6)

[a]: Mean (standard deviation).

Table 3. Most common combinations of lifestyle habit improvements according to the number of improvement outcomes (n=209)

	Number of behavioral improvements						
	1	**2**	**3**[a]				**4**
Lifestyle habits	(n=166)	(n=28)	(n=12)				(n=3)
Stress management	X	X	X	X	X		X
Physical activity		X		X	X	X	X
Sleep habits			X		X	X	X
Eating habits			X			X	X
Smoking				X			
Alcohol consumption							
Participants with this profile (%)	34.3	32.1	16.7	16.7	16.7	16.7	66.7

[a]: Four common combinations of lifestyle habit improvements were noted among employees who improved three habits between baseline and post-intervention.

Table 4. Odds ratio of significant predictors of each improvement outcome among high-risk employees

Predictors	**OR_{BI} (95% CI)**	**OR_{MULTI} (95% CI)**
PHYSICAL ACTIVITY (n=273)		
Sex[a]	0.50 (0.29 - 0.87)	-
Activate Your Health program's options[a]		
Moderate	3.09 (1.07 - 8.93)	-
High	2.35 (1.29 - 4.27)	2.25 (1.23 - 4.11)
Intention to reduce alcohol consumption[b]	2.39 (1.19 - 4.80)	2.15 (1.06 - 4.39)
EATING HABITS (n=429)		
Perceived life satisfaction[c]	2.49 (1.17 - 5.31)	-
Intention to improve eating habits[b]	-	0.41 (0.20 - 0.84)
Intention to improve sleep habits[b]	2.39 (1.21 - 4.72)	2.96 (1.45 - 6.06)
STRESS MANAGEMENT (n=426)		
Depression[d]	2.16 (1.16 - 4.02)	2.13 (1.13 - 4.00)
Intention to improve sleep habits[b]	1.96 (1.22 - 3.15)	1.95 (1.21 - 3.14)
Intention to improve stress management[b]	1.63 (1.01 - 2.66)	-
STRESS LEVELS AT WORK (n=498)		
Perceived general health[c]	0.52 (0.34 - 0.79)	0.40 (0.26 - 0.63)
Sleep habits[b]	2.02 (1.31 - 3.12)	2.07 (1.29 - 3.32)
Alcohol consumption[b]	2.87 (1.29 - 6.36)	3.18 (1.36 - 7.43)
Intention to improve stress management[b]	1.77 (1.18 - 2.65)	1.77 (1.15 - 2.73)
BODY MASS INDEX (n=243)		
Sex[a]	0.59 (0.36 - 0.99)	-
Pleasure[d]	0.43 (0.22 - 0.84)	0.43 (0.22 - 0.84)

CI: Confidence interval; OR_{BI}: Odds ratio of binary logistic regression analyses; OR_{MULTI}: Odds ratio for multivariate logistic regression analyses.

[a]: The reference categories for sex and options of the *Activate Your Health* program were being a man and being in *Light*, respectively.

[b]: The reference categories for lifestyle habits and intention to improve were not being at risk and not intending to improve, respectively.

[c]: The reference categories for the various perceptions (general health, life satisfaction, and stress-related measures) were being in the optimal categories.

[d]: The reference categories for depression and loss of pleasure were absence of depression and absence of loss of pleasure.

The binary logistic regression and the multivariate logistic regression analyses of sleep, alcohol and smoking improvement did not show any significant results.

Supplementary material 1:

High blood pressure, high or abnormal cholesterol or triglyceride levels, diabetes, heart disease, stroke, cancer, osteoarthritis or another type of arthritis, osteoporosis, asthma or chronic lung disease, chronic back or neck pain, migraines or chronic headaches, depression, anxiety disorder or any other mental health problem, neurodegenerative disease, attention deficit disorder with or without hyperactivity, and sleep disorders (e.g., insomnia, sleep apnea).

Chapter 6 – General discussion

The current thesis attempts to fill some gaps that were identified in the literature, and which were presented in the first chapter of this thesis. No studies have examined the impact of a program composed of different numbers of interventions. Moreover, several systematic reviews and meta-analyses question the effectiveness of WHPPs at improving the health and lifestyle habits of employees. However, it is important to note that those results represent the average of a sample. In these samples, there are individuals who will have benefited from the program and improved their health and lifestyle habits. Moreover, based on Muir et al. (2019) only a few studies have dived into their program, at least those targeting PA, to identify who benefited from these programs. This made it valuable to look further into the *Activate Your Health* program, and this was the secondary focus of the current thesis. The thesis was interested in the characteristics of those who improved in that program.

The first objective of this thesis was to evaluate the impact of a WHPP mentioned earlier called the *Activate Your Health* program. This was offered by Capsana to companies in Quebec (Article 2; Chapter 3). Since this WHPP was composed of different options (*Control*, *Light*, *Moderate*, and *High*), we were more specifically interested in identifying which option was the most advantageous in terms of its effects on employees' health and lifestyle habit-related outcomes. Considering that intention is a predictor of behaviour (Ajzen, 1985; Prochaska & Velicer, 1997), the second objective was to study the predictors of intention to improve each lifestyle habit (Article 3; Chapter 4). Another component of the second objective was to study the association between intention to improve a specific lifestyle habit and its behavioural improvement following the *Activate Your Health* program. The third objective was to identify the baseline characteristics of employees who, following this WHPP, improved different lifestyle habits as well as two health risk factors (Article 4; Chapter 5). The health risk factors were chosen following the results of the first objective; BMI and stress levels at work changed over time, regardless of option, following the *Activate Your Health* program, so the predictors for these outcomes were also explored.

In this chapter, the first article on the study protocol of the *Activate Your Health* program published in the *BMC Public Health* journal will not be discussed because it does not contain results (Article 1; Chapter 2). Having mentioned that, that article is still relevant for the present thesis as it details the program, which was briefly presented in the other articles. It is important to note that because of the pandemic that took place in March 2020 in Canada, the data collection of this program was affected. For research purposes, data collected during the pandemic could not be compared to data pre-pandemic. Consequently, to simplify wording, the terms “post-intervention” and “post-program” will indicate the end of the first cycle of interventions that were included in each option.

Therefore, the beginning of this chapter will summarize the main significant results of each article presented in earlier chapters. Then, some main concepts that stood out from Articles 2 to 4 will be discussed. The strengths and limitations of the current program and studies will then be evaluated. Finally, future perspectives will be given on how to improve literature on WHPPs.

6.1 Summary of main results

Firstly, Article 2 studied the impact of the different options of the *Activate Your Health* program on health and lifestyle habit-related outcomes (Chapter 3). Based on HRAs completed at baseline and post-intervention, most variables did not evolve differently depending on the different options except for the intention to improve sleep habits for which the interaction term was significant. There was an increase in the percentage point of employees intending to improve sleep habits in *Light* (+ 11%). The time effect was significant for body weight (+0.5 kg), perceived stress levels at work (-0.1 on a Likert scale from 0 to 4), percentage point of employees intending to improve alcohol consumption (+6%), percentage point of employees intending to quit smoking (-3%), and percentage point of employees not smoking (+2%). When the analyses were separated by sex, in women, most interaction terms were not significant except for the proportion of women intending to improve sleep habits. The percentage point of women intending to improve sleep habits decreased in *Moderate* (-26%). In women, time effect was significant for limiting frequency of fat intake rating (+ 0.1 on a Likert scale from 0 to 2), limiting frequency of salt intake rating (+0.1 on a Likert scale from 0 to 2), perceived stress levels at work (-0.1 on a Likert scale from 0 to 4), percentage point of women intending to reduce alcohol consumption (+6%) and percentage point of women intending to stop smoking (-3%). In men, there was an interaction effect for body weight and BMI. For body weight, while there was a decrease in *High* (0.6 kg), there was an increase in *Control* (2.6 kg). A similar pattern was observed for BMI (*High*: -0.2 kg/m^2; *Control*:

+0.8 kg/m^2). There was a time effect for the percentage point of men intending to reduce alcohol consumption (+7%).

Article 3 examined predictors of different intentions at baseline and the association between the initial intention to improve a lifestyle habit and its behavioural improvement after the *Activate Your Health* program (Chapter 4). There were many significant predictors for each lifestyle habits' intention to improve. Significant predictors and the direction (increase or decrease) of OR for each outcome are presented in Figures 5 and 6. Based on multivariate analyses, some predictors were common for multiple positive intentions: age, sex, BMI, perceived general health, non-adherence to lifestyle habit recommendations, and perceived stress management. Overall, women were more likely to hold a positive intention to improve PA, eating habits, sleep habits and stress management. Younger individuals were more likely to have the intention to improve PA, eating habits, sleep habits, and stress management. Employees with a higher BMI were more likely to have the intention to improve PA, eating habits, and alcohol consumption. The number of current health problems increased the odds of displaying an intention to improve alcohol consumption and stress management. Not adhering to a given lifestyle habit increased the odds of having the intention to improve that lifestyle habit. All intentions to improve were associated with their behavioural improvement following the program, except for eating habits. These associations were also analyzed per option. In *Control*, intentions to improve eating habits and stress management were associated with their behavioural improvements. In *Light*, intentions to improve sleep habits, smoking (quit), alcohol consumption, and stress management were associated with their behavioural improvements. In *Moderate*, only, the intention to quit smoking was associated with smoking cessation. In *High*, all intentions to improve were associated with their behavioural improvement, except for eating habits.

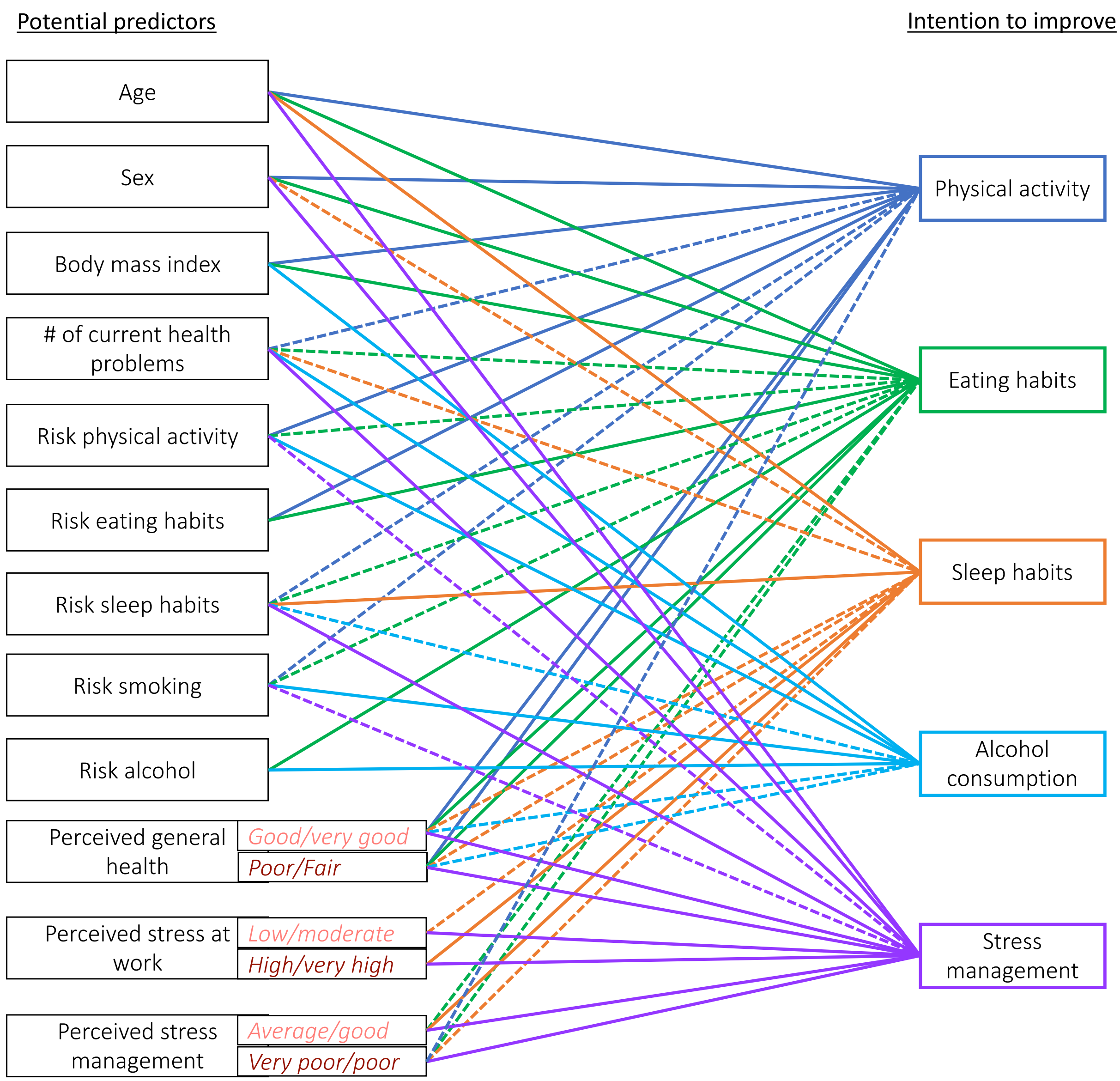

Figure 5. – Significant associations between potential predictors and intention to improve different lifestyle habits in all employees at baseline (Article 3; Chapter 4).

The reference categories for sex, risk for lifestyle habits, perceived general health, perceived stress at work and perceived stress management are being a man, not being at risk, excellent, very low, and very good. A dotted line signifies that the variable was present only in the bivariate analysis; a solid line signifies that the variable was significant in multivariate analysis.

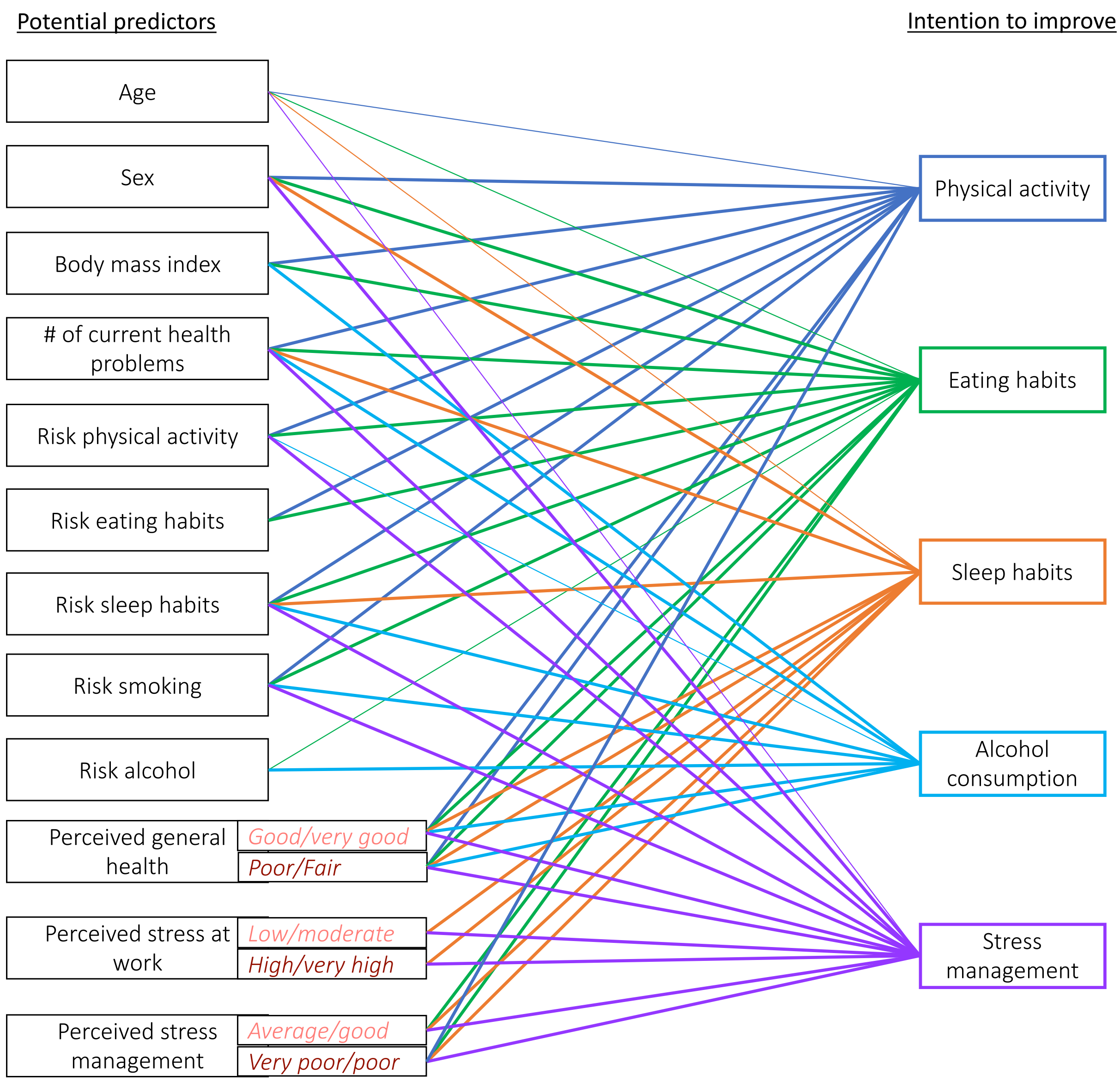

Figure 6. – Direction of the odds ratio between each potential predictor and intention to improve a lifestyle habit in all employees at baseline (Article 3; Chapter 4).

The reference categories for sex, risk for lifestyle habits, perceived general health, perceived stress at work and perceived stress management are being a man, not being at risk, excellent, very low, and very good. A thinner line means that the variable decreases the odds of intending to improve; a thicker line signifies that the variable increases the odds of intending to improve.

Article 4 studied predictors of behavioural improvements following the *Activate Your Health* program (Chapter 5). Significant potential predictors and the direction (increase or decrease) of OR for each improvement in behaviour and health risk factor are illustrated in Figures 7 and 8. The analyses were performed among employees who either do not meet a specific lifestyle habit recommendation or had suboptimal lifestyle habit, referred to as "high-risk," for their respective outcomes because these subsets had the potential to improve. The categorization of high risk is presented in Table 1 in Article 4 (Chapter 5). Among employees at high risk, based on the final multivariate regression, different baseline characteristics predicted the different lifestyle habit and health risk factor improvements. Employees in *High* and employees intending to improve alcohol consumption were more likely to show improvement in PA. Intention to improve eating habits (not intending) and intention to improve sleep habits (intending) increased the odds of showing improvement in eating habits. Reporting depression and intending to improve sleep habits increased the odds of stress management improvement. Predictors were not identified for smoking habit, alcohol consumption, and sleep habit improvements, probably due to an under-representation of these lifestyle habits in the current program. For the health risk factors, being at high risk due to suboptimal sleep habits, being at high risk due to excessive alcohol consumption, and intending to improve stress management increased the odds of showing improvement in stress levels at work. However, poor perception of general health decreased the odds of showing improvement in stress levels at work. Employees reporting feelings of pleasure at baseline were more likely to show improvement in BMI.

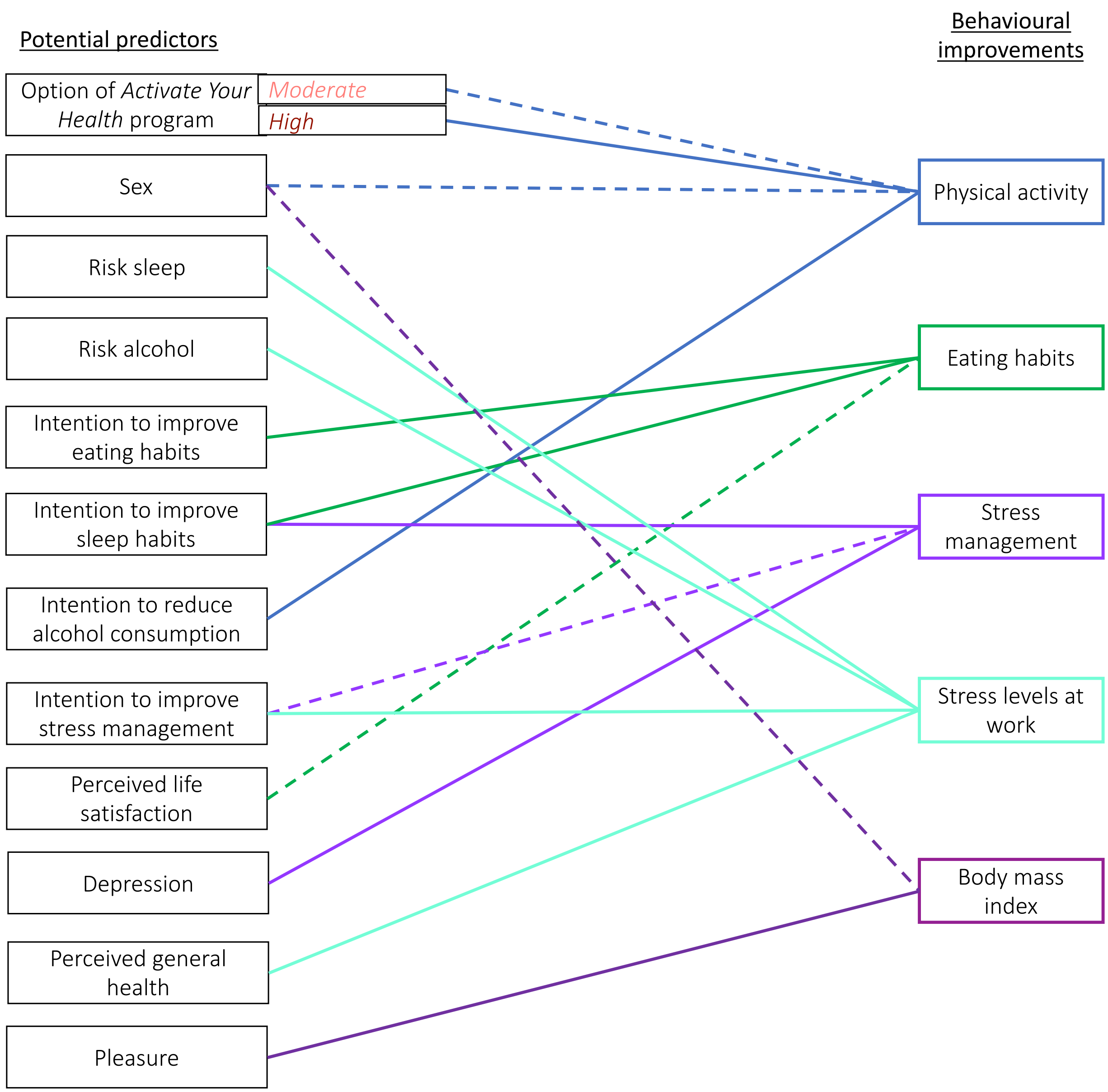

Figure 7. – Significant associations between baseline characteristics and improvement in lifestyle habits and health risk factors among employees who were at high-risk for that habit or health risk factor (Article 4; Chapter 5).

The reference categories for sex, options of the *Activate Your Health* program, risk for lifestyle habits, various perceptions (general health, life satisfaction and stress-related measures), depression and loss of pleasure were being a man, being in *Light*, not being at risk, not intending to improve, being in the optimal categories, absence of depression and absence of loss of pleasure, respectively. A dotted line signifies that the variable was present only in the bivariate analysis; a solid line signifies that the variable was present in the multivariate analyses.

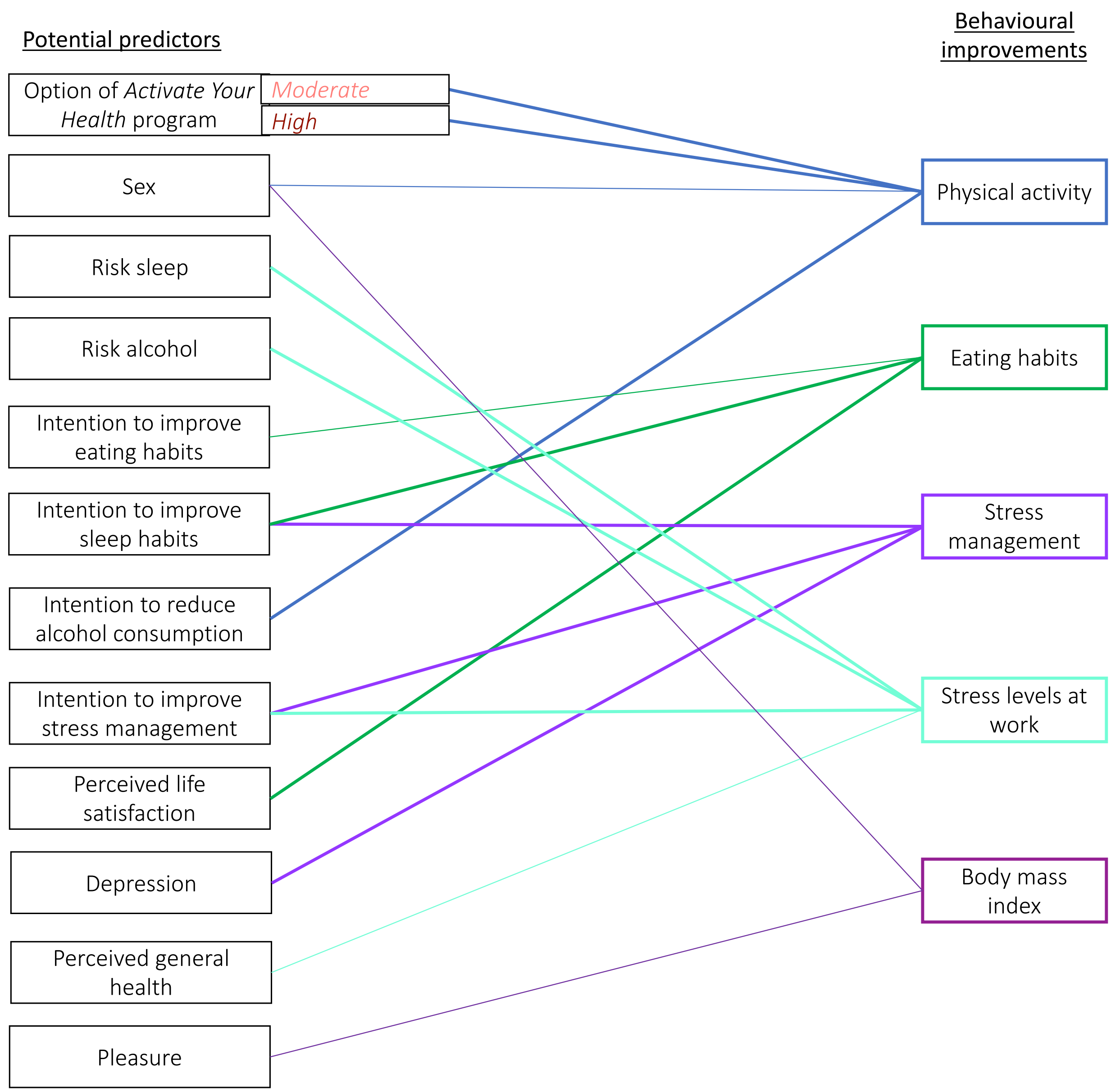

Figure 8. – Direction of the odds ratio between each potential baseline characteristics and improvement in a lifestyle habit/health risk factor among employees who were at high-risk for that habit or health risk factor at baseline (Article 4; Chapter 5).

The reference categories for sex, options of the *Activate Your Health* program, risk for lifestyle habits, various perceptions (general health, life satisfaction and stress-related measures), depression and loss of pleasure were being a man, being in *Light*, not being at risk, not intending to improve, being in the optimal categories, absence of depression and absence of loss of pleasure, respectively. A thinner line means that the variable decreases the odds of showing improvement; a thicker line signifies that the variable increases the odds of showing improvement.

6.2 Discussion of main concepts

6.2.1 Intention and behavioural improvement

In the current thesis, as reported by the article evaluating the impact of the *Activate Your Health* program, there was no interaction effects (time x option) for most outcomes including the proportions of employees classified at high risk for poor lifestyle habits. There were, however, some time effects, for example, an increase in the number of non-smokers, a decrease in stress levels at work and a slight weight gain between the two time points regardless of options. This is in line with the systematic reviews and meta-analyses that were presented in Chapter 1, which brought up questions regarding the effectiveness of WHPPs on health and lifestyle-habit related outcomes (Conn et al., 2009; Fisher et al., 1990; Geaney et al., 2013; Lee et al., 2014; Malik et al., 2014; Marshall, 2004; Redeker et al., 2019; Robbins et al., 2019; Wong et al., 2012; Yuvaraj et al., 2019). Considering this, it was important to investigate beyond the effectiveness of the program and find other factors that were related to behavioural change with the goal of changing many employees' unhealthy lifestyle habits.

In this thesis employees who did not adhere to a given lifestyle habit recommendation were more likely to intend to improve that lifestyle habit. This suggests that the *Activate Your Health* program was able to reach those that needed such a program because these specific employees took the time to complete the baseline HRA. Interestingly, it reached participants with various positive intentions, which reiterates the pros of offering multiple lifestyle habit WHPPs. Employees intending to improve exercise were more interested by WHPPs targeting PA in comparison with those who already exercised (Phipps et al., 2010). Taking these results together, health promotion practitioners may want to identify employees who do not meet each healthy lifestyle habit recommendation as they seem to have a positive intention to improve that specific lifestyle habit. Given this knowledge, health promotion practitioners could direct interventions to employees with positive intentions with the goal of translating these into behavioural improvement. This may be achieved by using implementation intention, which has been shown to have positive effects in changing health behaviour (Adriaanse et al., 2011; Armitage, 2007a, 2007b; Bélanger-Gravel et al., 2013). Interestingly, the number of employees displaying a certain positive intention changed between baseline and post-program in the sample regardless of option (Article 2; Chapter 3). For instance, the proportion of employees intending to reduce alcohol consumption increased regardless of option between the two time points. The proportion of employees intending to stop smoking decreased regardless of option. In the context of smoking cessation WHPPs, it was suggested that such services be offered to employees who already want to quit (Fishwick et al., 2013). This agrees with our findings. Based on the results of Article 3, baseline intention to quit smoking was associated with improvement in this lifestyle habit (stop smoking) after the program and the stratified analyses showed that it was the case in *Light*, *Moderate* and *High*. This shows that baseline intention led to behavioural improvement following the program.

In the current thesis, intention to improve PA, sleep habits, smoking habits, alcohol consumption, and stress management were associated with behavioural improvement (Article 3; Chapter 4). This agrees with Rhodes and Quinlan (2015) who studied predictors of natural change in PA over at least three months using observational studies (excluded studies with interventions in place). Positive intention defined, as "an overall willingness to try hard to perform PA," was associated with PA improvement (Rhodes & Quinlan, 2015). Also, intention and behaviour are linked as stated by a couple of theories e.g., Theory of Reasoned Action and Theory of Planned Behaviour (Ajzen, 1985, 1991; Prochaska & DiClemente, 1983; Schwarzer, 2008). Thus, intention may be an important factor to consider when implementing a WHPP. However, in the context of PA promotion interventions, targeting the stage of change of the Transtheoretical model was equally effective than non-stage-matched interventions, as well as interventions selecting participants based on their stage of change (Romain et al., 2018). This shows that stage of change of Transtheoretical Model may not be the most important factor to consider in interventions targeting PA. The meta-analysis of Romain et al. (2018) included four studies among adult workers, which corresponds to our study population, in the context of workplace programs (Aittasalo et al., 2004; Mutrie et al., 2002; Proper et al., 2003a; Purath et al., 2004). Among these studies, two studies' intervention was not a stage-selection intervention, both favoured the intervention with only one reaching statistical significance (Aittasalo et al., 2004; Proper et al., 2003a). The two studies that were stage-selection intervention favoured the intervention, both reaching statistically significant (Mutrie et al., 2002; Purath et al., 2004). A similar pattern among these four articles was observed for the stage-matched vs. non-stage-match intervention question. The current program was not specifically designed to study this question, but supports that in this specific context, baseline intention may be an important factor to consider for health promotion interventions.

One hypothesis for the association between most intentions and their behavioural improvement following the *Activate Your Health* program is that employees offered the program may have perceived that they had more control over their behaviour. Perceived behavioural control is known to be moderator of the intention-behaviour association as mentioned in Chapter 1 (Ajzen, 2020). It is possible that the simple fact of offering a WHPP increased employees' perception of control over their behaviour. Because the program was offered at work, they may have felt that they have good resources and perceived more opportunity to adopt healthy behaviours outside of home, which consequently led to positive intentions converting to improvements in behaviour. In fact, one of the predictors of PA maintenance was having high perceived behavioural control in the context of WHPP (Rhodes et al., 2008). Higher perceived behavioural control/self-efficacy was associated with an increase in PA in general (Rhodes & Quinlan, 2015). A 4-week computer-based WHPP targeting PA and eating habits reported that employees in the stage-match group were twice as likely to show improvement in these lifestyle habits compared to the control group (Lippke et al., 2015). While intention to improve PA or eating habits did not mediate the relationship between stage-matched intervention and improvements in both lifestyle habits as one outcome, PA planning improvement was the only mediator (Lippke et al., 2015). It is also possible that the *Activate Your Health* program somehow influenced the following processes of intention and behaviour association, which may have resulted in the findings of the current program: viability, activation, and elaboration (Prestwich et al., 2015). It is important to note that the current WHPP was not designed to study the effects of a program using a given theory on behavioural change. This is why the other components of these theories were not measured in the current thesis. Knowing that there is an intention-behaviour gap, it is important to measure other variables that can influence this association (Rhodes & Dickau, 2013; Webb & Sheeran, 2006). To better understand how such programs influence them, future studies could measure these components before and following a WHPP similar to the *Activate Your Health* program. Nevertheless, based on our findings, it seems to be beneficial to explore the effects of baseline intentions on behaviour improvements in the context of WHPPs.

It is also important to note that the intention to improve eating habits was not associated with its behavioural improvement in the current study. This may be explained by the fact that employees could not focus on many lifestyle habits at once. Indeed, the meta-analysis by Wilson et al. (2015) introduced earlier in this thesis observed an inverted "U" relationship between the number of recommendation and improvements. A moderate number of recommendations (i.e., 2-3) led to optimal improvements (more effective) compared to little or too many recommendations (Wilson et al., 2015). Based on Article 3 (Article 3; Chapter 4), 68% of employees had 2-4 positive intentions in our baseline sample. When we looked at the most common combination of lifestyle habits for each number of positive intentions at baseline, employees who had at least two positive intentions intended to improve eating habits (Article 3; Chapter 4). It is possible that employees were not able to fulfill all their positive intentions and ignored one of those, and it could have been the one for improving eating habits.

Interestingly, the results of the article on predictors of behavioural improvements (Article 4; Chapter 5) indicated that among high-risk employees, initial intentions may not be the most important predictor of behavioural improvements. For example, while the intention to improve PA was associated with PA improvement in the whole sample, initial intention to improve PA was not a significant predictor of PA improvement among employees at high risk due to insufficient PA, i.e., less than 150 minutes of MVPA per week. Thus, in this subgroup, which needs WHPPs, positive intention to improve PA may not be the most important factor. Health promotion practitioners could focus on other factors such as the *Activate Your Health*'s option or intention to improve alcohol consumption since individuals with these characteristics were more likely to show improvement in PA, which will be discussed later (Article 4; Chapiter 5).

Unexpectedly, among employees classified as high risk due to poor eating habits, intention to improve eating habits at baseline was a significant predictor of improvement in eating habits, with those intending to improve this lifestyle habit at baseline being less likely to show improvement in this health behaviour (Article 4; Chapter 5). Interestingly, employees in the *Activate Your Health* program, who already do not adhere to recommendations for eating habits (i.e., number of servings of fruits and vegetables), were more likely to improve this lifestyle habit at baseline, indicating that they were able to recognize that they need to improve this lifestyle habit (Article 3; Chapter 4). It seems, however, that they were not able to convert this health behaviour to improvement using the current form of the *Activate Your Health* program. Because Article 4 was composed of *Light*, *Moderate* and *High* options, the common interventions that were offered in these options that could possibly have targeted eating habits were personalised online menus, support in creating a favourable environment, *Health Challenge*, conferences and coaching.

Together these interventions focusing on individual and environmental levels made these options multimodal. However, our results contradict systematic reviews, which have reported positive effects of multimodal WHPPs on fruit and vegetable intake (Engbers et al., 2006; Kahn-Marshall & Gallant, 2012). It is possible that to convert the positive intention to improve eating habits—particularly in those who do not meet the recommendations—the individual level intervention of the current WHPP should be present throughout the study period. For example, in the *Activate Your Health* program, a coaching session was supposed to be offered once, which may not be enough to lead to improvement. To improve this outcome the frequency of contact with participants may have to be higher than in the current program, and perhaps even weekly (Greaves et al., 2011; Rongen et al., 2013). Our results also disagree with studies outside the context of WHPPs, which showed association between intention and behavioural improvement. For example, Brug et al. (2006) questioned 627 adults aged 18-78 years old regarding, among other variables, intention to eat at least two servings of fruit daily. This intention was one of the significant predictors of consuming at least two servings of fruit daily at two-weeks follow-up, with those intending being more likely to show improvement (Brug et al., 2006). Another study was performed with 144 patients aged 20-68 years old who attended health promotion clinics (Conner et al., 2002). Patients met with a nurse for nearly 30 minutes for minimal technological interventions, and they filled out a questionnaire at baseline, six months later, and six years later (Conner et al., 2002). The frequency of these sessions per week or per year could not be found. Intentions regarding healthy eating behaviour at six months predicted improvement in healthy eating behaviour six years later, and as intention stability increased, intentions was a stronger predictor of healthy eating (Conner et al., 2002). It is possible that participants in the *Activate Your Health* program did not have high stability in their intention, thereby not improving this lifestyle habit at follow-up. However, in the *Control*, intention to improve eating habits was associated with its behavioural improvement (Article 3; Chapter 4). This may be because this group received only a mandatory HRA, thereby focusing on accessible lifestyle habits. This result will be further discussed in section 6.2.5.

As for improvements in sleep habits, smoking habits and alcohol consumption, predictors were not identified, probably due to an under-representation of these behaviours (n = 124, n = 38 and n = 26 employees, respectively) in the current sample. For stress management, initial intention to improve this lifestyle habit was associated with its behavioural improvement (Article 3; Chapter 4). This was true even among employees at high risk due to not "very good" perceived stress management at baseline, with those intending to improve this lifestyle habit at baseline being 1.6 times more likely to show improvement (Article 4; Chapter 5). However, this intention was not the most important predictor once all the other factors were considered. No studies were identified regarding the association between intention to improve stress management and improvement in stress management in working adults following a multimodal WHPP targeting multiple lifestyle habits. Interestingly those intending to improve stress management were 1.8 times more likely to show improvements in stress levels at work among those who had at least low levels of stress at work (Article 4; Chapter 5). WHPPs targeting occupational stress have been reported to be effective (Montano et al., 2014; Richardson & Rothstein, 2008; Ryan et al., 2017). Based on these results, identifying employees who intend to improve stress management at baseline can be beneficial as they are more likely to show improvement in stress-related variables including stress management itself.

Based on the results of the current studies, the intention to improve a given lifestyle habit were associated with its behavioural improvement in the context of this multimodal WHPP targeting multiple lifestyle habits offered to Quebec workers. However, knowing that there is an intention-behaviour gap, measuring other variables that may influence intention-behaviour association could have provided more insights into our results. Future studies could explore intention to improve eating habit and its improvement to better understand this association in order to provide proper support for employees in the context of WHPPs.

6.2.2 Associations between different lifestyle habit-related outcomes

As presented in Chapter 1 of the current thesis, changes in one behaviour can influence another one (Fleig et al., 2015; Johnson et al., 2008; Mata et al., 2009). In the current study some positive intentions involving a given lifestyle habits was associated to another behaviour's improvement following the *Activate Your Health* program. For example, among those at high risk due to less than "very good" stress management, employees intending to improve sleep habits at baseline were more likely to show improvement in stress management (Article 4; Chapter 5). Similarly, compared to those with very good perceived stress management, those with average/good perception were more likely to intend to improve sleep habits (Article 3; Chapter 4). Thus, these lifestyle habit-related variables seem to point toward a possible inter-health behaviour association.

Previous studies outside the context of WHPPs, and not limited to adult populations, have observed inter-health behaviour associations particularly between PA and eating habits (Geller et al., 2017; Grembowski et al., 1993; Kremers et al., 2004; Mata et al., 2009). Some variables related to one behaviour were related to another one. For example, PA self-efficacy was associated with regular fruit and vegetable intake adoption in a large cross-sectional study (Lippke, Nigg, & Maddock, 2012 cited in Geller et al., 2017). Older adults who reported higher self-efficacy had better health profile (Grembowski et al., 1993). In another study, in the population of adolescents, intentions to engage in PA and/or eating habits were correlated much more strongly with the other behaviour outcome than the correlations between these behaviours themselves (Kremers et al., 2004). In the weight control RCT of 1-year conducted in women with overweight/obesity, exercise motivation was one of the facilitators for improvement in eating self-regulation (Mata et al., 2009). Geller et al. (2017) suggested that future studies explore this important area to better understand the inter-health behaviour relationship, which can in turn improve interventions regarding multiple behaviour interventions. Our study results agree to a certain extent, as intentions from some behaviours were related to another behaviour and some behaviours were associated with the intention of improving another behaviour. This supports the Compensatory Carry-Over Action Model that was presented in Chapter 1, in which variables such as self-efficacy, intentions, and stress management/well-being had an essential place in the inter-relation of two behaviours (Lippke, 2014). Comparing the articles on predictors of intentions (Article 3; Chapter 4) and predictors of behavioural improvements (Article 4; Chapter 5), some lifestyle habits and intentions to improve them were predictors of intentions and/or improvements in other lifestyle habits. Although these articles cannot be directly compared because Article 4 was in subsets of employees (e.g., high risk due to suboptimal lifestyle habits), they hint at possible patterns of associations between different lifestyle habits. In the context of WHPPs, these lifestyle habits can be targeted together to achieve better results.

Employees at high risk due to suboptimal sleep habits were more likely to intend to improve eating habits at baseline (Article 3; Chapter 4). Among employees at high risk due to poor eating habits at baseline, those intending to improve sleep habits were more likely to show improvement in eating habits (Article 4; Chapter 5). This could be explained by the fact that poor sleep habits can negatively impact eating habits. Indeed, poor sleep habits can lead to many metabolic and endocrine changes such as increased ghrelin level, which is known to increase food intake, and decreased leptin level, a hormone that increases satiety (Beccuti & Pannain, 2011; Park & Ahima, 2015; Sato et al., 2011). For example, Spiegel and colleagues (2004) observed that following a sleep restriction condition, leptin decreased by 18%, ghrelin increased by 28%, and ratings on visual analogue scales assessing hunger (24%) and appetite (23%) were increased in healthy men. However, this study reported that appetite for fruit and vegetable did not change depending on the condition (Spiegel et al., 2004). A review reported that while more experimental studies were necessary to better understand the effects of sleep disruption (sleep continuity, timing, or duration changes) on fruit and vegetable consumption, observational studies suggest that sleep influences fruit and vegetable consumption (Noorwali et al., 2019). Moreover, an inverted "U" relationship was reported between sleep durations and this outcome, with those complying to the recommended sleep duration having the highest consumption (Noorwali et al., 2019; Noorwali et al., 2018). These results suggest that sleep habits and eating habits may be targeted together. In the current thesis, participants intending to improve sleep habits may have improved this lifestyle habit, which could have consequently improved their eating habits, potentially through an improvement in stress management. The relationship between stress and sleep-related variables will be discussed in the next paragraph, but this hypothesis was articulated because stress management mediated the relationship between sleep quality and uncontrolled eating or emotional eating in 1,073 nurses (Gázquez Linares et al., 2019). Nurses with no sleep problems (good quality sleep) had higher stress management ratings, and those with higher stress management ratings had lower uncontrolled and emotional eating (Gázquez Linares et al., 2019). Interestingly, in undergraduate students, subjective sleep quality was found to moderate the association between mindfulness and nutrition behaviour (Lentz & Brown, 2019). These three lifestyle habits are of interest. In the context of WHPPs offering interventions targeting stress management and sleep habits and may be effective in improving eating habits. Documenting sleep habit-related variables and identifying those that do not have proper sleep habits may help health promotion practitioners improve the eating habits of employees, which is interesting considering that intending to improve eating habits did not translate into improvement in this habit.

Being at high risk due to suboptimal sleep habits increased the odds of intending to improve stress management at baseline (Article 3; Chapter 4), and among those at high risk due to less than "very good" stress management, employees intending to improve sleep habits at baseline were more likely to show improvement in stress management (Article 4; Chapter 5). Moreover, compared to those with very good perceived stress management, those with average/good perceptions were more likely to intend to improve sleep habits (Article 3; Chapter 4). Interestingly, compared to those with very low stress levels at work, employees with high/very high perceived stress levels at work were two times more likely to intend to improve sleep habits (Article 3; Chapter 4). Also, among those who had at least low levels of stress at work, those who were at high risk due to suboptimal sleep habits were two times more likely to show improvement in stress levels at work (Article 4; Chapter 5). These results suggest a possible relationship between sleep habit- and stress-related variables, which is in agreement with the study by Gázquez Linares et al. (2019). Other studies have also observed the importance of good sleep habits on stress-related variables including resilience (Garbarino & Magnavita, 2019; Gerber et al., 2013). Considering these results, in the context of WHPPs, it would be important to target both lifestyle habits together as they may improve the effectiveness of such program and lead to improvement in two lifestyle habits.

Employees at high risk due to insufficient PA were less likely to intend to improve alcohol consumption at baseline (Article 3; Chapter 4), and among employees at high risk due to insufficient PA at baseline, those intending to improve alcohol consumption at baseline were more likely to show improvement in PA (Article 4; Chapter 5). There might be a relationship between alcohol consumption- and PA-related variables. However, the number of alcoholic drinks per week was not associated with natural change in PA among adults (Rhodes & Quinlan, 2015). In another study, compared to those who do not drink, individuals who were physically active consumed more alcohol across all age groups (Piazza-Gardner & Barry, 2012). In the general population, moderate drinkers were more likely to exercise regularly at moderate and/or high intensities during their leisure time compared to abstainers (Smothers & Bertolucci, 2001). There might be a curvilinear relationship between alcohol consumption and PA levels, aligning the highest levels of PA with moderate consumption (Piazza-Gardner & Barry, 2012). Moderate consumption of alcohol was suggested to have some benefits such as decreasing the risk of coronary heart disease (Corrao et al., 2000), but this association may be because those who consumed moderate amounts of alcohol also did more PA, thereby decreasing this risk (Piazza-Gardner & Barry, 2012). To a certain extent, the association between intention to improve alcohol consumption and improvement in PA in the current thesis is in line with the identified curvilinear relationship reported in Piazza-Gardner and Barry (2012). It is possible that in the current study, among employees at high risk due to insufficient PA, those who intended to improve alcohol consumption were moderate drinkers on the higher end of range who decreased their consumption, which resulted in improvement of PA. Outside the context of WHPPs, Keller et al. (2008) examined health behaviours (fruit and vegetable consumption, exercise, smoking and binge drinking) of university students using a survey. They observed that 87% of students had at least two unhealthy lifestyle habits. The exercise (min/week) was weakly correlated ($r = 0.05$) with binge drinking episodes (Keller et al., 2008). In the study by Lippke et al. (2012), a weak correlation between the stages of these two lifestyle habits was also observed in individuals who presented with a type of diabetes ($r = 0.06$). Another study observed that the association between PA and total alcohol use was no longer significant after controlling for the within-person process that link PA and alcohol consumption (Conroy et al., 2015). Nevertheless, in the context of WHPPs, based on our results, PA could be paired with alcohol consumption as they seem to lead to positive results. Targeting alcohol consumption-related variables may result in improvement in PA.

Health behaviours may be inter-related, and some pairs seem to be more linked than others. Geller et al. (2017) explain that some health behaviour-related variables had been more correlated with one another. For instance, PA-and-eating habits as well as smoking-and-alcohol consumption (Boudreaux et al., 2003; Keller et al., 2008; Lippke et al., 2012). However, their observations were not limited to the context of WHPPs and were not solely based on healthy adults (e.g., university students and outpatients). Studies reported varying correlations, for example, smoking-alcohol consumption was 0.07 in (Lippke et al., 2012) and 0.35 in (Keller et al., 2008). However, in an intervention targeting PA no changes were observed in fruits and vegetables or dietary fat intakes (Dutton et al., 2008). Thus, targeting a single behaviour did not result in changes in an untargeted behaviour. Interestingly, based on the findings of Articles 3 and 4, as mentioned above, three pairs of lifestyle habits were found to be inter-related in the context of the current program: eating and sleep, sleep and stress, as well as alcohol consumption and PA. Indeed, the intention to improve one lifestyle habit was associated with another lifestyle habit's improvement. Also, non-adherence to one lifestyle habit increased the odds of intending to improve another behaviour's intention. It is possible that in the current program because many lifestyle habits were targeted together potential inter-health behaviour associations were found. Future studies may target these behaviours together in the context of WHPPs targeting multiple lifestyle habits and conduct focus groups to better understand.

Moreover, behaviour clusters have been reported (de Vries et al., 2008; Noble et al., 2015; Schneider et al., 2009). For example, outside the context of WHPPs, in patients aged >12 years, a cohort study aimed to explore the existence of clusters in smoking, alcohol consumption, fruit/vegetable consumption, and "physical exercise" (de Vries et al., 2008). This study did not include sleep habits or stress management. The authors found two sets of health behaviours: health promoting ones and health risky ones (de Vries et al., 2008). They also identified three clusters of individuals based on their adherence to Dutch recommendations: healthy, unhealthy and mixed. While the healthy cluster had moderate-to-high probabilities of satisfying the recommendations for those lifestyle habits, those in the unhealthy one had low probabilities of adhering to the recommendations for all lifestyle habits (de Vries et al., 2008). The third cluster exhibited mixed probabilities of adhering to the recommendations, namely low probabilities of adherence to PA and fruit and vegetable consumption recommendation and high probabilities for smoking and alcohol consumption (de Vries et al., 2008). There seems to less studies including sleep behaviours in cluster studies (Noble et al., 2015). Lippke et al. (2012) explain that this shows that some individuals can transfer successful behaviour changes from one health behaviour to another one much more easily than others. It is possible that in the current study individuals were able to change one lifestyle habit and this successful change transferred into another habit, thus explaining the three pairs of associations described above. Furthermore, the three pairs of lifestyle habits discussed in this section (e.g., eating and sleep, sleep and stress, as well as alcohol consumption and PA) should be explored in future studies because these may be promising combinations of health behaviours to target in order to improve the effectiveness of WHPP targeting multiple lifestyle habit.

To conclude this section, there seem to be several associations between the different lifestyle habit-related variables. However, it is important to note that behaviour change is complex and the exact mechanisms through which they interact require more studies (Geller et al., 2017; Prochaska et al., 2008). Moreover, there seem to be differences in the associations between health behaviors when analyzed between-individuals vs. within-individuals (Conroy et al., 2015). Indeed, in the context of a multiple lifestyle habit change intervention, in adults with overweight and obesity, the combinations of lifestyle habit associations observed between participants (average of the sample) were different from those observed within-participants (Chevance et al., 2020). Nevertheless, it is essential to study these associations in the context of WHPPs targeting multiple lifestyle habits in order to better understand how they interact together. Health promotion practitioners can take advantage of these findings because, by targeting one lifestyle habit, another complementary one may also improve. Consequently, this could improve the effectiveness of WHPPs. However, focus groups are necessary in future studies in order to better understand these associations and the mechanisms behind them.

6.2.3 Effect of sex

In the current thesis, sex was an important variable because it prevailed among the three articles and showed differences in results based on sex. Indeed, when the study population was stratified by sex to study the effect of the *Activate Your Health* program on outcomes (Article 2, Chapter 3), some interesting results were found. In the bivariate analysis, among employees with either overweight and obesity at baseline, men were more likely to show improvements in BMI compared to women (Article 4, Chapter 5). These results disagree with a fairly old study that observed women seeming to be slightly more successful at losing weight compared to men following a 10-week WHPP focusing on PA and health education classes (Brill et al., 1991). However, our results agree with the study by Ross and Wing (2016): men lost more weight compared to women at 3-month after a 12-week internet-based WHPP targeting weight loss in participants with a baseline BMI ≥25 kg/m^2. A systematic review on sex difference, not focusing on WHPPs specifically, also agrees with our results i.e., most studies observed that men lost significantly more weight compared to women, but women did lose weight as well (Williams et al., 2015). However, in the current thesis, sex was not a significant predictor in the final multivariate analyses. A 4-month pedometer WHPP also did not identify sex as a significant factor in waist circumference change when other factors were considered (Freak-Poli et al., 2011). In another WHPP offered to employees with BMI ≥30 kg/m^2, gender was not a significant predictor of any weight loss and ≥5% weight loss (Feldman et al., 2019). Therefore, in the context of WHPPs targeting lifestyle habits, sex may not be the most important factor to consider when targeting weight loss. However, future studies are necessary to clarify this link because, while the body weight and BMI of men in *High* decreased, these outcomes increased in men in *Control* between baseline and post-program (Article 2; Chapter 3). This was not observed in women.

In the bivariate analysis, among employees at high risk due to insufficient PA at baseline, men were more likely to show improvements in PA compared to women (Article 4, Chapter 5). In a WHPP targeting at least PA, males were more likely to reach the goal of a 70,000 weekly step count (Ablah et al., 2015). In another WHPP, females had less MET minutes of MVPA compared to males (McEachan et al., 2011). These agree with our findings. However, a 12-week web-based WHPP promoting healthy practices such as healthy aging, diet, PA, stress management, and tobacco use among 50-year-old employees observed that females improved overall exercise and exercise planning (Cook et al., 2015). Based on these results, women seem to have difficulty improving PA in the context of WHPP. This underlines the necessity to approach women and men differently in the context of WHPPs. One of the reasons that may explain why women in the *Activate Your Health* program were less likely to show improvement in PA may be that they perceive more barriers to performing PA compared to men. Indeed, compared to male, female reported more barriers, and these gender discrepancies start early (Hickey & Mason, 2017; Rosselli et al., 2020). Additionally, gender was one of the two determinants for not meeting the World Health Organization's PA criteria, and the two main barriers among girls were lack of energy and willpower to exercise (Rosselli et al., 2020). Those who perform PA for external motivations such as appearance are less likely to be confident in their ability to do PA and thereby less likely to improve PA (Muir et al., 2019). Women have been observed to perform PA for these external motivators (Markland and Ferguson, 2009, cited in Rodrigues et al., 2019). Taking these results together, women do seem to need more support, even in the context of WHPPs, even if sex was not the most important predictor in the multivariate analyses (Article 4; Chapter 5).

Fortunately, in the current study, women were more likely to intend to improve most lifestyle habits including intending to improve PA (Article 3, Chapter 4). The fact that men did not intend to improve PA at baseline maybe because men perceive health promotion-related activities to challenge masculinity e.g., beliefs such as compared to women, men are more "powerful," "less vulnerable," and their bodies are "structurally efficient" (Courtenay, 2004; Courtenay, 2000). Taking care of themselves and asking for help is feminine, and a man who is powerful is one who does not care for health and safety (Courtenay, 2000). In the *Activate Your Health* program, men represent 37% of those who completed the baseline HRA (Article 3; Chapter 4), which also agrees with the literature that male employees had lower participation levels compared to women in WHPPs, except for those given access to fitness centers (Robroek et al., 2009). However, it has been reported that, compared to other lifestyle habits, men engage in behaviours revolving around PA because it was associated with being stronger, muscular and competitive (Messner, 1995; Sloan et al., 2010). This is also in line with the current WHPP because men who completed the second HRA were more likely to show improvement in PA, even though sex was not a significant predictor in the final logistic regression model. Taking all these findings together, to improve the reach of a WHPP, practitioners can focus on male-centered health promotion to increase the reach, but once enrolled, they may want to provide women with additional support to convert their positive intentions to actual behaviour. Women may also need support once they have adopted PA. Indeed, outside the context of WHPPs, Rodrigues and colleagues (2019) wanted to identify individuals (including gender difference) with low levels of intentions among gym exercises who attended fitness group classes or cardio/resistance workouts. Among exercisers, female had weaker intentions towards exercising in the future compared to male (Rodrigues et al., 2019). Rodrigues et al. (2019) recommended that special attention be paid to female participants as they may have a weaker intention to exercise in future which may increase their risk of withdrawal. Thus, it is also possible that in the current WHPP, women intended to do more PA at baseline and converted their intention into actual behaviour, but discontinued exercising, thereby not showing PA improvement. This highlights the importance of a closer follow-up regarding this lifestyle habit when working with women in the context of WHPPs, including more frequent measurements.

There seems to be mixed results regarding sex as a predictor of PA improvement (Muir et al., 2019). Thus, future studies could explore predictors of PA improvement in their programs to clarify this link. Nevertheless, regardless of option, some positive findings were observed between baseline and post-program in women: the proportion of employees intending to improve sleep habits increased between baseline and post-program in *Moderate*. Other improvements were also observed such as an increase in the frequency of limiting fat and salt, and a decrease in the rating of stress levels at work (Article 2; Chapter 3). For instance, at baseline, women intend to improve most lifestyle habits compared to men, but later men seem to benefit from the program. Depending on what phase the WHPP is at, sex seems to play different role.

6.2.4 Results involving body mass index

Throughout the articles, BMI was considered as a predictor variable at times and as an outcome at other times. When BMI was considered a predictor variable (Chapter 4 and Chapter 5), employees with higher BMI were more likely to intend to improve PA, eating habits and alcohol consumption (Article 3; Chapter 4). The reason for these positive intentions may be due to the fact that relative weight was associated with intention to change it (Davis et al., 1984). Furthermore, these positive intentions may explain why participants with overweight and obesity were more likely to show improvements compared to those with normal weight in previous WHPPs studies (Colkesen et al., 2011; Groeneveld et al., 2011). However, BMI was not a potential predictor of any improvement in lifestyle habits or stress levels at work (Article 4; Chapter 5), showing that the body weight of employees at baseline did not predict whether or not they would improve a given lifestyle habit. This is in agreement with the Lippke et al. (2015) study, but in disagreement with Ablah et al. (2015). On the one hand, Lippke et al. (2015) did not identify BMI as a predictor of participants meeting the recommendations for PA and eating habits (portions of fruits and vegetables) following their 4-week WHPP targeting these lifestyle habits. On the other hand, in Ablah and colleagues (2015) results evaluating predictors of a weekly goal of 70 000 steps identified that those with a BMI <25 kg/m^2 were more likely to achieve this objective. Other studies that did not examine predictors of behavioural improvements per se also observed differences between different BMI categories and outcome improvements. There seem to be mixed results regarding the effects of BMI on behavioural improvements (Muir et al., 2019). For example, a 6-month RCT found that while construction workers who were at high risk for cardiovascular diseases with a BMI <25 kg/m^2 reduced their leisure time PA, those with overweight and obesity increased their time following the WHPP focusing on PA and nutrition (Groeneveld et al., 2011). The effects on initiating health behavioural change four weeks after a web-based HRA program were studied in 2,289 employees (Colkesen et al., 2011). The program included a questionnaire, biometric measures, laboratory evaluation and tailored feedback based on employees' answers to health-behaviour constructs of theories. Compared to employees with normal weight, those with overweight or obesity were more likely to initiate health-behaviour change and increase PA, and those with obesity were also more likely to improve their diet (Colkesen et al., 2011). However, another study observed that participants with a BMI >30 kg/m^2 exercised the least at baseline and following a 4-year web-based WHPP named "5-10-25 Challenge." Those with a BMI <25 kg/m^2 exercised the most at both times (Pratt et al., 2006). Therefore, BMI may be an important factor when identifying participants with positive initial intention to improve various lifestyle habits as seen in Article 3 of this thesis. Later into the program BMI may not be an important factor. Proper additional resources may be required to convert their intentions to action in the context of WHPPs.

BMI as an outcome showed some interesting results. In the bivariate analysis, among employees with a BMI ≥25 kg/m^2, men were more likely to show improvement in BMI following the *Activate Your Health* program (Article 4; Chapter 5). As discussed previously—although sex was not a predictor of body weight and body composition measures (Feldman et al., 2019; Freak-Poli et al., 2011)—men may be able to lose weight much more easily compared to women (Ross & Wing, 2016; Williams et al., 2015). In the current WHPP, men in *High* specifically showed a decrease in body weight and BMI following the program (Article 2; Chapter 3). As mentioned earlier, in *High*, most intentions were associated with their behavioural improvement. Therefore, it is possible that men with higher BMI intended to improve PA, eating habits, and alcohol consumptions at baseline and were able to convert their intentions to behavioural improvements because *High* enabled men to do this conversion. Consequently, these men decreased their BMI, thereby bringing the average BMI of men in *High* to 25.0 kg/m^2 at post-program. This hypothesis could be true, because Feldman et al. (2019)—who studied predictors of weight loss following their WHPP targeting weight management in employees with overweight/obesity—found that employees who were in action stage for PA were more likely to lose weight compared to those in the maintenance stage. Therefore, WHPP practitioners could target men with overweight and obesity specifically because they may hold positive intentions to improve various lifestyle habits including PA. To successfully convert their positive intentions to behaviour, an option similar to *High* could be offered.

Moreover, pleasure at baseline was the only predictor of BMI improvement among individuals at high risk due to a BMI ≥25 kg/m^2. Those having feelings of pleasure were more likely to show improvement in this outcome (Article 4; Chapter 5). To my knowledge, very few studies have examined mental health variables as predictors of BMI improvements in the context of WHPPs targeting multiple lifestyle habits (Freak-Poli et al., 2011; Muir et al., 2019). One study was identified and mental health functioning was not a significant predictor of waist circumference change following a 4-month pedometer WHPP (Freak-Poli et al., 2011), which disagrees with our findings. But in the treatment of obesity, one barrier to treatment is mental health co-morbidities such as depression and impulsive behaviours (Mauro et al., 2008; Sharifi et al., 2013). A systematic review and meta-analysis reported that among 15 longitudinal studies, presenting depression was a predictor of obesity and not of overweight. However, in studies with a follow-up duration of ≥10 years, there was a significant association between these two variables (Luppino et al., 2010).

Outside the context of WHPPs, a 12-month behavioural treatment programs offered to women aged 40- to 65-year-old with obesity and depression showed that decrease in depression increased the odds of showing at least 5 kg weight loss in the first six months (Simon et al., 2010). Moreover, decrease in depression was associated with improvement in PA in the first six months (Simon et al., 2010). It is possible that participants were more open to PA because their mental state was improved, which resulted in an improvement in body weight, but causality cannot be inferred (Simon et al., 2010). However, past six months, changes in depression and weight loss were not associated (Simon et al., 2010). This could be explained by the fact that certain anti-depressants can increase the risk of weight gain, making it less likely that participants would show improvement in body weight (Serretti et al., 2010). In their study, Simon et al. (2010) documented that a large number of women (78%) took anti-depressant medications throughout their study and 58% used them for at least 3 months. It is important to note that in the current program, depression was not a significant predictor of BMI improvement. Nevertheless, although the *Activate Your Health* program is not a weight-loss program, the fact that the mental state of participants, e.g., loss of pleasure, was a predictor of BMI improvement following on average 1.4 years of the program shows the effects of mental health on weight-related changes in the context of WHPPs.

To conclude this section, BMI is an important variable that could be considered at baseline because it increased the odds of having the intention to improve several lifestyle habits. That said, interventions and support may not need to be tailored based on BMI to improve lifestyle habits. Certain subgroups of employees improved their BMI post-program, which could be further studied.

6.2.5 Which option of the *Activate Your Health* program was optimal?

Compared to *Control*, *Light*, and *Moderate*, *High* seems to be the most optimal (Articles 2-4; Chapters 3-5). As a reminder, there were nearly 12 different interventions specific to *High*, while *Moderate* included 11 interventions (Article 1; Chapter 2). *Light* was composed of 7 interventions and *Control* had only one mandatory intervention, which was the HRA. In the program, there were also two non-compulsory interventions offered to all options, increasing the count to 14 potential interventions specific to *High*. The only difference between *High* and *Moderate*, was the activity tracker draw.

Based on the articles included in the current thesis, offering a high number of interventions, as was the case in *High*, produced the most benefits. For example, the body weight and BMI of men in *High* decreased between baseline and post-program (Article 2; Chapter 3), and most intentions were associated to their behavioural improvement in *High* except for eating habits (Article 3; Chapter 4). Also, among employees who were at high risk due to insufficient PA, participants in *High* were two times more likely to show improvement in this lifestyle habit compared to those in *Light* (Article 4; Chapter 5). Although not present in this final model, participants in *Moderate* were three times more likely to show improvement in PA compared to those in *Light* (Chapter 5). Thus, offering many interventions could be especially beneficial for PA and body weight. The meta-analysis by Wilson et al. (2015), mentioned earlier, studied the optimal number of recommendations to improve behaviours. However, the current WHPP allowed us to study differing number of interventions on health and lifestyle habits of employees within the same WHPP. Indeed, in the *Activate Your Health* program, the four options uniquely increased in the number of interventions. In the literature, most studies on WHPPs have a maximum of two arms: one intervention and one control (Freak-Poli et al., 2020; To et al., 2013). Most of the time, the second arm is a control group without intervention or minimal intervention (e.g., health information) (Freak-Poli et al., 2020; Malik et al., 2014), thus not presenting differing number of interventions within the same WHPP. In other cases, the second arm was another intervention with the goal of comparing those groups, for example, face-to-face vs. telephone support (Malik et al., 2014; Opdenacker & Boen, 2008; To et al., 2013). Some studies had more than two arms, but did not uniquely vary by the number of interventions included in them (Anderson et al., 2009). For example, a stage-matched group, a stage-mismatched email intervention group, and a control group (Hager et al., 2002). Taking these results, offering many interventions may be more beneficial than one, even for PA in the context of multiple lifestyle habit WHPP (Anderson et al., 2009; Buckingham et al., 2019; Freak-Poli et al., 2020; Schröer et al., 2013).

Although the *Activate Your Health* program was not designed to identify which interventions in *High* led to these benefits, the only intervention differentiating the latter from *Moderate* is the lottery to win activity trackers. Therefore, it is also important to discuss use of an activity tracker specifically. It is possible that those who received an activity tracker made good use of it and thereby showed improvement in BMI (Article 2; Chapter 3) and PA (Article 4; Chapter 5). Capsana sent an anonymous survey to employees who won activity trackers in *High*. These results are not presented in the articles, it is reported here simply to give an indication of how successful this initiative was. The survey was completed nearly one year after the post-program data collection and had a response rate of 26%. A large proportion of employees (86%) reported that they had used their smartwatch in the first year of the project at least a few hours a week to every day. Half of the respondents mentioned that they still use their smartwatch from a few hours per week to everyday. The majority (70%) of respondents stated that they were motivated at least a little to be more active. Only a small number of employees (8%) said that a smartwatch was not worth getting in workplace wellness programs. In a 6-week RCT WHPP, the number of steps increased in the intervention group that received activity trackers to enroll in a walking program and decreased in the no-program control group (Poirier et al., 2016). Outside the context of WHPP, activity trackers such as Fitbit have been shown to improve PA (Ringeval et al., 2020) and weight (Cheatham et al., 2018). Therefore, the activity trackers may explain some of the positive findings in *High*. Based on the literature, it may be the combination of activity tracker with other interventions that made *High* more successful. Indeed, there was some evidence that activity trackers alone—without additional offline interventions—were less likely to improve PA (Buckingham et al., 2019). Outside the context of WHPPs, a systematic-review and meta-analysis observed that consumer-based wearable activity trackers were effective on their own but were even more beneficial to improve PA participation when combined with other interventions (Brickwood et al., 2019). Programs with the following characteristics were more likely to be effective at improving PA: less rigorous research designs, including pedometers, using approaches based on the Internet, and comprised of activities targeting social and environmental levels (To et al., 2013). These results are somewhat in line with the findings of the *Activate Your Health* program, which had the lottery to win activity trackers as one of many interventions offered in *High* in addition to other interventions that targeted other levels. Indirectly the lottery could have motivated other individuals to purchase activity trackers, which may explain the improvements in certain outcomes in *High*. Providing an activity tracker, in addition to many other types of interventions, seems to be beneficial.

However, it is important to note that depending on the outcome of interest, the completion of HRA might be enough to generate changes in the context of a real-life setting WHPP with minimal input from a research group. Indeed, in the article assessing the impact of the *Activate Your Health* program on health and lifestyle-related outcomes, most interaction terms were not significant, indicating that employees in the four options did not evolve differently since baseline (Article 2; Chapter 3). Moreover, stress levels at work, proportion of employees intending to improve alcohol consumption, and proportion of employees who did not smoke changed over time, regardless of option (Article 2; Chapter 3). The control group in the current WHPP was not a true control group because employees completed the HRAs since it was the data collection tool, but along with that they also received quick feedback making it more like a minimal intervention group. This may explain why higher options were not significantly more successful than this group when evaluating the effects of the program's options (Article 2; Chapter 3). Moreover, in *Control*, intention to improve eating habits and stress management were associated with their respective behavioural improvement (Article 3; Chapter 4). Compared to providing no feedback or feedback in the form of only information regarding risks, HRA with behaviour change feedback were more likely to change at least one behaviour at 6-month follow-up (Kreuter & Strecher, 1996). Their HRA was tailored to patient's risk profile and behaviour-related variables, such as his/her interest in changing a behaviour, and it "appeared to promote changes" in PA, cholesterol screening and fat intake (Kreuter & Strecher, 1996). In this study, the authors documented many behaviours not limiting to lifestyle habits and the conclusion did not indicate clearly that the completion in HRA would lead to improvement in lifestyle habits. Another study by Colkesen et al. (2011) evaluated the effects of a web-based HRA with feedback on lifestyle habit change specifically. Among the 638 employees who completed the HRA with tailored feedback on health behavioural change initiation, 58% reported initiating health behaviour change, 10% reduced alcohol consumption, 14% quit smoking among smokers, 38% improved PA and 44% improved diet at four weeks (Colkesen et al., 2011). Interestingly, being satisfied with the HRA increased the odds of initiating health behaviour change, improved PA, and improved diet (Colkesen et al., 2011). Thus, it is possible that employees in *Control* were satisfied with the HRA in the *Activate Your Health* program, which was online and provided tailored feedback, thereby converting their positive intention to behavioural improvements regarding eating habits and stress management (Article 3; Chapter 4).

Moreover, intention to improve eating habits was associated with its behavioural improvement only in *Control* (Article 3; Chapter 4). Improvement in eating habits was one of the behaviours to improve following tailored HRA (Colkesen et al., 2011; Kreuter & Strecher, 1996). Employees in *Control* may have identified their weakness via the HRA and focused only on the 2-3 lifestyle habits that were the most accessible to them; as mentioned earlier, providing 2-3 recommendations led to the greatest benefits (Wilson et al., 2015). Eating habits may have been more accessible to this control group that did not receive any other mandatory interventions. For example, employees in *Control* could have changed what they consumed or bought at the grocery. This may be more accessible to them than becoming physically active, which can require money and time, thereby making PA more difficult to access. However, to the best of my knowledge, this hypothesis has not been tested. Furthermore, the intention to stop smoking was associated with its behavioural improvement in the whole study sample, and there was a significant decrease over time in the total number of smokers in the *Activate Your Health* program (Article 2; Chapter 3). This is a positive finding as it shows that offering WHPP regardless of the number of interventions could encourage some employees to quit smoking, most probably those who were on the edge of quitting (Fishwick et al., 2013). Another study also noted that their control group, which received feedback regarding their health risk profile based on health screening, improved PA, weekly fruit pieces and smoking six months following the 6-month WHPP (Groeneveld et al., 2011). However, knowing that behavioural change is complex, it could also be argued that HRA with quick feedback completed at baseline may not lead to improvements on average 1.4 years later. It is also important to note that most RCTs on the effectiveness of WHPPs focusing on PA had a minimal intervention group, which may hinder effects that could have been observed if the program was compared to a no-program group (Malik et al., 2014). This may have occurred in the current program as well. It is also important to note that in Article 2 (Chapter 3), employees who newly ceased were not identified as different from those who do not have the intention to improve this behaviour. Future studies with a larger sample of smokers in a program similar to the *Activate Your Health* program may provide insights regarding this habit in this context. Nevertheless, for certain outcomes, and given the low investment for employers, an online HRA with tailored feedback may be beneficial.

In brief, the *Activate Your Health* program seem to have maintained or improved certain outcomes regardless of options. But, for certain outcomes, *High* seems to be the most beneficial option of the program. The current WHPP was supposed to be offered for three years, but for many reasons including the pandemic that started in March 2020, the medium and long-term effects of the options of this WHPP could not be evaluated. These results could have provided more insights as to which option is the most beneficial for employees' health and lifestyle habits in the long run. Future studies could examine the impact of different numbers of interventions similar to the ones in the *Activate Your Health* program on outcomes.

6.2.6 Who benefited from the *Activate Your Health* program?

As mentioned in another section, participants in *High* seem to have benefited from the program compared to *Moderate*, *Light*, and *Control*. When the options of the *Activate Your Health* program were considered in multivariate analyses, employees in *High* were two times more likely to show PA improvement (Article 4; Chapter 5). Moreover, as mentioned earlier, most positive intentions to improve were associated with their behavioural improvement following the program, except for eating habits in *High* (Article 3; Chapter 4). It could be further hypothesized that it was men in *High* who benefited most from the program. This could be put forward because, in the bivariate analysis, men were more likely to show PA improvement, but sex was not present in the final model when *High* was a predictor (Article 4; Chapter 5). Furthermore, while men in *Control* increased their body weight and BMI, men in *High* decreased both outcomes (Article 2; Chapter 3). This indicates that men in *High* were the ones who benefited the most from the program, potentially via improvements in their PA. Employees in the action stage for PA were more likely to lose weight compared to those in the maintenance stage (Feldman et al., 2019). It could be hypothesized that in the *Activate Your Health* program, men, who received greater support because of the multiple interventions offered in *High*, improved their PA (action stage) and thereby decreased their BMI. Additionally, the program benefited men with overweight compared to women with overweight because, among employees with a BMI ≥25kg/m^2 at baseline, men were more likely to show improvement in BMI compared to women in the bivariate analyses (Article 4; Chapter 5).

The *Activate Your Health* program was able to reach those who needed the program because employees with poor lifestyle habits were more likely to report having the intention to improve them. But was it those who had had poor health- and lifestyle habits at baseline who improved following the program? To a certain extent, the answer to this question could be “yes” based on the article on predictors of improvements (Article 4; Chapter 5). The rationale behind this is that employees reporting depression were more likely to show improvement in stress management (Article 4; Chapter 5). Employees who were considered at high-risk for sleep habits and alcohol consumption were at least two times more likely to show improvement in stress levels at work (Article 4; Chapter 5). Employees intending to improve given lifestyle habits were more likely to show improvement in other lifestyle habits bearing in mind that employees intending to improve a given lifestyle habit probably had that poor lifestyle habit, thereby indicating that they intended to improve. This was noticed in the article on predictors of various intentions (Article 3; Chapter 4):

Employees who were classified as high risk for a given lifestyle habit were more likely to intend to improve that specific behaviour. In the bivariate analysis, among employees at high risk due to poor eating habits, those with suboptimal perception of life satisfaction were two times more likely to show improvement in eating habits (Article 4; Chapter 5). Employees may have improved their life satisfaction, thereby improving their eating habits, because a positive association between life satisfaction and eating habits (fruit and fibre intakes, and limiting fat intake) has been previously reported (Grant et al., 2009). Thus, overall, it seems that those who had poor lifestyle habits or suboptimal perception or health at baseline were more likely to show improvements following the current WHPP.

It has been reported that participation of high-risk employees was one of the barriers for success in WHPP (Linnan et al., 2008). In Linnan et al. (2008), success was measured in different ways in different studies such percentage of participation, costs and presenteeism/absenteeism. Based on previous studies, it is difficult to categorize whether WHPPs benefit those who need the program or those who already have good health and healthy lifestyle habits. On the one hand, employees who were already active, those with lower BMI, those with greater physical function, and those meeting alcohol consumption guidelines seemed to show improvements in outcomes such as waist circumference and PA (Ablah et al., 2015; Davey et al., 2009; Freak-Poli et al., 2011; Macniven et al., 2015; Mulaney et al., 2021; Pratt et al., 2006). Additionally, those already meeting recommendations for healthy lifestyle habits at baseline were two times more likely to achieve those recommendations at follow-up (Lippke et al., 2015). On the other hand, employees with high BMI and those who were at high risks due to poor health/lifestyle habits were observed to show improvements in similar outcomes e.g., PA and health behaviours following workplace-based programs (Colkesen et al., 2011; Groeneveld et al., 2010; Hyatt Neville et al., 2011; Jørgensen et al., 2010; Yuvaraj et al., 2019). Our findings are more in agreement with the latter results meaning that those at high risk benefitted more from the current WHPP. Future studies should further examine their WHPPs to clarify whether it is those at high or low risks who benefit the most from their program.

However, there are some exceptions that were noted in the current thesis, which may be indicative of further research before targeting certain outcomes. For example, employees who had suboptimal perception of general health were less likely to show improvement in stress levels at work among those at high risk due to at least low levels of stress at work. Perception of general health is associated with stress levels (Khamisa et al., 2015). This association needs further investigation in future studies on WHPPs. Also, among employees with a BMI ≥25 kg/m^2, those who reported a loss of pleasure were less likely to show improvement in BMI following the *Activate Your Health* program. It would have been a positive finding if individuals who reported loss of pleasure were the ones who improved following the program because they represent a subgroup that needs these programs the most. However, this highlights the fact that employees' baseline perception of health and mental health can be important variables to document before offering certain lifestyle habit programs to employees.

To conclude, while there seem to be many studies examining the characteristics of employees and WHPP participation (Jørgensen et al., 2013; Joslin et al., 2006; Lerman & Shemer, 1996; Robroek et al., 2009), more research is necessary regarding the characteristics of employees and improvements in health- and lifestyle habit-related outcomes following WHPPs. Based on our findings, men and those with poor health- and/or lifestyle habit-related variables were more likely to show improvement in certain lifestyle habits.

6.3 Strengths and limitations

The current thesis has numerous strengths. Firstly, the *Activate Your Health* program was offered to employees in Quebec, Canada, which rarely include an evaluation component of the program by researchers. The program was offered to many employees in multiple companies throughout the province. Secondly, within the same program, there were different options from which the company could select (*Control*, *Light*, *Moderate*, and *High*). These options varied in number, which allowed us to study the effect of increasing number of interventions on health- and lifestyle-related outcomes. Usually, programs have an intervention with or without control group (Freak-Poli et al., 2020; Malik et al., 2014; To et al., 2013), but in the current program there were a couple of intermediate options. Also, not only did the program target multiple lifestyle habits, it also included different types of interventions: in-person/online, individualized/impersonalized and targeting individual/environment. Thirdly, one of the unique qualities of this program is that it was offered to employees with minimal input from the research team. The program was offered in a context of uncontrolled environment, where program practitioners may face many "real-world" challenges when implementing such a program. This made it possible to study the impact of a real-life program on the main outcomes of interest. Fourthly, in the current thesis, in addition to the evaluation of the program, we went further and analyzed other interesting associations. We explored who benefited from the program, which is rarely done. We also study the association between intention and behavioural improvement, which has been rarely done following a WHPP with many lifestyle habits at once. This provides new ideas and avenues for future researchers in the field. It also helps in identifying what may or may not have worked and for whom rather than simply saying that the program "worked" or "did not work."

It is important to recognize some limitations of the current WHPP and studies. Firstly, all the studies are based on self-reported data with social desirability bias from HRAs that depends on memory and individuals' recall ability (Althubaiti, 2016; Fisher, 1993; Sallis & Saelens, 2000). Furthermore, HRAs did not capture what happened between baseline and post-program and were used as a proxy for the enrollment in the program. Secondly, the *Activate Your Health* program was not based on theory. A meta-analysis (N = 77 RCTs) on interventions targeting PA adults not limited to the workplace reported that theory-based interventions had a positive impact on PA compared to control groups, which did not receive a theory-based intervention or did not take part in the intervention (Gourlan et al., 2016). The explicit use of a theory to inform the intervention also impacts PA (Taylor et al., 2012). A larger average ES was found for workplace interventions describing the use of theory explicitly in comparison to those who did not describe the theory use in depth and those who did not mention a theory use (Taylor et al., 2012). The systematic review and meta-analysis of Webb et al. (2010) reported that internet-based interventions with extensive use of theory have larger effects than those that barely used a theory and those that did not. However, Prestwich et al. (2014) conducted a meta-analysis (N = 140 studies) and reported that interventions targeting PA and eating habits not reporting to be based on a theory were as effective as those reporting being based on a theory (Prestwich et al., 2014). Thus, there is evidence that theory-based interventions are useful. Due to the fact that the *Activate Your Health* program was not based on a given theory, it is challenging to identify which components were effective at producing the positive changes that were observed. Thirdly, in the current program, one company chose two options: *Moderate* and *Control*. There is a possibility that this may have caused contamination and consequently, impacted the results observed in *Control*. However, some interventions such as coaching and health screenings in *Moderate* were offered to individual employees, so it is possible that it did not have any impact. Moreover, *Control* completed HRA, which could be considered minimal intervention and could minimize the effect of this contamination (Malik et al., 2014). Fourthly, participation in the current program was on a voluntary basis, therefore it is possible that it was the employees with high motivation levels who completed the HRA at both time points. Although this is a limitation, it is unavoidable in a real-life program, in which a RCT would be impractical (Malik et al., 2014). Fifthly, the specific intervention that distinguished *High* from *Moderate* was the possibility of winning of an activity tracker lottery. In two articles, *High* was concluded to be the most beneficial. Considering that nearly 300 participants completed baseline and post-program HRAs and that 250 employees won the activity tracker draw at baseline, it is possible that it was those exhibiting the beneficial effects were the winners. But since the lottery was anonymized, it is difficult to assess to what extent this specific intervention had an impact on results. Sixthly, the number of companies in each option was not equally distributed across options. *High* included one company and it was observed to be the most beneficial. There is a possibility that that company was an exemplary company with the characteristics necessary to be successful, for example, a culture of health and a supportive social and physical environment (Burton, 2010; Goetzel et al., 2014). Consequently, employees improved and appeared as the most beneficial option. However, in the analyses of the program evaluation, the cluster effect was considered thereby decreasing the impact of this limitation on results. Seventhly, although many types of interventions were offered, the degree or the frequency of use of each intervention was not documented. For example, when conferences were offered, Capsana did not document which participants assisted in this activity, making it difficult to assess the level of engagement, adherence and participation in the program with the results of the studies. Also, the active component of the program that could explain the finding of this thesis could not be pinpointed. Eighthly, although the terms *habit* and *behaviour* are conceptually different, in the current thesis, lifestyle habit was used interchangeably with health behaviour to be coherent throughout the thesis, which included published peer-reviewed articles. Ninthly, due to the partnership nature of the current study, Capsana oversaw this questionnaire (HRA). More readily available and validated questionnaires could have been used to collect certain variables such as mental health outcomes and health behaviour outcomes. For instance, intention has a greater effect on behaviour that was self-reported than objectively measured (Armitage & Conner, 2001). The meta-analysis by Webb and Sheeran (2006) exhibited a greater impact of intention on behaviour when objective measures of health behaviours were taken as opposed to subjective measures (ES

= 0.67 vs. 0.30). Additionally, the question assessing intention could have been collected according to the recommendations of Ajzen (2002). Also, some essential variables such as determinants of health behaviour (e.g., annual income and level of education) were not collected, thus not added to the statistical analysis of Article 4 (Chapter 5). Future studies can confirm the results obtained in the current studies using more appropriate measurement tools such as the International Physical Activity Questionnaire-Short Form and Alcohol Use Disorders Identification Test (Craig et al., 2003). Also, in the current program, the presence of sleep disorders/problems was used to classify participants at risk due to poor sleep habits. Sleep duration or quality could have been collected, particularly using validated tools. Tenthly, the behavioural change techniques used during the coaching sessions were not documented by Capsana; this makes it challenging to replicate (Michie & Johnston, 2012).

6.4 Future perspectives

In the *Activate Your Health* program one of the most prevailing lifestyle habits that was not addressed and measured is sedentary behaviours. It is known that office workers can spend up to 71% of their worktime in a seated position (Clemes et al., 2014). Considering that most companies included in the current program contained white-collar employees, it would have been essential to include an intervention regarding this behaviour. For example, active workstations could be incorporated in such programs because they improved many outcomes, including sedentary time (Dupont et al., 2019; Josaphat et al., 2019). However, when the current WHPP began, the scientific knowledge on sedentary behaviour and potential solutions for this unhealthy lifestyle habit were only starting to emerge (Hamilton et al., 2007; Marshall & Ramirez, 2011; Owen et al., 2010; Torbeyns et al., 2014). Future studies may develop a program similar to the *Activate Your Health* program with this behaviour. Furthermore, future studies should be developed with a research component which can evaluate the program, but also the process, as this may allow researchers to better understand which factors influenced the results of their study. For example, in the current study, the *Moderate*, which is distinguished from the *High* by only one intervention, was not as beneficial as expected. Also, the organization's level of support was not explored and the employees' hierarchy in their companies was not documented, which may have helped in understanding certain results. The 6-month WHPP by Edmunds et al. (2013) also consisted of training several employees to promote PA (promoter group) to their colleagues (participant group).

Compared to baseline, physical health and psychological well-being, including perceived social support from friends, improved in the participant group (Edmunds et al., 2013). Moreover, the major themes that arose in the focus groups held at 6-month were feeling motivated because colleagues counted on them to be their "exercise buddies" and the promotor group increased social networking among participants in addition to providing encouragements and ideas to increase PA (Edmunds et al., 2013).

Implementing WHPPs can change the social environment at work in such a way that employees are supporter or supported in the adoption healthy lifestyle habits. This could be evaluated in a future program similar to the *Activate Your Health* program. The process evaluation would have allowed us to better understand why this was not the case. Focus groups could be part of future studies to better understand the results that were obtained in the articles on predictors of intention and improvement outcomes (chapter 4 and 5). Moreover, future studies should explore the association between initial intention and behavioural improvement following WHPPs. In the context of WHPPs, it seems to be possible to convert intentions into behavioural improvements. Tools such as implementation intention, which was discussed earlier to be beneficial, as well as coaching regarding positive intentions, may help employees convert their intention to actual improvement. Due to an under-representation of individuals with certain unhealthy lifestyle habits such as smoking and excessive alcohol consumption, predictors of intention or behavioural improvement were not identified. Future studies could explore the predictors of intentions and improvement of these lifestyle habits in the context of WHPPs. Moreover, other outcomes of interest about workers' health, such as musculoskeletal pain, were not evaluated in the context of the *Activate Your Health* program. A 1-year cluster RCT was composed of three groups of office workers: 1) Exercise (WHPP targeting neck and shoulder exercises), 2) PA (WHPP focusing on being physically active), and 3) No-program control that received support to improve health and working conditions (Andersen et al., 2010). The intensity of pain in the neck, low back, and right elbow and hand decreased in both intervention groups compared to control group (Andersen et al., 2010). Systematic reviews agree that WHPPs can reduce or prevent musculoskeletal-related problems (Coury et al., 2009; Proper & Van Oostrom, 2019). It would have been interesting to see the effects of each option of the current WHPP on this outcome. Finally, a program similar to *Activate Your Health* with varying number of interventions may be offered to other populations such as younger and older individuals. Another example of a target population is the indigenous population in Canada. For example, compared to the non-Aboriginal adults and teens of Ontario, a larger number of First Nations adults smoked cigarettes (Chiefs of Ontario and Cancer Care Ontario, 2016). Therefore, it would be interesting to test a program similar to the current one for these populations, particularly tailoring it to their culture in the case of Indigenous youth of Canada, for example (Habash et al., 2021). It would be noteworthy to study, among the different options, which one is the most beneficial for these different populations.

Chapter 7 – Conclusions

In summary, this thesis succeeded in presenting and evaluating the *Activate Your Health* program, which is a WHPP implemented in the province of Quebec, Canada by Capsana. It was also able to identify predictors of intention to improve various lifestyle habit and of improvements in behaviours and health risk factors. Based on the articles included in the current thesis, the *Activate Your Health* program, a real-life program with minimal input from any research team, was able to maintain most outcomes stable between baseline and post-program. For some subgroups of employees, this program had substantially more benefits, for example, to the men in the *High* option. Overall, *High* seems to be the most beneficial option of the program. This was apparent in all three original articles: larger number of intentions to behavioural improvement conversions, BMI and body weight improvement in men, and improvement in PA among employees who were at high risk due to an insufficient amount of PA. In the context of multimodal WHPPs targeting multiple lifestyle habit, it may be beneficial to document employees' baseline intention to improve various lifestyle habits as these seem to be an important factor in behavioural improvement. This thesis also found some combination of lifestyle habits, including intentions to improve them, to target in the context of WHPPs. These combinations need to be further studied in the context of WHPPs, potentially via focus groups.

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Annex

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Activate Your Health, a 3-year, multi-site, workplace healthy lifestyle promotion program: study design

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Abstract

Background: Workplace Health Promotion Programs (WHPP) have been shown to be an efficient way of improving workers' health. These programs can be incorporated in the worker's daily schedule and improve their productivity at work. Improving employees' health also benefits the employers by increasing their return on investment and lowering healthcare costs. The *Activate Your Health* program, created by Capsana in 2015, is a WHPP targeting multiple lifestyle habits for a three-year period. This WHPP includes tailored web-based interventions and the support of different health professionals throughout the years. We hypothesize that this approach will yield long-term lifestyle changes. The objective of the current paper is to describe the *Activate Your Health* program's design.

Methods/design: Eleven companies are taking part in this WHPP and had to choose among five different options of this program and all their employees were encouraged to participate. Each option differs by the number and type of interventions included. The limited option, which is considered the control group, only consists in completing a questionnaire regarding their health status, lifestyle habits and behaviors. On the other end, the extensive option receives a combination of multiple interventions: online menus, health challenges, support in creating a healthy work environment, coaching by health professionals (nurse, nutritionist, and kinesiologist), health screening and flexibility assessment, online resources, social health platform, and activity tracking. The remaining options are in between these options and vary by the amount of intervention. Baseline data are already gathered; two other data collection periods will take place after one and 2 years into the program. The primary outcomes of the current program are physical activity and fitness measures, nutritional data, smoking habits, stress and intention to change.

Discussion: The *Activate Your Health* program will allow us to compare which combinations of interventions are the most effective. It is expected that the extensive option will be the most advantageous to improve lifestyle habits. The results will indicate the strength and weakness of each intervention and how it could be improved.

Trial registration: Clinicaltrails.gov, registration number: NCT02933385 (updated on the 26th of March 2019, initially registered on the 5th of October 2016).

Keywords: Workplace, Health promotion program, Lifestyle habits, Lifestyle change

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Background

The World Health Organization states that chronic conditions are the leading cause of death and disability worldwide [1]. More than one out of every five Canadian lives with one of the following chronic conditions: cardiovascular disease, cancer, chronic respiratory disease, or diabetes [2]. These four chronic diseases represent 67% of annual deaths [3].

In Canada, 50% of workers live with a minimum of one chronic condition [4]. This situation increases absence rates due to functional limitations and creates a financial burden to the employers [5]. Moreover, poor health and unhealthy lifestyle habits were observed to decrease productivity [6]. Thus, decreasing chronic conditions is crucial. This could be achieved by adopting healthy lifestyle habits [7, 8]: i.e., being physically active, eating healthy, limiting alcohol and tobacco, and having good sleep habits, [9] which can prevent at least 70% of major chronic diseases [10]. Engaging in 180 min of moderate intensity physical activity (PA) per week, which is roughly the recommended amount of PA, decreases the risk of mortality [11]. However, it has been noted that the Canadians lack compliance to the recommendations for a healthy lifestyle. For example, 78% of Canadians are not sufficiently active and 60% have poor eating habits [12]. It is also encouraging to note that partly fulfilling the recommendations could have beneficial effects on health. For example, a sedentary individual who does any PA would benefit from a decrease in mortality risk [11].

Some of the reasons for failing to comply with these healthy lifestyle recommendations are a lack of time, social norms, built environment and cost [13]. As workers spend roughly 8 h per day at work [14], a program targeting changes in the lifestyle habits could begin at the workplace. To do so, some companies have started seeking the help of health specialists to improve their workers' lifestyle habits and working environment by implementing a workplace health promotion program (WHPP). Studies indicate that these programs are beneficial for the workers' physical [15, 16] and mental [17, 18] health, but also improve their work performance by increasing productivity [19, 20] and decreasing absenteeism [21]. These changes indirectly reduce health-care costs [22] and increase "return on investment (ROI)" [19, 22]. Hence, WHPP would advantage the workers, employers and the society as a whole [23–25]. However, this type of program needs to be designed properly. For example, a WHPP offering only a health-related questionnaire and/or an online platform does not lead to a successful outcome [26]. Moreover, to detect the population health effects and to yield a positive ROI, a minimum of 3 years of implementation is suggested [26].

Capsana is a Canadian organization dedicated to promoting healthy lifestyle habits, and preventing and managing chronic diseases in the workplace for the past 25 years. In 2015, Capsana [27] created a program called "*Activate Your Health*". This WHPP allows workers to adopt healthy lifestyle habits in their workplace with web-based and tailored interventions along with personalized advice over a 3-year period. The program also helps workers identify their risk factors associated with chronic diseases. In addition, it also assists the employers in changing the culture of health within the company in the goal of supporting the employees in achieving a better health profile and lifestyle habits. The eventual goals of the evaluation component of the *Activate Your Health* program are to evaluate the effectiveness of this WHPP on the short and long term, investigate which workers would benefit the most, compare the responses to the different interventions, and identify the challenges associated with the implementation of this type of program in the participating workplaces. We hypothesize that the option targeting several lifestyle habits at once will yield the biggest improvement in health and work-related parameters. The aim of the current paper is to describe the *Activate Your Health* WHPP.

Methods/design

Study design

The *Activate Your Health* program is an already-existing three-year program that was designed and implemented by Capsana in Canada (Quebec). This quasi-experimental study with an exploratory framework takes into account previously identified limitations regarding WHPP and interventions that previously have been shown to be beneficial [26, 28, 29]. The baseline data was collected between December 2016 and July 2018. The employees will be reevaluated one and 2 years into the program. There was no specific risk associated with participating in this program other than the ones associated with the adoption of an active lifestyle. The Health Research's Ethic Committee of Université de Montréal approved this study (16–063-CERES-D (1)). The study was registered on Clinicaltrials.gov on 16th of October 2016, and was updated on the 26th of March 2019 (NCT02933385).

All the gathered information was kept confidential and was not shared with any employers. The employers received only an overall report regarding the health of their employees without any given individual's portrait. Participating employees were aware of this and also knew that the data collected throughout the *Activate Your Health* WHPP would be part of a research study. Only certain Capsana's employees associated with data management and the research team had access to this information.

Recruitment of participants/study population

Through phone calls and in-person meetings, Capsana contacted the different companies to participate in their *Activate Your Health* program. Eleven companies are taking part in the current project. Among the participating companies, six were related to banks, two were related to financial markets, one was a graveyard parish, one was related to workplace health safety and security, and one was a marketing firm. The participating companies encouraged their employees to take part in this WHPP and participation was on a voluntary basis. Only pregnant women could not partake in the program. After an information session about the *Activate Your Health* WHPP and motivating their willingness to participate, an email was sent out to all the employees. Those who completed the online consent form (written) were able to fill the self-administered questionnaire.

Intended sample size explained

Based on recruitment experience for similar workplace interventions, financial support available and pilot data yielding significant benefits for the employees and their organizations with 656 participants, this program had the potential to enrol 6000 employees [30]. Therefore, *Activate Your Health* included as many employees as possible. Also, the purpose of this program is to evaluate for the first time the overall impact of the different options on a lot of health-related variables and lifestyle habits therefore the goal was to involve as many participants. The data collected for this program will thus be used for the first time to evaluate this program and will serve as a model for sample size calculation of future studies.

Study intervention/allocation to interventions

Capsana and their sponsors are offering the interventions throughout the year and at the same time of year throughout the 3-year period (ex: a company that received an intervention in January 2017 will receive the same intervention in January 2018, 2019). Table 1 summarizes the different interventions included in each of the five options (A to E) and the number of companies enrolled in each of them. Briefly, option A had the most extended number of interventions, and involved numerous web-based and innovative tools to improve lifestyle habits. Moreover, some interventions in option A and B were tailored and personalized to the participants' needs while participants in option E will not receive any interventions other than the informational/motivational sessions at baseline and at the end of each year (control group). There was no concomitant care or interventions that were prohibited while taking part in this program.

The companies had to choose one out of the five options offered by Capsana. Most of the companies ($n = 8$) chose option C and none picked option D. One company chose two different options (one group was placed in option A while the others in option E). One company won a promotional draw and Capsana placed it in one of the five options (Option E). In-person interventions took place at the workplace whereas the web-based ones were accessible anywhere.

Each company started the interventions at a different time point as each company differed by the administrative work necessary for the implementation of such program. Employees were unaware that other companies were participating in the *Activate Your Health* program and that the others could have a more or less beneficial option than theirs. Participants could also withdraw from the program at any given time. Participants are welcome to communicate with the research team if they have any questions/concerns during the program. Participants are also questioned at the end of the study regarding any adverse effects that took place during the study period. An employee from Capsana visited at least once a year each company to improve the adherence that will also be monitored by completing a questionnaire at the end of each year. The research team assisted annually to at least one data collection session and one of the interventions offered in this WHPP.

Data collection tools

Self-administered questionnaire – year 1, 2, and 3

All employees taking part in *Activate Your Health* are asked to fill out an online self-administered questionnaire that is based on an adaptation of existing questionnaires, lifestyle guidelines and opinion of health experts. Participants are asked to provide basic socio-demographic, anthropometric, health, medication and work information and extreme values are checked before inclusion. Lifestyle habits are also auto-reported: PA (frequency, duration and intensity), eating habits, smoking, alcohol consumption, sleeping habits, and stress level. As the *Activate Your Health* program aims to modify the employees' lifestyle habits, their intention to improve their habits is also evaluated. Once the questionnaire is submitted to Capsana, each of them is assigned a questionnaire ID to anonymize the data. The data are kept for 7 years by the Data Monitoring Committee. The Data Monitoring Committee is led by the principal investigator (MEM) in collaboration with one member of Capsana. It supervises data collection and analyses. For any further details please contact the principal investigator. After which, a total health score is calculated on 100 points: the higher the score, the better their health (100 equals optimal health and lifestyle habits). This score and action plan are sent to the employees personally.

Table 1 Details on the interventions included in each option ($n = 11$ companies)

Interventions	Options				
	Extensive				Limited
	A ($n = 1$)	B ($n = 1$)	C ($n = 8$)	D ($n = 0$)	E (Control) ($n = 2$)
Personalised online menus	X	X	X	X	
Support in creating a favourable environment	X	X	X	X	
Health Challenge	X	X	X	X	
Conferences	X	X	X		
Coaching	X	X	X		
Closing events	X	X	X		
Health screening and flexibility assessment	X	X			
CANRISK questionnaire	X	X			
Distribution of publications	X	X			
Social health platform	X	X			
Activity tracker	X				
Optional: Quit to Win! Challenge	X	X			

Detailed description of each intervention

Personalized online menus – year 1, 2, and 3

Each employee has access to an online platform called *SOScuisine*: it offers weekly menus, discounts, recipes and grocery shopping lists adapted to the employee's preferences and health goals (improve cholesterol, manage diabetes, weight control, etc.).

Support in creating a favorable environment – year 1, 2, and 3

Health professionals visit each participating companies to host and present an information booth on how to create a favorable environment to improve their employees' health (PA, nutrition and life balance). For example, they show the employees how to be active around their workplace, and highlight the healthiest menus in their cafeteria or vending machine in order to improve their eating habits.

Health challenge – year 1, 2, and 3

Employees are invited to participate individually or as a team in a 4-week activity called *Health Challenge*. It is publicized at their workplace and participation is voluntary. This intervention aims to guide companies and their workers towards better eating habits (i.e., five servings of fruits and vegetables/day), PA level (be physically active 30 min/day) and mental wellness (take time to relax). Capsana guides and motivates the employees who take part in this challenge. Employees who successfully fulfill the challenge receive an incentive (i.e., a sport bag). The participating company managed this intervention.

Conferences –year 1, 2, and 3

Different health professionals (nurse, kinesiologist, physician, psychologist, etc.) present a 60-min conference each at the work site of participating company at different time points into the study. The purpose of these sessions is to inform and educate employees on the importance of adopting and maintaining a healthy lifestyle. The health professional also gives tips and ideas to help employees achieve these goals. More conferences emphasizing mental well-being are planned.

Coaching – year 1, 2, and 3

Employees are offered assistance in maintaining or improving their lifestyle habits. They have the opportunity to talk, through the phone or in person, to a nurse and receive personal motivational coaching to enhance, among others, psychological health, well-being and lifestyle habits, and to reduce stress (Year 1). The following years, they will have the opportunity to talk to a nutritionist (Year 2), and to an exercise specialist/kinesiologist (Year 3).

Closing events – year 1, 2, and 3

At the end of each year, at the work site, employees will take part in a closing event organized by Capsana. An example of this is "Jeux Spin [31]" which consisted of various recreational activities such as soccer in an inflatable structure. It is to note that for logistic reasons, these events are offered to the participating companies (not just the participants of the *Activate Your Health* program). These events aim to congratulate the employees for taking control over their own health and motivate them to maintain their acquired/improved habits.

Health screening and flexibility assessment – year 1, 2, and 3

A team of nurses meets the employees individually to screen for their risk factors. The goal of this intervention is to identify any abnormal blood profile (unfasten state). It serves as an indicator and does not replace a regular blood test. If any abnormal results were found, employees were encouraged to consult their family doctor in order to do a follow-up. The plasma HDL level and HDL/total cholesterol ratio (CardioChek P.A.®-LIT001539, QC, Canada) and glucose concentration (Contour®Next - 85, 303,759, New Jersey, US) are measured. Blood pressure is manually taken using the conventional auscultatory method (stethoscope: 3 M™ Littmann® Classic II S.E-MMM2201, US; sphygmomanometer: Welch Allyn & Tycos model, Boston, US). Employees are asked to stand erect in order to take their height using a vertical stadiometer (Seca213, Hamburg, Germany), and weighed using a scale (Tanita-BF-350, IL, US). Waist circumference is measured at the iliac crests using a measuring tape. The "sit-and-reach" test (Sit and Reach Test Tester- EN-121085, NY, US) is performed to determine posterior chain flexibility. The results of these tests are available to the employees at the end of their session, and the nurse gave appropriate health advice to improve their health profile.

CANRISK questionnaire – year 1, 2, and 3

During the screening session, participants also complete the CANRISK [32] questionnaire to determine their risk of developing prediabetes or diabetes. It consists of 12 multiple-choice questions, resulting in a score that is associated with three risk categories: low (< 21 points), moderate (21–32 points), and high (> 32 points). Employees also receive this score with the interpretation.

Distribution of publications – year 1, 2, and 3

During the conferences, screening and informational sessions, interested employees receive Capsana's documentation (flyers/brochures/booklets/etc.) on chronic diseases (diabetes and cardiovascular health), mental health, medication, etc. These resources are also available on Capsana's website.

Social health platform – year 1, 2, and 3

Each employee has access to a Social health platform (Sprout [33]), which allows employees to interact with one another. They can set goals, create an interest group, and challenge their colleagues and themselves. For example, an employee could challenge a colleague to take the stairs as often as they can.

Activity tracking – year 1

Capsana offered an accelerometer bracelet (Vívosport, Garmin, 2017) to 250 employees selected at random and invited them to track their own physical activity information through the Garmin website or phone application.

Optional: Quit to Win! Challenge

This intervention is part of the provincial program (« J'arrête, j'y gagne! ») initiated by Capsana [34]. Only the interested companies take part in this challenge. It is promoted at the workplace and information booth with documentation available to all the employees. Those who are interested are invited to stop their tobacco use for 6 weeks, and Capsana guides and assists the employees throughout. Employees are guided through this challenge and the winner receives an incentive such as a trip to Jamaica.

Outcomes measures

Yearly assessments of a broad range of physical and psychological health outcomes will be performed to assess yearly changes and changes from baseline of each option.

Primary outcomes

Physical activity parameters, eating habits, smoking habits, alcohol consumption, sleeping habits, stress level and intention to improve these habits are measured.

Secondary outcomes

Waist circumference, weight, height, body mass index (BMI), plasma HDL and HDL/total cholesterol ratio, blood glucose concentration, systolic and diastolic blood pressure, flexibility level and risk factor profile are assessed.

Statistical analyses

In future analyses, option D will be excluded as no company selected this option. To examine if the different options have similar baseline characteristics, i.e., to verify the homogeneity between the four options for the selected baseline variables one-way ANOVA analysis with the effect size (partial eta squared) and Chi-square test with Cramer's V effect size will be used. Future studies will also explore the effect of each option on all outcomes. For continuous variables, mixed models for repeated measures with two factors will be used to analyze the effect of time and option on each outcome following one and 2 years of measurements. As for the categorical variables, generalized estimating equations (GEE) will be used. Possible confounders will be considered. Future studies will also take into account the cluster effect as the participants within the same company undergo the same implementation process and working environment, and therefore individual results from a same participating company could be dependent on each other. In future studies, intent-to-treat analysis will be used as well as multiple imputations. In addition, a particular consideration will be given to the sex and weight category of the participants.

Discussion

There is a growing body of literature confirming that WHPPs are advantageous for employees' physical and mental health, and this has been confirmed objectively and/or subjectively [35–38]. WHPP also improves employee's lifestyle habits, which are related to the presence of chronic diseases [9, 10]. These programs benefit the individual, company and the society [23–25]. The current study describes a recently implemented program called *Activate Your Health* that aims to improve employees' lifestyle habits through a WHPP in the working environment. The data collected through this WHPP will be used for the first time to evaluate the efficacy of this large-scale program.

One of the potential strengths of the *Activate Your Health* is that it targets multiple modifiable lifestyle habits and biometric measures associated with a decrease in the risk of cardiovascular disease and stroke [39]: eating healthy, being physically active, discontinuing smoking, and maintaining a healthy weight, blood pressure range, blood cholesterol and glycaemia. Recent studies in the field targeting at least three habits [40, 41] were observed to be effective. Therefore, it is expected that multiple lifestyle habits in one option would lead to greater health benefits for employees. Adherence rates in WHPP are generally in the low range [42] (< 50%), and web-based interventions, when tailored, were observed to be effective [43] only for a short period of time after the study period [44]. In the current study protocol, the web-based tailored interventions are accompanied with the support of different health professionals (nurse, nutritionist and exercise specialist/kinesiologist) throughout the 3-year period. Therefore, the adherence rate and effectiveness of the options A, B and C are expected to be higher. In addition, a study [45] with a similar approach, i.e., targeting six health behaviors, but differing in the study population (male participants at high risk of cardiovascular disease without a control group), the variety of interventions offered (3.5 h of health promotion class), and study duration (6 months) led to an increase in physical activity, improved stress management, diet control, blood pressure, total cholesterol and BMI, which are some of the variables that will be included in future studies. Therefore, *Activate Your Health* might lead to similar or better results as it regroups any health profile of employees, has a longer study period, provides different interventions that are web-based, and support the company in creating a favorable work environment.

One of the advantages of the *Activate Your Health* program is the varying number of interventions, which allows us to compare the effect of different combinations of interventions on health and work-related variables. We did exclude the option D as none of the companies chose that option. We can deduct that such an option might be less appealing for companies. It would have been interesting to compare the option A, which contains all the interventions targeting eating and PA habits vs. the option D, which had only interventions improving eating habits. Nevertheless, we do have the limited option (control group) that did not receive any interventions to compare the effectiveness with the other options. Moreover, Nöhammer et al. (2010) suggested that WHPP could benefit from documenting the employee's perspective of the interventions. At the end of the current WHPP, a questionnaire regarding each intervention will be sent to all the employees, in order to study their perspective. Also, throughout the year, Capsana also supports each company in the creation of a favorable environment by providing advice and/or help [46]. Modifying the work environment by decreasing unhealthy food available at the work site within the company, for example, could have positive impact on the employees' health and the organization as a whole [46].

Some limitations should be considered. The data collection method consists of filling questionnaires. Most of the variables of interest, such as PA level and eating habits, in the current program and its variations come from these self-reported answers. Objective measures such as accelerometer data could have been used to identify the changes that are taking place within the different options. Moreover, participants who have successfully changed their lifestyle habits will be more inclined to remain actively involved in the *Activate Your Health* program, and to be reassessed, which was the case in another study [47]. In addition, Nilsen et al. [47] (2014) noted the majority of their participants with diabetes who dropped out were the participants with a poor life satisfaction and needed help with their lifestyle habits. Taking these observations into account, specific analysis will be performed to examine this aspect in *Activate Your Health*.

In the *Activate Your Health* program, among other advantages, assessing employees' health using health-related assessments, targeting several lifestyle habits at once, offering tailored interventions, providing social platforms, improving the workplace environment, and offering a three-year program would most likely improve employees' lifestyle habits [46]. Future studies will also focus on gender and body weight status response. In the end, the goal would be to articulate which type of intervention works best and for whom, to consolidate but also to improve interventions.

Abbreviations
BMI: Body mass index; PA: Physical activity; ROI: Return on investment; WHPP: Workplace Health Promotion Program

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Roles and responsibilities of the different groups overseeing the project:
Sponsors
(*SOScuisine* and Sprouts)
Provide an initial financial support and intervention tools
Trial management committee and data collection
(Capsana, Senior Director: Isabelle D'Aoust)
Recruitment of participating companies
Communication with the participating companies
Data collection from each participant
Data entry
Data anonymization all the data
Intervention delivery
Data verification, in collaboration with the research team
Control the data access (sharing data with the research committee only)
Provide a general portrait of the employees to the respective companies
CAPSANA is the owner of the data but gives to the Université de Montréal a non-exclusive and perpetual user license for non-commercial teaching and research purposes. Both institutions share the decision towards publication of the results.
Research committee
(Principal investigator Marie-Eve Mathieu)
Study design
Preparation of the protocol and revision
Data analysis
Evaluation of the program
Agreement of the final protocol
Advice trial management committee and data collection
Final decision of the changes to the protocol
Writing publications and submission of the articles
Presentation of the results

Protocol version 1 (May 12, 2019)

World Health Organization Trial Registration Data Set:

Data category	Information
Primary Registry and Trial Identifying Number	NCT02933385
Date of Registration in Primary Registry	October 5' 2016
Secondary Identifying Numbers	NONE
Source(s) of Monetary or Material Support	Public Health Agency of Canada and Capsana
Primary Sponsor	Public Health Agency of Canada and Capsana
Secondary Sponsor(s)	*SOScuisine* and Sprouts
Contact for Public Queries	Isabelle D'Aoust www.capsana.ca 514,985–2466, poste 232 300, rue Léo-Pariseau, 18[e] étage, bureau 1810 Montréal (Québec) H2X 4B3
Contact for Scientific Queries	Pr. Marie-Eve Mathieu me.mathieu@umontreal.ca Tel. 514–343-6737 EKSAP, Université de Montréal, P.O. Box 6128, Downtown Station, Montreal, Canada. H3C 3 J7. Université de Montréal
Public Title	Activate Your Health, a workplace healthy lifestyle promotion program: study design
Scientific Title	Activate Your Health, a 3-year, multi-site, parallel-group, workplace healthy lifestyle promotion program: study design
Countries of Recruitment	Canada
Health Condition(s) or Problem(s) Studied	Lifestyle habits and health risk factors
Interventions	Four different arms varying by the number and type of interventions included (one control group with no intervention). Personalised online menus, support in creating a favorable environment, challenges, conferences, health coaching, closing events, health screening and flexibility assessment, CANRISK questionnaire, distribution of publications, social health platform, and activity tracker.
Key Inclusion and Exclusion Criteria	Program offered to everyone who is not at risk upon adoption of health lifestyle habits. Pregnant women were excluded.
Study Type	Interventional Non-randomized, Double blind (subject, investigators and outcomes assessors), evaluate which combinations of healthy lifestyle habits are the most beneficial.
Date of First Enrollment	December 2016
Sample Size	Target: 5000.
Recruitment Status	Completed
Primary Outcome(s)	Self-administered questionnaire filled at baseline and after years 1, 2, 3. Physical activity parameters, eating habits, smoking habits, alcohol consumption, sleeping habits, stress level and intention to improve these habits.

World Health Organization Trial Registration Data Set: *(Continued)*

Key Secondary Outcomes	Health screening by nurses at baseline and after years 1, 2, 3.Waist circumference, weight, height, body mass index (BMI), plasma HDL and HDL/total cholesterol ratio, blood glucose concentration, systolic and diastolic blood pressure, flexibility level and risk factor profile are assessed.
Ethics Review	Approved (November 1, 2016) Guillaume Paré, CERES 333 Queen-mary, 2e étage, bur. 220–3 Montreal, QC H3V 1A2 514–343-6111 ext. 2604 ceres@umontreal.ca
Completion date	Ongoing study
Summary Results	NONE
IPD sharing statement	No

Authors' contributions

For the current paper, TAK wrote the manuscript. FL performed the data management, provided feedback on the draft and final manuscript. SL and JT: Conception and substantial revision. MEM: Conception; contributed to the design, substantial revision and supervised the research team. All authors have read and approved the manuscript. In the future, MEM will remain the last author and the student or co-investigator leading a publication project will be the first author. Other contributors will be second to second-to-last authors, in diminishing order based on their contribution.

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Availability of data and materials

Not applicable. The results will be communicated to the participants and to other relevant groups via publications (open access will be prioritized) and presentations, including webinars.

Ethics approval and consent to participate

The Health's Research Ethic Committee of Université de Montréal approved this study (16–063-CERES-D (1)). Participants consented online (written) before filling the self-administered health questionnaire.

Consent for publication

All the participants included in the *Activate Your Health* program consented for publication. No additional individual person's data in any form (details, images or videos) were used.

Competing interests

All the authors (TAK, FL, SL, JT, MEM) declare a potential conflict of interest as the program is co-financed by the Public Health Agency of Canada and Capsana. However, none of the authors work for Capsana.

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