# WORK HOURS, SOCIAL RELATIONSHIPS, AND PHYSICAL ACTIVITY AMONG THE CANADIAN WORKFORCE

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## DEDICATION

This research is dedicated to my family and friends, the struggling workforce, and anyone fighting a chronic disease.

## ABSTRACT

The purpose of this study was to examine associations between work hours, social relationships, and domain-specific physical activity among the Canadian workforce. This study utilized cross-sectional data of about 24,132 participants aged 18 to 74 from the 2018 Canadian Community Health Survey (CCHS). Descriptive statistics and negative binomial regression controlling for age, sex, income, education, and occupation were used for the data analysis.

Higher work hours were associated with less active transportation (incidence rate ratio (IRR): 0.996, 95% CI (0.995, 0.997)), more recreational physical activity (IRR: 1.003, 95% CI (1.002, 1.005)), and less work and household physical activity (IRR: 1.01, 95% CI (1.005, 1.009)).

Social relationships assessed with social provisions scale were associated with less active transportation (IRR: 0.84, 95% CI (0.772, 0.921)), less recreational physical activity (IRR: 0.68, 95% CI (0.622, 0.742)), and less work, and household physical activity (IRR: 0.80, 95% CI (0.727, 0.879)).

The findings of this study suggest that social relationships are associated with lower rates of physical activity in all domains whereas the effect of work hours varies by domain.

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## LIST OF ABBREVIATIONS

WHO World Health Organization
GNI Gross National Income
BMI Body Mass Index
GDP Gross Domestic Profit
DALY Disability-adjusted Life Years
CCHS Canadian Community Health Survey
SPSS Statistical Package for Social Sciences
NOC National Occupation Classification
IRR Incidence Rate Ratio

# CHAPTER 1: INTRODUCTION

As early as 2500 BC, historical studies indicated the importance of physical activity on well-being (MacAuley, 1994). During the twentieth century, occupational physical activity was more frequent among workers with lower socioeconomic status, while workers with higher socioeconomic status were at greater risk of chronic diseases (MacAuley, 1994). Hence, epidemiological research on the importance of physical activity for the workforce began to expand, and awareness of physical activity benefits for disease prevention increased (MacAuley, 1994). Over the years, humans have become less physically active due to lifestyle and technological advancement (Katzmarzyk & Mason, 2009; Shimoga et al., 2019; World Health Organization, 2020). For example, lack of motivation, lack of support, insufficient time, elevators, escalators, vehicles, and computers have been linked with reduced physical activity levels (Kuiack et al., 2007; Shimoga et al., 2019; Welk, 2002). Although technology has made life easier, it has contributed to lower levels of physical activity. For instance, many individuals in this present day and age would rather send a text message than walk to the next room to the intended recipient, more people engage in online shopping than walk into stores, and more people use the elevators at their offices than the stairway (Shimoga et al., 2019).

Apart from technology, conditions in which people live and work, also known as the social determinants of health, may influence people's lifestyle and health (World Health Organization, 2010, 2018). The social determinants of health can impact an individual's access to health services, better health care, and longer life expectancy (Raphael, 2016; World Health Organization, 2010). Instead of viewing physical activity as the responsibility of each individual, it is crucial to consider social factors that might be related to physical

activity. Therefore, this study examines the associations between work hours, social relationships, and physical activity among the Canadian workforce.

## Conceptual Framework

The conceptual framework for this research is the social determinants of health. According to the World Health Organization (2008), conditions in which people grow, live, work, and age contribute to health circumstances. Although the social determinants of health are essential to Canadians, the effects of the social determinants of health on health behaviours are not well acknowledged (Raphael, 2016). For instance, there is increasing awareness about the benefits of improving health, but less attention is given to improving living and working factors contributing to poor health (Raphael, 2016). This conceptual framework portrays how aspects of the social determinants of health can influence physical activity.

### *Education*

Education enables better collection and understanding of information. Individuals with different levels of education have different employment opportunities, income levels, social status, and knowledge of healthcare. Furthermore, education is associated with job characteristics and work conditions (Mikkonen & Raphael, 2010). For example, workers with higher levels of education are more likely to have jobs with a better working environment, including safer physical, social, and psychosocial work circumstances (Braveman et al., 2011).

On average, greater educational attainment leads to higher income, and there is evidence that income enables the availability of resources to improve health (Glymour et al., 2014). Furthermore, Solar and Irwin (2007) emphasize that education is a significant factor in determining an individual's socioeconomic status. Moreover, the higher a person’s

educational attainment and social status in the occupational hierarchy of the workplace, the better chances of health improvement (Glymour et al., 2014).

### *Income*

Income is obtained through employment, and income is essential for a good living (Solar & Irwin, 2010). An individual's income contributes to their standard of living and social class. Moreover, income is connected to occupation, job characteristics, work conditions, social class, and residence. People with better income have better chances of affording necessities required to improve health (Mikkonen & Raphael, 2010; Raphael, 2016; Solar & Irwin, 2007), and thus have higher life expectancy than people living in impoverished areas (Mikkonen & Raphael, 2010). The mortality rate of Canadians living in poor neighbourhoods is 28% higher than in wealthy neighbourhoods (Mikkonen & Raphael, 2010), and they have access to fewer environmental, social, and health amenities due to income inequality.

Income inequality has increased over the years, and Canada is among the developed nations with increasing income inequality (Mikkonen & Raphael, 2010). A Canadian study estimated that income inequalities contribute to 40,000 excess deaths annually (Tjepkema et al., 2013). This study included about 2.3 million Canadians, with the researchers following participants for 16 years. These deaths could have been avoided if the majority of Canadians were as healthy as the few highest income earners (Tjepkema et al., 2013). This is because high-income earners can afford resources to maintain health and have greater access to health care facilities. Reducing income inequality is essential for improving population health.

Health outcomes are dependent on the distribution of resources and wealth in society (McNeill et al., 2006). Another Canadian study reported that 67% of poor men and

52% of poor women are at higher risk of premature mortality than wealthy men and women (Raphael, 2016). The study indicated that poor people have a higher risk of morbidity and early mortality than wealthy individuals (Raphael, 2016). Furthermore, Raphael (2016) found that countries with unequal wealth distribution are prone to insufficient health improvement, even among higher-income nations. At the same time, countries with better wealth distribution have a higher life expectancy, lower infant mortality rate and more remarkable health improvement (Raphael, 2016). Wealth distribution and income inequality contribute to population health differences across the globe. Poor health limits people's ability to work and earn a living.

### *Occupation and Employment*

Employment generates income and enhances well-being. Employment insecurity leads to poor work conditions (inflexible work hours, lower-income, poor physical and psychosocial work environment), and Canada is experiencing increasing employment insecurity (Mikkonen & Raphael, 2010; Osberg, 2020). The Whitehall study of British civil servants revealed that people with higher occupational rank possess better health behaviour, including physical activity, than people with lower occupational positions (Marmot et al., 1991). Hence, awareness of occupational status' impact on health increased (Pronk et al., 2019). Occupation contributes to socioeconomic status and social networks (Raphael, 2016). Diverse occupations have different work conditions, income levels and job demands. For example, individuals in the manufacturing industry, transport sector, engineers, lawyers, managers, and health care workers are likely to work more hours because of job characteristics (Employment and Social Development Canada, 2017). Occupational classification creates a social hierarchy (Raphael, 2016; Solar & Irwin, 2010),

and people in the same occupational group tend to belong to similar economic and social groups.

### *Gender*

Gender is an essential determinant of health connected to differences in socioeconomic status and health outcomes (Phillips, 2005). Research has highlighted the effect of gender-based inequality in society. Gender inequality has affected health through discriminatory laws, lack of resources, lower-income, and education restrictions. For example, in some societies, women are not encouraged to have secondary and post-secondary education; instead, they are persuaded to get married and have children (Solar & Irwin, 2007, 2010; World Health Organization, 2010). There are also fewer women than men in workplace leadership roles and they tend to have lower positions and pay, even for comparable duties (Johnson, 2020; Solar & Irwin, 2007).

Researchers have found that women are more likely to perform domestic work than professional duties compared to men (Mikkonen & Raphael, 2010; Moyser, 2017; Solar & Irwin, 2007). In Canada, many women earn less than men and are less likely than men to be promoted at work and receive unemployment benefits (Antonie et al., 2016; Mikkonen & Raphael, 2010). Additionally, more men are in the workforce than women because many women stay home to deal with domestic duties and child care (Mikkonen & Raphael, 2010). Even women in the workforce can have greater domestic duties while working due to social roles and gender norms regarding domestic tasks (Solar & Irwin, 2010; World Health Organization, 2010). Studies show that the effects of women working longer hours have been more recognizable in this present decade (Artazcoz et al., 2009; Mikkonen & Raphael, 2010; Weeden et al., 2016). For example, many women are expected to spend more hours

at work to be viewed as dedicated workers, and they are also expected to perform domestic duties after work to be viewed as ideal women and homemakers (Weeden et al., 2016).

### *The Health System*

An essential role of the health system is to foster healthy policies that will improve public health and generate greater access to health promotion services. Another essential role is to provide public health education (Solar & Irwin, 2010). Studies have shown that education and counselling provided by health care professionals have led to increases in physical activity (Coom et al., 2020; Vuori et al., 2013). Results from a randomized trial revealed an 18 minutes per week increase in physical activity among people receiving physical activity counselling from their health care facility (Vuori et al., 2013). Researchers have emphasized that having health professionals evaluate people's needs, motivation, and physical activity barriers is important for promoting physical activity (Coom et al., 2020; Vuori et al., 2013). Vuori et al. (2013) suggest educating health care workers on ways to incorporate physical activity in patient care. For instance, medical professionals should receive training on assessing the physical activity needs of individual patients, advising patients and following up with patients (Vuori et al., 2013), because physical activity counselling is often omitted from the curriculum of many health care workers, and health care workers may have limited time to read research on physical activity counselling (Coom et al., 2020; Vuori et al., 2013). Therefore, encouraging health care workers to advance their knowledge of physical activity counselling will benefit public health.

Although Canada is known for its prominent role in developing global health promotion policies, the impact of the social determinants of health on the Canadian population is not given adequate attention (Raphael et al., 2008). A significant reason for this lack of proper attention is that the social determinants of health are often treated as an

individual's duty rather than using a population approach (Raphael et al., 2008). Viewing the determinants of health from an individual lens takes responsibility away from stakeholders such as policy makers, health professionals, and the government. Further, it implies that an individual's working, living, and health conditions are entirely the choice of the individual (Gerlach et al., 2018; Raphael et al., 2008; Solar & Irwin, 2010). Thereby, undermining the political, economic, and social factors that might affect health.

Although several frameworks and theories on health behaviours exist, they fail to provide an in-depth explanation of the influence of various social factors on health behaviours. For example, the Theory of Reasoned Action explains behaviours based on pre-existing attitudes and norms, the Theory of Planned Behaviour examines behavioural intentions and perceived control, and the Health Belief Model considers health behaviour as a function of individual-level factors such as attitude and belief (Glanz et al., 2015). The conceptual framework employed in this present study is relevant because it shows the impact of the social determinants of health on population health. This conceptual framework is based on the World Health Organization's Conceptual Framework for the Actions on the Social Determinants of Health (CSDH) by Solar and Irwin (2010). The framework examines structural determinants such as education, income, gender, and occupation (Solar & Irwin, 2010). The framework considers intermediary determinants such as work conditions, physical environment, health systems, age, and health behaviours (Solar & Irwin, 2010). The framework examines social capital (social relationships), a cross-cutting determinant linking structural and intermediary determinants (Solar & Irwin, 2010). The conceptual framework used in this study aims to highlight that populations are stratified based on structural determinants, thereby shaping intermediary determinants, and affecting health outcomes (Solar & Irwin, 2010).

## Background of the Study

Global levels of moderate to vigorous-intensity physical activity are low, with one in three adults not attaining the recommended levels of 150 minutes per week (Hayes et al., 2019). In a population-based survey of 1.9 million adults from 168 countries, the prevalence of low physical activity was 27.9% (Guthold et al., 2018). Out of 168 countries, the prevalence of physical activity was higher in men in comparison to women in 159 countries. Only Southeast and East Asian nations had more physically active women than men (Guthold et al., 2018). This study used self-reported physical activity, which is vulnerable to social desirability bias, hence the prevalence of physical inactivity may be underestimated.

The prevalence of low physical activity has increased in high-income countries, including Canada, while the prevalence has remained stable in low-income countries over a decade (Guthold et al., 2018; Statistics Canada, 2019). High-income countries are countries with a gross national income (GNI) per capita of $12,696 or more (The World Bank, n.d). Low-income countries are countries with GNI per capita of $1,045 or less (The World Bank, n.d). Research has shown that physical activity levels in low-income countries are two times higher than in high-income countries (Ding, 2018; Ozemek et al., 2019). In high-income countries, 42.3% did not achieve the recommended levels of 150 minutes of moderate physical activity or 75 minutes of vigorous physical activity per week whereas 17.9% did not fulfil the physical recommendations in low income countries (Ozemek et al., 2019).

This difference in physical activity can be attributed to policy, access to motorized transportation, social, cultural, and environmental factors (Katzmarzyk & Mason, 2009; Ozemek et al., 2019; World Health Organization, 2020). Individuals from countries that do

not experience extreme cold weather conditions may be more likely to engage in outdoor recreational physical activity, and active transportation (Guthold et al., 2018). However, a study in Iran reported that more individuals participated in indoor physical activity than outdoor activities in the summer because of the hot weather (Aliyas, 2019). In contrast, a study of older Norwegian adults reported greater outdoor physical activity levels in the warmer season than the colder season (Aspvik et al., 2018). Physical activity in cold regions increases during summer and declines during winter whereas physical activity in hot regions declines during summer than in winter (Tucker & Gilliland, 2007).

In a Canadian longitudinal study, weather and climate effects on pedometer-measured physical activity varied according to body structure and gender (Chan et al., 2006). During snowfall, lean men increased their physical activity, class I obese women decreased their physical activity, and there was no significant change in physical activity levels in lean women and class I obese men (Chan et al., 2006). Chan et al. (2006) classified individuals with a body mass index (BMI) of "20" as lean men and women. Men and women with a BMI of "30" were classified as class I obese men and women. Participants with a BMI of "35" were classified as class II obese men and women. There was a non-significant increase in physical activity for men with a BMI of "35" whereas there was a decline in physical activity for women with a BMI of "35" (Chan et al., 2006).

Technology is another factor associated with physical activity differences between low-income and high-income countries. With greater levels of technological advancement in high-income countries, there are fewer manual tasks and higher use of machinery to perform occupational and domestic duties (World Health Organization, 2020). Thus, people in high-income countries tend to be less physically active compared to people in low-income countries. In addition, there is less access to motorized transportation in rural

areas of low-income countries (Katzmarzyk & Mason, 2009). The World Health Organization (WHO), 2020 concluded that higher physical activity levels in low-income countries could be attributed to less technology and greater use of active transport.

Social norms and policy have been linked with physical activity levels (Ball et al., 2010; World Health Organization, 2020). For instance, active transportation and better community support for physical activity is a norm in many low-income countries (World Health Organization, 2020). Uganda is the most physically active country globally, with 94.3% of Ugandans achieving the WHO physical activity recommendation (Guwatudde et al., 2016). This high physical activity prevalence among Ugandans is attributed to societal norms, active transportation, occupation-related physical activity, and community-based physical activity. Although active transportation such as walking and cycling in China has decreased in the past decade (Gong et al., 2020), leisure-time physical activity in China has increased, which is attributed to the improvement of parks and increased park use for physical activity (Guthold et al., 2018).

Residents of higher-income countries are more likely to participate in leisure-time physical activity, whereas individuals living in lower-income countries have higher work and household physical activity (Strain et al., 2020). Generally, physical activity levels vary across countries; however, there are similarities between high-income and low-income countries: the younger population is more likely to increase their physical activity than the older population (Ozemek et al., 2019). This similarity is because physical activity levels tend to decline with age.

## Study Purpose and Significance

Canada needs a healthy workforce to function appropriately and compete in the global economy (Dollard & Neser, 2013; Shamian & El-Jardali, 2007). In order to achieve

a healthy workforce, it is vital to assess factors that might affect the health of the working population. In recent years, most studies on the working population focused on ergonomics, stress, and workplace injury. Improving the health of the workforce also requires preventive health care and upstream measures. According to prevention strategies in public health, physical activity is an example of preventive health care (Durstine et al., 2013), thus reducing the risk of diseases, limiting disease complications and improving the quality of life (Durstine et al., 2013; Hart et al., 2017; Kisling & Das, 2020).

Despite widespread knowledge of increased physical activity's importance for well-being, limited research looks at work hours, social relationships, and physical activity among Canadian workers. This study examines associations between work hours, social relationships, and physical activity among Canadian workers. These variables were selected because hours spent at work and social relationships are important aspects of workers' lives, and this study aims to examine their impact on workers' physical activity.

## Research Questions

The following research questions were answered in this study:

1. What is the association between work hours and physical activity among the Canadian workforce?
2. What is the association between social relationships and physical activity among the Canadian workforce?

## Hypothesis

The following hypotheses were tested:

1. **H0**: There is no association between work hours and physical activity among the Canadian workforce.

**H1:** There is an association between work hours and physical activity among the Canadian workforce.

2. **H0**: There is no association between social relationships and physical activity among the Canadian workforce.

   **H1:** There is an association between social relationships and physical activity among the Canadian workforce.

## Thesis Organization

This thesis is presented in chapters. In Chapter One, the study background, significance, conceptual framework, and research questions are introduced. In Chapter Two, the literature relating to social relationships, physical activity, work hours, and the Canadian workforce are extensively reviewed. In Chapter Three, the research methodology, including the variables characteristics and statistical method, is explained. In Chapter Four, the study results are presented. Chapter Five consists of overall study conclusions, including the discussion section, strengths and limitations, practical implications, and future research recommendations.

# CHAPTER 2: LITERATURE REVIEW

This chapter provides a brief review of the literature on physical activity, work hours, social relationships. A short description of the Canadian workforce is included. Due to the limited research on this topic in Canada, this literature review presents studies that examined work hours, social relationships, and physical activity not only from Canada but other countries as well.

According to the World Health Organization, physical activity is any bodily movement performed by the skeletal muscles, leading to energy expenditure (World Health Organization, 2020). The recommended level of physical activity is 150 minutes of moderate to vigorous intensity per week (World Health Organization, 2020).

Work has a significant role in human life by generating income and enhancing well-being. For this reason, more than 80% of North American adults belong to the workforce (Kirk & Rhodes, 2011). Because most individuals spend most of their lifetime working, it is vital to examine how hours spent at work may impact workers physical activity. Work hours in this study was operationalized as the usual total hours spent at work per week.

Humans are social beings and thus, require relationships to connect in society. The majority of studies on social relationships focused on the number of social relationships and the frequency of social gatherings. Other studies conducted for specific populations operationalized social relationships as the presence of social or emotional support (Eyler et al., 1999; Heaney & Israel, 2008; Singer, 2001; Smith et al., 2017; Spanier & Allison, 2001; Umberson et al., 2010). In the present study, social relationships consist of relationships that provide social, informational, appraisal, emotional, instrumental, and network support or companionship. Because social relationships are a vital form of human connection, and

people spend most of their lifetime working, it is beneficial to examine the association between work hours, social relationships, and physical activity.

## The Canadian Workforce

The Canadian workforce has evolved over the years, with changes in demographics and a growing population. Consider that, in the 1960s, 80% of Canadian men belonged to the workforce, while only 35% of Canadian women were workers (Phillips, 2015). In the 1980s, 55% of Canadian women and 75% of Canadian men belonged to the workforce (Phillips, 2015). Since the 1990s, the number of female workers is increasing, and 61.4% of women are present workforce members (Statistics Canada, 2020). There have also been changes in the age structure of the workforce. The current workforce consists of more men and women above the age of 50 compared to past decades (Statistics Canada, 2020). The proportion of individuals aged 60-64 in the workforce increased from 43% in 1995 to 61% in 2017 and from 23% for men and 49% for women (Martel, 2019). In addition, educational attainment in the Canadian workforce has increased over the years. There was a 23.6 % increase in full-time workers with tertiary education between 1980 to 2010 (Osberg, 2020). The proportion of immigrant workers and minority groups in Canada have increased from 7% in 1996 to 20% in 2020, with an estimated increase to 25% by 2036 (Martel, 2019). It is estimated that by 2036 there would be a growth of 3.2 million people in the workforce (Martel, 2019). The growing population of the workforce and the changing demographics contribute to the need for this research to examine conditions that may affect the health of the workforce.

## Prevalence of Physical Activity

Despite increasing awareness of physical activity benefits, only 16% of Canadians meet the recommended 150 minutes of moderate to vigorous intensity per week based on accelerometry data from the Canadian Health Measure Survey (Statistics Canada, 2019). The prevalence of physical activity in Canada was higher among men than women, and it declined with age, with younger adults being more physically active than older adults (Statistics Canada, 2019). This finding showed the relevance of the health determinants such as age and sex on physical activity.

A Canadian longitudinal study conducted between 2001 and 2005 examined physical activity levels among 6,134 men and 9,457 women between ages 35 to 69 (Csizmadi et al., 2011). The participants answered a short validated self-administered questionnaire on past year total physical activity. Participants were classified as “inactive”, “low active”, “active”, and “very active”. Occupation was associated with the highest proportion of physical activity in men categorized as very active (32%), active (18%), and low active men (11%). At the same time, there were no major differences in the levels of leisure and household physical activity for very active, active, and low active men.

Workplace and household activities accounted for a greater proportion of physical activity in Canadian men and women than leisure-time physical activity (Csizmadi et al., 2011). Occupational physical activity accounted for a greater proportion of physical activity in men classified as “very active”. Household physical activity accounted for the greatest proportion of physical activity for women classified as “inactive” and “low active” (Csizmadi et al., 2011).

In contrast, physical activity based on active transport was minimal for both men and women, notwithstanding the activity level (Csizmadi et al., 2011). Moreover, only 6%

of  Canadians use active transportation such as cycling and walking to work (Hilbrecht et al., 2014). This finding suggests that many Canadians do not frequently engage in active transport to work, but they could work or cycle to other places.

The World Health Organization announced COVID-19 as a pandemic in March 2020. (Lesser & Nienhuis, 2020). To reduce the spread of COVID-19, the Canadian Public Health Agency implemented self-isolation and movement restrictions, thereby enabling non-essential service workers to work from home (Jakobsson et al., 2020). Findings from a 2020 Canadian study revealed that 22.4% of physically active individuals became less active, while 40.3% of active individuals increased their physical activity during the pandemic (Lesser & Nienhuis, 2020). For physically inactive individuals, 40.5% became less active, while 33% increased their physical activity during the pandemic (Lesser & Nienhuis, 2020). Interestingly, there was a greater reduction in physical activity among inactive individuals than their physically active compeers.

During the lockdown, some individuals had more time to increase their physical activity at home (Lesser & Nienhuis, 2020). In comparison, other individuals spent more time working on their computers since they were absent from the workplace (Ainsworth & Li, 2020). However, Jakobsson et al. (2020) emphasized that attaining the recommended guideline of 150 minutes of moderate-vigorous intensity physical activity per week during the pandemic is feasible. Whether there is a pandemic or not, many Canadians do not fulfil the physical activity recommendation. This finding highlights the need to increase physical activity of Canadians. Thus, this research will be useful in contributing to information to support the development of interventions to increase physical activity of Canadians.

## Domains of Physical Activity

### *Active Transportation*

Active transportation is a form of physical activity that involves walking or cycling. Active transportation is an efficient way to increase physical activity levels. For example, Brockman and Fox (2011) discovered that approximately 70% of participants who frequently went to work using active transportation achieved 80% or more of the recommended physical activity guideline. Likewise, another study reported that people who engaged in active transportation displayed higher total physical activity levels compared to people who did not engage in active transport (Sahlqvist et al., 2012). Populations with higher rates of active transportation are less prone to metabolic diseases (Brown et al., 2016; Gordon-Larsen et al., 2009) and work absence due to sickness (Hendriksen et al., 2010). Active transportation is associated with higher levels of physical well-being in the workforce, and reduced mortality rate due to air pollution, carbon dioxide emission, and traffic accidents (Humphreys et al., 2013; Rojas-Rueda et al., 2016). Therefore, active transportation is beneficial to health and the environment.

### *Recreational Physical Activity*

Recreational physical activity, also known as leisure-time physical activity, include gym exercises, activities, and sports performed during free time. Physical activity for recreation has been associated with higher health-related quality of life in males and females (Vuillemin et al., 2005).

### *Work and Household Physical Activity*

Household physical activity includes cleaning, gardening, vacuuming, carrying heavy loads and other chores performed in the house for more than ten minutes (Statistics

Canada, 2018). Household physical activity performed for at least ten minutes have been reported to increase the prevalence of fulfilling the WHO physical activity recommendation, especially in women and older people (Murphy et al., 2013; Phongsavan et al., 2004). Household physical activity is associated with cancer risk reduction (Shi et al., 2015), and reducing the risk of early mortality (Martínez-Gómez et al., 2014; Park et al., 2020).

Physical activity performed at work, also known as occupation physical activity, includes walking, carrying heavy loads, construction, and manual labour performed for more than ten minutes (Statistics Canada, 2018). Some studies found that physical activity during work is greater in blue-collar workers than white-collar and professional workers (Azevedo et al., 2020; Steele & Mummery, 2003). This finding was foreseeable because blue-collar workers perform mostly manual labour. Meanwhile, Steele and Mummery (2003) using Occupational Physical Activity (OPA) questionnaire and a pedometer for three consecutive days found no differences in workplace physical activity between white-collar workers and professional workers in Australia. Managers and administrators were classified as professionals (Steele & Mummery, 2003). Sales, clerical, and service workers were classified as white-collar workers (Steele & Mummery, 2003). Transport workers, production workers and labourers were classified as blue-collar workers (Steele & Mummery, 2003).

## Benefits of Physical Activity

Physical activity is vital for reducing the risk of morbidity and early mortality. The World Health Organization declared insufficient physical activity as a major risk factor of global premature deaths, accounting for 6% of global mortality (World Health Organization, 2018). Globally, chronic diseases account for three in five deaths, and 10%

of chronic diseases were attributed to insufficient physical activity (Hajat & Stein, 2018; Ozemek et al., 2019). Meanwhile, in Canada, the prevalence of chronic diseases associated with insufficient physical activity is 82.5% for adults (Branchard et al., 2018). Indeed, physical activity reduces the risk of chronic diseases, including cancers such as breast, oesophageal, stomach, endometrial, and colorectal (Booth et al., 2012; Warburton et al., 2010; Yang, 2019). Physical activity has a significant role in preventing metabolic disorders such as obesity and diabetes, improving metabolic rate and reducing the likelihood of weight gain (Strasser, 2013). In addition, physically active individuals are less likely to be obese than their physically inactive counterparts (Strasser, 2013). Physical activity is also important for glucose and insulin metabolism (Strasser, 2013).

Physical activity has been associated with reducing the risk of cardiovascular diseases, and there is evidence that improving physical activity is a protective factor for normal heart rate, normal blood pressure, and healthy blood circulation (Vuori, 2010). Furthermore, Warburton et al. (2010) found a 32% risk reduction of hypertension among physically active individuals. Apart from cardiovascular health, other benefits of improving physical activity are strengthened musculoskeletal health, better bone health, and protection against fractures and osteoporosis (Warburton et al., 2010). Additionally, physical activity is vital for cerebrovascular health, and it was ascertained that physical activity reduces the risk of stroke (Warburton et al., 2010). These findings show that physical activity is necessary for chronic disease prevention.

Physical activity is vital for mental health. For example, in a cohort study, Harvey et al. (2018) found a 12% reduction of future cases of depression among physically active individuals compared to physically inactive individuals. Biddle (2016) found that physical activity is associated with stress reduction, while Lesser and Nienhuis (2020) reported that

physically active individuals have less anxiety than their inactive counterparts. Physical activity is also beneficial to worker's performance. For example, Brown et al. (2011) found a positive association between physical activity, job satisfaction, and emotional well-being. Physically active workers displayed an excellent mood and exemplary job performance (Brown et al., 2011). In conclusion, numerous studies have established that physical activity is essential for preventing diverse health problems and promoting work performance. Physical activity fosters immediate and long-term health benefits.

## Workers' Perception about the Benefits of Physical Activity

Although only 16% of Canadians met the recommended physical activity guidelines, most Canadians agree that physical activity is beneficial to health (Cragg et al., 2008; Statistics Canada, 2019). For instance, 91% of Canadians acknowledge that physical activity is a coping mechanism for workplace stress (Cragg et al., 2008). At the same time, 89% and 85% of Canadians acknowledge that physical activity is beneficial for recovering from slight sickness and increasing work productivity, respectively (Cragg et al., 2008). Although existing studies have reported that men are more physically active than women, Cragg et al. (2008) found that more women than men acknowledge that physical activity is beneficial for workers' health. Women were more likely than men to strongly agree that physical activity enables them to recover from slight sickness quickly, increasing work productivity and effectiveness (Cragg et al., 2008). Physical activity participation and perception were different between men and women.

Canadian workers with higher socioeconomic status are more likely to strongly agree that physical activity is beneficial to workers' health than workers with lower socioeconomic status (Cragg et al., 2008), the higher the level of education and income, the higher the likelihood of agreeing that physical activity is significant for workers health.

Professional workers, including managers, are more likely than non-professionals to strongly agree that physical activity improves job effectiveness and stress management (Cragg et al., 2008). Furthermore, employees in smaller companies (< 100) are less likely than employees in larger companies (≥1000) to strongly agree that physical activity is beneficial for stress management (Cragg et al., 2008). These findings showed that although most Canadian workers agree that physical activity is vital for their health, this agreement was more frequent among workers with better social determinants of health.

## Workers' Health and the Economy

The health of the working population is indispensable because a healthy workforce is necessary for good living and the national economy. Indeed, a healthy working population positively impacts the gross domestic product (GDP), national economy and national life expectancy (Dollard & Neser, 2013). A healthy workforce will increase work productivity, generate profits, and reduce labour costs, while a sick workforce results in work absence. Interestingly, Masala et al. (2017) found that increasing physical activity level was associated with reduced sick days and absence from work. Absence from work contributed to higher production costs, workers' substitution, and economic distress (Dollard & Neser, 2013). Losina et al. (2017) examined the association between physical activity and absenteeism among 292 workers for 24 weeks. Workers who fulfilled the physical activity recommendation had an average work absence of five hours due to unplanned sickness (Losina et al., 2017). In comparison, workers with the least level of physical activity had 19 hours of absenteeism (Losina et al., 2017). This finding was consistent with other studies regarding physical activity and work absence, including studies about workers with chronic sickness (Burton et al., 2014; López-Bueno et al., 2020). A systematic review revealed that moderate-vigorous physical activity was associated with

reduced work absenteeism in 19 studies (Pereira et al., 2015). These findings indicate that physical activity is vital for workers' health and the economy.

## Economic Burden of Physical Inactivity

Physical activity is an advantage to the economy. Insufficient physical activity generates a burden of cost for individuals, the government, and the health care system. For example**,** physical inactivity generated an annual cost of $53.8 billion globally and $10 billion in Canada (Ding et al., 2016; Krueger et al., 2015; Krueger et al., 2014). Early mortality due to low physical activity contributed to an economic burden of $13.7 billion in Canada and 13.4 million disability-adjusted life years (DALY) globally (Ding et al., 2016). The financial burden attributable to insufficient physical activity has increased over the years. For instance, the total health expenditure attributable to insufficient physical activity in Canada was $2.1 billion in 1999, $5.3 billion in 2009, and $10.8 billion in 2013 (Janssen, 2012; Krueger et al., 2015). It was estimated that 28% of Canada's economic burden associated with insufficient physical activity could be avoided by increasing physical activity (Krueger et al., 2015). It was reported that 7.8% of workers who frequently use active transportation save the Canadian economy $2 billion yearly by not using vehicles (Campbell & Wittgens, 2004). Improving physical activity will decrease the financial burden on individuals, the government, and the health care system.

## Determinants of Physical Activity

Physical activity among individuals vary based on social, economic, cultural, and environmental factors, and inequalities in physical activity exist according to social stratification by gender, age, and socioeconomic status (Solar & Irwin, 2010). The determinants discussed in this section have been acknowledged to be important

determinants of physical activity (O'Donoghue et al., 2018; Solar & Irwin, 2010; World Health Organization, 2010).

### *Age*

Age is linked to differences in physical activity because energy expenditure, muscle mass and strength decline with ageing, resulting in a decrease in physical activity (Ayabe et al., 2009), and a decline in physical activity leads to reduced muscle mass, less strength and reduced bone density (Distefano & Goodpaster, 2018; Proctor et al., 2000). This does not mean that older workers cannot improve their physical activity, but on average, they are less physically active than younger workers. A 2018 study conducted on the general Canadian population showed physical activity among different age categories (Statistics Canada, 2019). The proportion of Canadians classified as "active" decreased from 64.3% in ages 18 to 34 to 37.3% in ages 65 or above in 2018 (Statistics Canada, 2019). The proportion of Canadians classified as "active" decreased from 68.1% in ages 18 to 34 to 40.6% in ages 65 or above in 2017 (Statistics Canada, 2019). This result showed a decline in physical activity in the Canadian population across age groups.

Varma et al. (2017) used accelerometer data from a United States cross-sectional survey to explore total physical activity in various age groups. Individuals between 20 to 30 years old had the highest level of physical activity across all age groups. In the study, physical activity stabilized at ages 31 to 59 and became lower at age 60 and above (Varma et al., 2017). The study result showed age as a correlate of physical activity. Lower physical activity in older adults was related to physiological changes associated with ageing, while lower physical activity levels in younger adults were related to environmental conditions and lifestyle (Varma et al., 2017). The reason for the decline in physical activity was different for younger and older adults.

### *Gender*

A Canadian study conducted on the general population examined physical activity levels among men and women of different age groups. In this study, 69.9%, 62.4%, 51% and 41.2% of Canadian men between ages 18 to 34, 35 to 49, 50 to 64, and 65 or more were physically active, respectively (Statistics Canada, 2019). Among Canadian women, the proportion decreased from 58.6% in ages 18 to 34 to 33.95% in ages 65 or more (Statistics Canada, 2019). The study findings showed that Canadian men are more physically active than women. Although Canadian men had higher physical activity levels than women (Statistics Canada, 2019), Canadian women were more likely than men to strongly agree that physical activity enhances recovery from sickness (Cragg et al., 2008).

In a systematic review, Sun et al. (2013) found that men were more physically active than women, even among older adults. This systematic review involved 22 studies, and the weekly physical activity difference between men and women ranged from 0.8% to 21.4%.

A Canadian cross-sectional study revealed that female industrial and construction workers were less physically active than men in the same occupation (Prince et al., 2020). Similarly, female customer service workers were less physically active than male customer service workers (Prince et al., 2020). The study examined various domains of physical activity such as domestic work, transportation, occupation, and leisure. Findings indicated that Canadian men were more physically active than Canadian women regardless of the job task. Although this finding showed that female industrial and construction workers were less active than their male compeers, it is essential to note that fewer female workers are in this occupational group compared to men, including in this study.

A cross-sectional study in Brazil examined relationships between gender and leisure-time physical activity. The findings showed that men had higher physical activity

levels than women (Azevedo et al., 2007), and more men than women reported enjoyment as a reason for leisure-time physical activity while more women than men reported doctor's recommendation as a reason for participating in leisure-time physical activity, which is a potential reason for the gender difference (Azevedo et al., 2007). There was no gender difference when other domains of physical activity such as household, occupation, and active transport were included (Azevedo et al., 2007).

***Education***

Several researchers have found that educational attainment is associated with physical activity (Cerin & Leslie, 2008; Humpel et al., 2002), suggesting that education can enable people to understand the importance of physical activity (Cerin & Leslie, 2008; McNeill et al., 2006). For instance, Cragg et al. (2008) reported that Canadian workers without a high school diploma were least likely to strongly agree that regular physical activity decreased the impact of workplace stress. The findings suggested that the perception of physical activity benefits were different, depending on the level of education.

A Canadian study using data from the 2002 Physical Activity Monitor found higher levels of total physical activity in women with higher education levels than women with lower levels of education (Pan et al., 2009). In this study, there was no significant association between physical activity and educational attainment in men. The authors argued that even men with lower levels of education tend to be physically active because they have higher self-efficacy for physical activity than women. (Pan et al., 2009). Although the authors recorded no response bias, they also reported that there might be possible differences between participants and non-participants of the study (Pan et al., 2009).

On the other hand, a Brazilian study found an association between recreational physical activity and education in men and women (Azevedo et al., 2007). In this study, men and women with higher levels of education increased their physical activity compared to people with lower educational attainment (Azevedo et al., 2007), indicating that men and women with greater educational attainment have better chances of knowing and understanding the benefits of physical activity.

***Income***

Not only have researchers found that people with higher income are more likely to increase physical activity (McNeill et al., 2006), but they also had better opportunities to attain higher levels of physical activity. For example, Pan et al. (2009) and Cerin and Leslie (2008) found that people with higher income have better access to facilities and environments that support physical activity. This finding was not surprising because wealthy neighbourhoods tend to have better parks for recreational services, gyms, safer streets, and spaces for active transport (Cerin & Leslie, 2008; Humpel et al., 2002; Pan et al., 2009).

A cross-sectional study in the United States examined the association between total physical activity and socioeconomic status using 559 randomly selected participants (Ford et al., 1991). The study findings showed a positive relationship between socioeconomic status and physical activity. Likewise, other studies have found that individuals with better socioeconomic status are more likely to increase their physical activity (Humpel et al., 2002; Lindström et al., 2001; Pan et al., 2009).

***Built Environment***

The settings where individuals live and work are viewed as a social determinant of health (World Health Organization, 2010). There is evidence that physical activity is related

to the environment. For example, Humpel et al. (2002) deduced from reviewing sixteen studies that environments that are pleasant and possess recreational amenities are related to physical activity. Likewise, Fraser and Lock (2011) found a positive association between built environment and cycling in 11 studies in a systematic review. Highly walkable neighbourhoods are more conducive to active transportation compared to low walkable neighbourhoods. For example, Sallis et al. (2004) reported that people residing in highly walkable neighbourhoods walked twice as much as residents living in low walkability neighbourhoods. Proximity to recreational activities (Sallis et al., 2004), neighbourhood safety (Bennett et al., 2007), and the presence of paths for walking and biking were related to physical activity (Cervero & Kockelman, 1997; Sallis et al., 2004; Troped et al., 2001). The presence of paths is also important to increase traffic safety (Sallis et al., 2004). Furthermore, neighbourhoods perceived unsafe for walking due to lack of recreational amenities or high crime rates may serve as physical activity barriers.

## Work Hours

Patterns of weekly work hours have changed over the years. In 1978, 47% of Canadian workers worked 35-40 hours per week (Heisz & LaRochelle-Côté, 2006). In contrast, 43% and 39% of workers in Canada worked 35-40 hours per week in 1989 and 2001, respectively (Heisz & LaRochelle-Côté, 2006). On the other hand, Canadians working less than 35 hours per week increased from 30.8% in 1987 to 34.1% in 2001(Heisz & LaRochelle-Côté, 2006). In 1997, 24% of individuals worked 40 hours per week compared to 22% in 2007 (Statistics Canada, 2015). More individuals were working above 50 hours per week in 1997 compared to 2007. From 2007, there have been reductions in individuals with weekly work hours above 50 (Statistics Canada, 2015). In Canada, 12% of women and 33% of men worked above 40 hours (Mikkonen & Raphael, 2010). Although

there have been reductions in work hours since the 1990s, some Canadians still work above standard hours.

## Determinants of Work Hours

According to Canada's labour code, the standard weekly workload is 40 hours, but some individuals work above 40 hours (Statistics Canada, 2009, 2015). Many reasons are given for hours spent at the workplace. First, human beings are creative, and this creativity is channelled into work to become productive. Work provides a means of livelihood, enhances skills, and promotes independence and responsibility. People derive pleasure from working because of the benefits of hours spent at work, stability and motivation for more accomplishment (Burke & Cooper, 2008). However, many individuals prefer to work fewer hours to achieve their desired goals (Skidelsky, 2019). Likewise, other researchers over the years have found that many individuals desire work hour reduction (Jacobs & Gerson, 2000; Maume Jr & Bellas, 2001; Stier & Lewin-Epstein, 2003). Apart from the pleasures derived from work, several other factors contribute to work hours. These factors include job insecurity, job characteristics, work conditions, income inequality and employer demands (Burke & Cooper, 2008). Similarly, Golden (1998) disclosed that weekly work hours could be associated with workplace norms, employer rules, employee decisions, economic circumstances, labour laws, and policy.

### *Employer Demands*

Employer demands contribute to weekly work hours because some employers use weekly work hours to grade their workers' progress and measure work productivity (Golden, 2009). Increasing weekly work hours is a prerequisite for attaining a managerial position in some workplaces. Studies have shown that two-thirds of individuals working

longer hours are viewed as committed (Golden, 1998; Kodz et al., 1998). Therefore, more hours spent at work is considered a sign of diligence and commitment.

### *Workplace Culture*

Workplace culture, including colleagues' and employer's behaviour, can affect weekly work hours. According to Kodz et al. (1998), some workers feel obligated to follow their employer's standards. For instance, workers may feel obligated to remain at the workplace until the departure of their employer. Moreover, some employers tend to extemporaneously increase the work hours of their workers whenever there is an increase in workload (Åkerstedt & Kecklund, 2005). Due to the time consumption and high cost of appointing and training new workers, employers prefer to increase work hours instead of employing new workers (Caruso et al., 2006). This situation happens mostly when new workers may only be needed temporarily to cope with the increasing workload and higher job demands (Caruso et al., 2006).

Hours spent at work can be due to peer pressure, for example, Kodz et al. (1998) found that some workers increased their work hours because of friends and co-workers. An increase in work hours is an achievement for some individuals. These individuals think the more hours they work, the more hardworking and successful they become (Kodz et al., 1998). Besides, workers may not want to be regarded as unreliable or not a team player for declining unsought work hours.

### *Workload*

The workload can contribute to weekly work hours because an enormous workload will require more time for completion. Kodz et al. (1998) found that many individuals mentioned workload as a reason for increasing work hours. Many workers in this study revealed that they had insufficient time to complete work duties before the deadline.

Therefore, these workers increased their work hours to enable completion. Other workers complained about the need to employ more staff to enable a division of labour and avoid overtime work (Kodz et al., 1998).

### *Job Insecurity*

Job insecurity is a significant social determinant of a worker's health (Raphael, 2016). Job insecurity is the uncertainty of retaining employment in the labour market (Raphael, 2016). The labour market is competitive, and the prospect of job dismissal is frightening. Kodz et al. (1998) found that one-third of workers felt at risk of losing their job if they did not increase their work hours. Thus, some workers increase their weekly work hours to uplift their importance at the workplace. Research has shown that job insecurity is more prevalent among low-income workers, and there is evidence that people with lower income tend to increase their work hours to make ends meet (Bell & Freeman, 2001; Raphael, 2016). Lack of permanent employment has also been linked with job insecurity, and temporary positions in Canada are increasing compared to permanent employment (Raphael, 2016). Many temporary workers end up working multiple jobs, thereby increasing weekly work hours to reduce income insecurity. Furthermore, the number of working poor in Canada is growing (Raphael, 2016).

### *Income*

Income inequalities contribute to weekly work hours. Bell and Freeman (2001) found that individuals who earn less often feel pressure to increase work hours to gain work promotion and a better salary. Conversely, Gunderson (2007) found that an increase in income can lead to decreased hours worked. A 2020 Canadian study of about 11,052 participants revealed that financial hardship and lower income contributed greatly to the increment of work hours (Glavin, 2020). Lower-income and financial hardship can give

rise to multiple jobs, and one in five Canadians acquired numerous jobs to make ends meet (Glavin, 2020).

German workers were asked to choose either salary increments or shorter work hours (Skidelsky, 2019). Fascinatingly, 56% of workers picked shorter work hours and longer work leave instead of salary increments. According to Skidelsky (2019), these workers had no worries about picking shorter work hours instead of a salary increment. The workers believed their income was sufficient and desired more free time (Skidelsky, 2019). Thus, insufficient income can prompt an increase in weekly work hours.

### *Work Productivity*

Although many workplaces believe there will be less work productivity by decreasing work hours, studies conducted in several countries found the opposite. Work hours in some European countries have been reduced due to the actions of the labour unions (Burke & Cooper, 2008). Standard weekly work hours in Denmark, Finland, France, and the Netherlands is 35 to 40 hours (Skidelsky, 2019). France implemented 35 hours standard weekly work hours without salary decrement for workers (Skidelsky, 2019). This implementation was done to improve the well-being of workers and foster a healthy work environment. More than half of French workers admitted to health improvement due to work hours reduction (Skidelsky, 2019).

Significantly, shorter work hours in France had no negative effects on the economy (Skidelsky, 2019). On the contrary, reducing work hours strengthened gender equality by enabling more women, especially women who require proper time for childcare, to join the workforce (Skidelsky, 2019). Reducing work hours to 35-40 hours per week in France and Germany have led to flexibility, more leisure time and overall health improvement (Skidelsky, 2019).

The same study found that besides the significant improvement of workers' health in New Zealand workplaces that reduced weekly work hours, there was a significant change in productivity (Skidelsky, 2019). Workers were able to improve their health as well as boost productivity. Similarly, workplaces that reduced their weekly work hours in the United Kingdom reported a 30% increase in productivity (Skidelsky, 2019). Working longer hours have been linked to a decline in productivity (Delmez & Vandenberghe, 2018). A possible explanation is that working longer hours will lead to energy depletion, thereby resulting in less productivity (Delmez & Vandenberghe, 2018).

In conclusion, many countries have benefited from work hours reduction. It has resulted in more free time for personal needs, family responsibilities, better work productivity, improved physical health, and better mental health.

***Labour Laws and Policy***

Labour laws are present in many countries to regulate working hours. In Spain, workers cannot exceed 80 hours of overtime work per person and year (Artazcoz et al., 2009). Japanese workers are encouraged to not exceed 45 hours of overtime work per month, and there are legal consequences for working greater than 100 hours per month (Artazcoz et al., 2009). In Germany, labour laws permit workers in workplaces with more than 45 hours the autonomy to reduce their work hours (Skidelsky, 2019). Labour laws in France reduced weekly work hours to 35 hours (Skidelsky, 2019), this policy in France was initially executed to reduce the unemployment rate by providing more work opportunities for the unemployed (Berniell, 2012). However, reducing weekly work hours was done without salary reduction, and led to health improvement for present workers and the newly employed (Skidelsky, 2019). The policy regarding reducing work hours without salary reduction was excellent because having low income contributes to the decision of an

individual to increase their work hours. In addition, government incentives were given to companies that complied with the work hours reduction (Berniell, 2012). Labour laws and government policy have led to a flexible work time system.

In Canada, 40 weekly work hours is the standard, while the weekly limit is 48 hours (Employment and Social Development Canada, 2017). However, there are work hours exceptions for many employees. Employees in the transportation industry, such as shipping, trucking, and railway operations, are liable to a maximum weekly workload of 48 hours (Employment and Social Development Canada, 2017). Other occupations such as health care professionals, company managers, engineers, lawyers, architects, professors, and construction workers often exceed 40 hours per week because of the job characteristics (Employment and Social Development Canada, 2017). Work hours in Canada vary depending on the occupation.

Labour union status contributed to work hours standard in some European countries and parts of Canada. For instance, in Quebec, workers are more likely to have shorter weekly hours of work and longer vacation time due to the labour union's efforts (Heisz & LaRochelle-Côté, 2007). Likewise, in Germany, labour unions have enabled extended holidays (Skidelsky, 2019).

***Gender***

Differences in work hours show that females in Canada worked an average of 34.5 hours per week while males worked 43.6 hours in 1976 (Moyser, 2017). 39 years later**,** Canadian women worked for 35.5 hours per week while men worked for 41.1 hours. Furthermore, 4.8% of Canadian females worked for more than 50 hours weekly compared to 18.1% of Canadian males in 1976. In 2015, 5.3% of Canadian women worked above 50 hours per week, coming in higher than men (4.3%) (Moyser, 2017). This study showed that

although working hours for females have increased over the years, females still work fewer hours than males. The reason given for the gender differences in work hours is that women dedicate more time to childcare and household duties. Another gender difference in working hours is that men working longer hours have higher access to informal flexi-time than women working extended hours (Messenger et al., 2007).

### *Education*

There are mixed findings in the literature regarding the impact of education on work hours. Some studies found that individuals with higher levels of education spend more hours at work, while other studies found that individuals with lower levels of education spend more hours at work (Burke & Cooper, 2008; Stier & Lewin-Epstein, 2003). Different reasons were found for working longer hours between workers with lower educational levels and higher educational levels. Working above standard hours among individuals with higher educational attainment is linked with workload and job position, such as workers with managerial positions or workers in highly skilled professions (Burke & Cooper, 2008) while working longer hours among individuals with lower education levels are linked to lower-income (Burke & Cooper, 2008). Stier and Lewin-Epstein (2003) found that highly educated individuals are less likely to work overtime and desire more leisure time because they possess higher income, unlike individuals with lower educational attainment. Nevertheless, some highly educated individuals, especially those with managerial positions, tend to work for pleasure during their leisure time or work break (Burke & Cooper, 2008). This finding suggests that an increase in work hours for highly educated individuals is often due to work demands or pleasure derived from work. For workers with lower education levels, more time spent at work is due to financial responsibilities.

### *Age*

Older adults are less likely to spend more time at work than younger adults (Luong & Hébert, 2009; Ng & Feldman, 2008). Since they are close to retirement, they may voluntarily reduce their work hours. A Canadian study revealed that 64% of workers ages 18 to 34, 70% of workers between ages 35 to 54, and 70% of workers aged 55 or above reported that they preferred to work 10 hours per day for four days per week instead of eight hours per day for five days per week (Varella, 2021).

### *Extrinsic Work Characteristics*

The global Covid-19 outbreak has resulted in remote work for many individuals (Collins et al., 2020). Remote workers reported that working outside their offices has resulted in being overworked and spending more hours completing work duties (Spurk & Straub, 2020). Essential workers who were needed at their workplaces during the pandemic experienced increased work hours in order to meet the changing consumer demands. On the other hand, there was a decline in work hours for individuals with jobs that cannot function remotely (Spurk & Straub, 2020). Work hours vary according to work demands and characteristics.

## Work Hours and Physical Activity

A cross-sectional study in the United States of America found an association between work hours and leisure-time physical activity (Xu, 2013). The study participants consisted of males aged 25 to 55 who were asked if they engaged in physical activity in the past month. The study result showed a 0.6% decline in physical activity for each one-hour increase in weekly hours spent at work. Xu (2013) found that people with lower socioeconomic status were more susceptible to a decline in physical activity.

Cragg et al. (2008) used data from the 2006 Physical Activity Monitor to examine physical activity levels among workers. The authors found that perceived insufficient time due to hours spent at work prevented 42% of workers from engaging in physical activity compared to 26% of workers who reported a lack of supportive physical environment as a barrier for physical activity. There were no significant differences among age groups and gender. Full-time workers were more likely than part-time workers to report a lack of time due to work demands as a physical activity hindrance (Cragg et al., 2008).

A cross-sectional study was used to examine relationships between work hours and physical activity in Spain. Results indicated no leisure-time physical activity among Spanish men working 51 to 60 hours per week (Artazcoz et al., 2009). The physical activity variable was categorized into two groups, "no leisure-time physical activity" versus "slight, moderate, or high leisure physical activity" (Artazcoz et al., 2009).

Another cross-sectional study found mixed results depending on gender and whether individuals worked full-time or part-time. Burton and Turrell (2000) found that Australian men working 20 hours had greater physical activity levels than men working 35 hours per week. In comparison, Australian women working 14 hours had greater physical activity levels than women working above 14 hours per week. Meanwhile, there were no physical activity differences among male and female full-time workers irrespective of the hours worked (35 to 50 hours, or above 50 hours) (Burton & Turrell, 2000).

On the other hand, Cook and Gazmararian (2018) found that Americans working longer hours, especially between 45 to 49 hours per week, were more likely to fulfil the physical activity guideline than Americans who worked less (Cook & Gazmararian, 2018). This cross-sectional study consisted of 1,425 workers, and the participants were asked if they participated in moderate-vigorous physical activity in the past week. Weekly work

hours were divided into groups (< 40, 40–44, 45–49, 50–54, and ≥55 hours per week). Cook and Gazmararian (2018) concluded that working longer hours did not affect achieving physical activity guidelines.

Van der Hulst (2003) found no association between work hours and leisure-time physical activity in a systematic review. However, the studies in this review were conducted in Japan, which focused on specific groups such as white-collar workers, males, overtime work, or workers living with chronic diseases.

Collectively, there are inconsistent findings in studies regarding work hours and physical activity. Some studies found an association, while other studies found no association.

## Social Relationships

Social relationships are interactions with family members, friends, peer groups, and other members of society (Umberson et al., 2010). Social relationships are determined by the presence of the relationships, norms of social networks, and the relationships' quality (Umberson & Montez, 2010). Sociologists and health researchers have expressed the importance of positive social relationships for health. For example, Umberson and Montez (2010) and Jetten et al. (2012) mentioned that individuals with stronger social relationships live longer than their socially isolated counterparts. According to Umberson and Montez (2010), social relationships promote health in the sense that members of a social group or close relationships can encourage each other to improve health. For instance, individuals with social relationships cherishing physical activity can encourage one another to participate in physical activity. This is because social relationships can foster healthy norms and facilitate a sense of responsibility towards one another (Jetten et al., 2012; McNeill et al., 2006).

Social relationships are often used interchangeably with social cohesion, social networks, and social capital. Although related, they may have slight differences. Social relationship is the interaction among individuals in society (Umberson et al., 2010). Social capital is the interaction of relationships with similar values and shared resources in the community (Nieminen et al., 2013; Scarapicchia et al., 2017). Social cohesion is the level of connectedness, the strength of relationships, and the extent of cooperation among people (Nieminen et al., 2013; Stanley, 2003). Therefore, social cohesion requires social relationships or social capital to function. Social network is made of individuals with similar connections (Berkman et al., 2014). Members of a social network tend to have social relationships with one another. Social network is measured based on the number of close social ties, proximity, and frequency of contact of social relationships (Nieminen et al., 2013). Social support, an outcome of social relationships (Nieminen et al., 2013), is the help provided by social relationships and refers to the quality of the relationships. Social relationships create a supportive environment by providing access to resources and individual and community coping measures (McNeill et al., 2006). Social relationships provide informational support, instrumental support, emotional support, and appraisal support (Glanz et al., 2015; Jetten et al., 2012; Umberson & Montez, 2010). Emotional support refers to the affection, compassion and care provided by social relationships (Berkman et al., 2014). For example, relationships with a strong emotional bond, relationships that provide a sense of emotional security and well-being, where competence and skill are recognized, and talents and abilities are admired (Statistics Canada, 2018). Instrumental support refers to tangible assistance provided by social relationships (Berkman et al., 2014). For example, relationships with people to depend on for help (Statistics Canada, 2018). Receiving financial assistance from social relationships may

encourage physical activity participation for individuals who cannot afford the cost of facilities and services that promote physical activity (Barte & Wendel-Vos, 2017; Giles et al., 2014; Scarapicchia et al., 2017). In addition, social relationships that provide help when needed may provide solutions, reduce tasks, and provide time for physical activity (Scarapicchia et al., 2017). Informational support refers to knowledge and advice provided by social relationships (Berkman et al., 2014), such as relationships with a trustworthy person for advice (Statistics Canada, 2018). Appraisal support refers to relationships that help with decision making and affirmation (Berkman et al., 2014; Glanz et al., 2015), such as relationships with people to talk to about important decisions (Statistics Canada, 2018).

Apart from the support provided by social relationships, social relationships may affect health through participation and companionship, thus, providing network support (Berkman et al., 2014; Scarapicchia et al., 2017; Umberson et al., 2010), for example, relationships with individuals who share attitudes and beliefs, and relationships with people who enjoy the same social activities (Statistics Canada, 2018). Social participation refers to being involved in social groups for cultural, religious, social or leisure activities. Berkman and Breslow (1984), in a 10 years prospective study, found that belonging to a peer group was associated with behavioural health improvement. In a similar vein, some researchers found a relationship between belonging to a religious group and higher levels of physical activity (Reed et al., 2011; Umberson et al., 2010).

## Determinants of Social Relationships

Social relationships are often associated with sociodemographic characteristics (Smith & Christakis, 2008). People with similar socio-demographic factors such as age, education, income group, and social status often belong to the same social groups (Ajrouch et al., 2005).

### *Gender*

Differences in social relationships exist between men and women. Studies have found that women tend to have greater social relationships compared to men (Ajrouch et al., 2005; Liebler & Sandefur, 2002; Turner & Marino, 1994). Women are more likely than men to develop new relationships, keep in contact with present relationships, and participate in social activities (Ajrouch et al., 2005). Female social relationships are mostly family members and close friends, whereas male social relationships are mostly non-kin such as peers from social gatherings and workplaces. (Agneessens et al., 2006; Ajrouch et al., 2005). A possible explanation is that women create social relationships from emotional intimacy while men create social relationships from shared interests or pursuits (Liebler & Sandefur, 2002). A longitudinal study used middle-aged white adults in the United States to examine social support among friends, neighbours, and co-workers (Liebler & Sandefur, 2002). The study showed that 60% of women and 51 % of men reported giving emotional support, while 50% of women and 33% of men reported receiving emotional support (Liebler & Sandefur, 2002). Women are presumed to provide emotional support, while men are presumed to provide instrumental support (Scarapicchia et al., 2017). Some studies have reported that women announced a greater need for social support when engaging in physical activity (Scarapicchia et al., 2017; Sherwood & Jeffery, 2000). In a similar vein, other studies reported that social support from relationships provided a greater impact on women's motivation for maintaining physical activity than men (Ayotte et al., 2010; Scarapicchia et al., 2017). These findings suggested that social relationships expectations and norms differ between men and women.

### *Age*

Older adults are more likely to have fewer social relationships than younger adults. For example, 15% of Canadian adults aged 75 years have less than three close relationships compared to 5% of Canadians aged 36 to 44. Canadians aged 18 to 35 were the most likely to have three or more close friends (Statistics Canada, 2015). Older people are likely to join social groups easily, but lack of close connection and time decreases their participation (Nieminen et al., 2013). Thus, older adults are more vulnerable to fewer social relationships and isolation.

### *Socioeconomic Status*

Education contributes to the social networks of individuals (Ajrouch et al., 2005; Umberson & Montez, 2010); people with higher educational attainment are more likely to have relationships that provide better support (Krause & Shaw, 2000; Pan et al., 2009). This is because education promotes the ability to form social relationships and generate quality social networks. Indeed, education is associated with improved social skills, cognitive ability, and problem-solving skills (Glymour et al., 2014; Guerra-Carrillo et al., 2017).

Income is another socioeconomic variable linked with social relationships (Nieminen et al., 2013). Individuals with lower income are less likely to participate in social groups and develop new relationships (Nieminen et al., 2013). A possible explanation is that people with low-income may lack time to participate in social activities and develop new relationships because they need to make ends meet. Moreover, people with lower income have limited resources and may not have sufficient finances to provide tangible support.

## Social Relationships and Physical Activity

Social relationships have been used in health interventions to promote physical activity (Uchino et al., 2012; Umberson et al., 2010). Research conducted on diverse populations, including older Chinese adults, Hispanic women, and American university students, indicated relationships between greater social relationships and physical activity (Eyler et al., 1999; Gao et al., 2015; Kouvonen et al., 2012; Randazzo, 2016). Other studies conducted on people with brain injury and individuals with diabetes showed associations between social relationships and physical activity (Driver, 2005; Gleeson-Kreig, 2008). Because these studies were conducted using specific groups, the study results might be less generalizable to the working population.

A Brazilian cohort study examined relationships that provide social support and recreational physical activity engagement and maintenance (Oliveira et al., 2011). The study consisted of 4030 university workers in Brazil with higher income and greater educational attainment, and physical activity was assessed via self-report. Physical activity engagement was monitored for 14 days, while physical activity maintenance was monitored for 2 years. The type of recreational physical activity and the time spent per week were reported. Social relationships were assessed using multiple dimensions of social support such as positive social interaction, emotional support, and material support. The study result showed the different impacts of social support on physical activity maintenance and engagement. Positive social interaction, material and emotional support were associated with engagement in group physical activity, whereas material support was associated with physical activity maintenance. The study indicated that social support is more important for physical activity engagement than physical activity maintenance. In contrast, Croezen et al. (2012) found no association between positive social support and total physical activity

engagement in a Dutch prospective study. However, negative social support was associated with reduced physical activity engagement (Croezen et al., 2012).

Spanier and Allison (2001) conducted a study using a 1990 health survey to examine the relationship between social support and recreational physical activity. Study participants between ages 18 to 59 were asked if they participated in physical activity in the past month. Study findings indicated that having numerous friends and family members and a greater frequency of contact with family and friends were significantly associated with higher physical activity levels. Findings also showed that men were more likely than women to have higher physical activity levels. People with higher socioeconomic status had higher levels of physical activity compared to people with lower socioeconomic status. It is essential to point out that the social support variable was operationalized as the quantity of friends and family members, and the quality and content of the social relationships such as emotional support, informational support, appraisal support and instrumental support were not assessed.

Molloy et al. (2010), in a longitudinal study, found that lower levels of social support were associated with lower levels of recreational physical activity for females but not for males. The loss to follow up in the study was 33% for women and 42% for men, which might have affected the study. The study sample consisted of only university students, making it less generalizable to the working population.

Kouvonen et al. (2012), in a cohort study, examined the association between social support and physical activity among British workers aged 35 to 55. The data collection was from 1997 to 2004. Social support in this study consisted of emotional support and practical support, while physical activity was assessed via self-report. The study findings revealed

that high social support such as emotional and practical support from social relationships was associated with increases in physical activity.

Pan et al. (2009) examined associations between social support and total physical activity among 5,167 adults. Physical activity was assessed by asking participants the number of days spent on moderate to vigorous activity in the past seven days. Physical activity included all domains of physical activity such as leisure, occupational, domestic activities, and transportation. Social support consisted of instrumental support and informational support. The study results showed that having a higher income was associated with sufficient physical activity for both men and women. However, greater educational attainment was associated with higher odds of sufficient physical activity for only women. There was no significant association between social support and physical activity for both men and women (Pan et al., 2009).

Scarapicchia et al. (2017), in a systematic review, found conflicting results regarding relationships providing social support and physical activity in prospective studies. Some studies in this systematic review found a positive association, some studies found a negative association, and some studies found no association between social support and physical activity. The authors concluded that regardless of the type of social support, relationships, physical activity, the strength of the study, and study participants, there were inconsistent results across studies.

Collectively, there are mixed findings in the literature regarding social relationships and physical activity, and inconsistent findings regarding work hours, social relationships, and physical activity. First, some studies focused on only relationships among employees, co-workers and employers, relationships among families, relationships regarding the number of friends, frequency of contacts, or relationships that provide only emotional

support (Molloy et al., 2010; Spanier & Allison, 2001). Second, some studies categorized work hours or operationalized work hours into full-time, part-time, and overtime work (Artazcoz et al., 2009; Burton & Turrell, 2000). Third, some studies examined physical activity levels among a particular gender, age group, ethnicity, or occupation (Eyler et al., 1999; Gao et al., 2015; Kouvonen et al., 2012; Kouvonen et al., 2013; Liebler & Sandefur, 2002; Oliveira et al., 2011; Randazzo, 2016; Van der Hulst, 2003). Fourth, most studies focused only on leisure-time physical activity, while there is limited research on active transport and physical activity for work and household**.** No study investigated the association between work hours and physical activity specific to work, household, and active transportation among Canadian workers to the best of my knowledge. Yang et al. (2018) conducted a cross-sectional study on active transportation, but it aimed to compare levels of active transportation between the employed and the unemployed. No study investigating associations between social relationships and physical activity specific to work, household, and active transportation among Canadian workers was found.

Despite the various studies on work hours, social relationships, and physical activity globally, comparability is complicated because of the operationalization of study variables, variability in study measures, and distinct study populations. Therefore, the present study will contribute to research on work hours, social relationships, and physical activity among the Canadian workforce. This thesis aims to fill the knowledge gap by using various domains of physical activity, a composite measure of social relationships, and work hours to generate findings useful to the workforce.

# CHAPTER 3: METHOD

## Study Design and Data Source

A cross-sectional study design was used in this research. The cross-sectional design often uses population survey data, and larger sample size, so the findings may provide a better representation of the source population than other epidemiological studies (Oleckno, 2008). A cross-sectional study is excellent for descriptive analysis, generating hypotheses, and studying multiple exposures and outcomes. Furthermore, a cross-sectional study compared to other epidemiological studies is cost-effective and less time consuming, especially during the present COVID-19 pandemic. Data collection is less time consuming, and there are no problems of losses during follow up that alter study participants and response rates in other epidemiological studies.

Data for this cross-sectional study was acquired from the 2018 Canadian Community Health Survey (CCHS). CCHS obtained health determinants and health status information of Canadians for health surveillance, epidemiology, and health promotion (Statistics Canada, 2018). CCHS enables extensive evaluation and analysis of health issues at provincial and national levels across Canada. CCHS collected data between January 2018 to December 2018 from about 24,132 workers aged 18 to 74 years in 10 provinces and three territories. According to Statistics Canada (2018), workers living on reserves and full-time Canadian Forces members were excluded since they represent less than 3% of the target population (Statistics Canada, 2018). Data collection was performed through computer-assisted face-to-face interviews, computer-assisted telephone interviews, and voluntary survey responses (Statistics Canada, 2018). The interviews were conducted using English and French, while interpretative services were available for other languages (Statistics Canada, 2018).

Secondary data are frequently collected by the government and research institutions (Vartanian, 2010). Using secondary data enables me to research with a larger data set while saving time and costs associated with data collection. Secondary data offers a wide range of information and includes participants with diverse sociodemographic characteristics. Secondary data questions may not be framed in a way that is suitable for the researcher, which is a potential limitation (Vartanian, 2010).

Using the CCHS dataset is relevant to my work because it does not limit me to only workers in Lethbridge, it provides me with access to Canadian workers within and outside Alberta. CCHS can obtain larger sample sizes and a variety of questions than individual researchers, and larger samples can increase generalizability (Johnston, 2017). In addition, with the present COVID-19 pandemic and lockdown restrictions, collecting primary data is difficult, time-consuming, and increases health and safety risks (Adom et al., 2020).

## Study Variables

### *Independent variables*

The independent variable is also known as the exposure variable. This study consisted of two independent variables, known as work hours and social relationships.

Work hours were measured in the Canadian Community Health Survey (CCHS) as an open-ended question: "*What is the total usual number of hours worked weekly?*" Hours worked per week was analysed using the scale variable of usual total hours worked weekly.

Social relationships were measured using the social provisions scale-10 item (Caron, 2013; Statistics Canada, 2018). The social provisions scale-10 item is a validated scale used to measure the presence of social provisions and support such as social integration, emotional support, and tangible help (Caron, 2013). The social provision scale has a strong concurrent validity ($r = 0.930$), construct validity, internal consistency, and a

total item correlation (Caron, 2013). Furthermore, the social provision scale has a moderate correlation of 0.469 to 0.632 between subscales, and its subscales are greatly related to the global score ($r = 0.755\text{-}0.835$, $p<0.001$) (Caron, 2013). Therefore, the social provision scale is reliable and valid for measuring the availability of social relationships (Caron, 2013). For each item, the response options are 1 = strongly agree, 2 = agree, 3 = disagree, 4 = strongly disagree. The ten social relationships items were not asked in relation to physical activity. The average of the following social relationship questions was computed as a measure of social relationships.

1. There are people I can depend on help if I really need it.
2. There are people who enjoy the same social activities I do.
3. I have close relationships that provide me with a sense of emotional security and wellbeing.
4. There is someone I could talk to about important decisions in my life.
5. I have relationships where my competence and skill are recognized.
6. There is a trustworthy person I could turn to for advice if I were having problems.
7. I feel part of a group of people who share my attitudes and beliefs.
8. I feel a strong emotional bond with at least one other person.
9. There are people who admire my talents and abilities.
10. There are people I can count on in an emergency.

***Dependent Variables***

The dependent variable is also known as the outcome variable. The dependent variables in this study are physical activity for recreation, active transportation, work, and household. Participants aged 18 or above were asked three questions to assess physical activity levels in the past 7 days (Statistics Canada, 2018).

1. What were the total minutes spent in the last 7 days on active transport ways like walking or cycling to get to places such as work, school, bus stop, shopping centre or visit friends?
2. What were the total minutes spent in the last 7 days on recreational activities that lasted a minimum of 10 continuous minutes? Examples are walking, home or gym exercise, swimming, cycling, running, skiing, dancing, and team sports.
3. What were the total minutes spent in the last 7 days on physical activity while at work, in or around your home or while volunteering that lasted a minimum of 10 continuous minutes? Examples are carrying heavy loads, shovelling, and doing household chores such as vacuuming or washing windows.

***Confounders***

Confounders are variables that were adjusted in the analysis. The confounders adjusted in this study are age, sex, personal income, occupation, and education.

**Age.** Age was re-categorized into 18 to 29, 30 to 39, 40 to 49, 50 to 59, 60 to 69, 70 to 74.

**Sex**. The sex variable was dichotomous, coded as male and female.

**Income.** Respondents were asked to select their annual personal income from all sources. The income variable consisted of the following categories:

1. No income or income loss.
2. Less than $20,000.
3. $20,000 to $39,999.
4. $40,000 to $59,999
5. $60,000 to $79,999
6. $80,000 or more

**Education**. Respondents were asked to select their highest level of education from the following options.

1. Less than secondary education
2. Secondary school graduation, no post-secondary education
3. Post-secondary certificate diploma or university degree

**Occupation group**. Occupation group is a category used to classify jobs based on their characteristics and duties. CCHS used the National Occupation Classification (NOC). The NOC is a standardized structure that allocates a code to every occupation in Canada. In this study, the occupational groups consist of the following NOC.

1. NOC Code first digit: 0, 2, 3, 4, 5
2. NOC Code first digit: 1
3. NOC Code first digit: 6
4. NOC Code first digit: 7
5. NOC Code first digit: 8, 9

The following are the interpretation of the NOC code (Statistics Canada, 2018).

0 – Management occupations

1 – Business, finance, and administration occupations

2 – Natural and applied sciences and related occupations

3 – Health occupations

4 – Occupations in education, law and social, community and government services.

5 – Occupations in art, culture, recreation, and sport

6 – Sales and service occupations

7 – Trades, transport and equipment operators and related occupations

8 – Natural resources, agriculture, and related production occupations

9 – Occupations in manufacturing and utilities

## Study Sample

The study sample consists of about 24,132 participants aged 18 to 74 years working in a job or a business in the past 12 months. Out of 24,132 participants who responded to working in Canada in the past year, about 23,333 answered the questions on physical activity. There are 21,251 participants aged 18 to 74 who answered the questions on work hours and physical activity, and there are 6,490 participants aged 18 to 74 in the workforce who answered the questions on social relationships and physical activity. The working population consisted of 75.7% of the entire CCHS data set, with 24,132 being members of the workforce and 7,736 being non-members.

## Data Techniques

### *Data Processing and Editing*

The 2018 Canadian Community Health Survey data was adequately developed and edited before release. The required answers, minimum values and maximum values were included. Inconsistent values were replaced with "not stated" (Statistics Canada, 2018). The study questionnaire was made appropriate to the respondent during data collection. The data collection equipment was tested to identify any inaccuracy in the program flow and text. Bootstrap procedures were used to establish appropriate inferences. Master survey weights were made available to ensure that survey data represents the target population (Statistics Canada, 2018).

### *Data Cleaning*

Data cleaning was done to ensure data accuracy for data analysis and the fulfilment of negative binomial regression requirements. Although missing values were present, they were not replaced because the values were assumed to be missing at random.

## Data Analysis

The study data were analysed using a statistical package for social sciences version 26 (SPSS) (IBM Corp, 2019). Descriptive statistics, such as frequency and percentage, were generated. Negative binomial regression with 95% CI for Exp(B) was used to assess associations between hours worked per week, social relationships, and physical activity while controlling for confounding variables (age, sex, education level, income, occupational group). Normalized master weight divided by the mean was applied to the data analysis, and this was applied to amend uneven distribution (Bollen et al., 2016).

### *Descriptive Analysis*

Descriptive statistics performed with normalized master weights were used to describe the pattern and content of the data. Frequency of distribution was used in this study to obtain the frequency of value and percentage for the study variables. Mean and standard deviation were used to estimate the distribution of values for the study.

### *Inferential Analysis*

Inferential analysis was used to draw conclusions based on the hypothesis and make inferences about the study. Because of the over-dispersion and skewness of the dependent variable with non-negative whole numbers, a generalized linear model using the negative binomial distribution with log link was used for the inferential analysis.

Logistic regression was not used for this research because the dependent variable is an over-dispersed non-categorical variable. To avoid data misinterpretation and loss of information, the dependent variable was not dichotomized to accommodate the requirements of binary logistic regression (Sroka & Nagaraja, 2018). Poisson regression was not used due to the over-dispersion of the count data. Multiple linear regression was not used because the data violates the assumptions of linear regression due to the skewness

and over-dispersion of the physical activity variables. This statement was supported by Schober and Vetter (2021), who emphasized that assumptions of linear regression must be fulfilled to perform multiple linear regression. Therefore, a negative binomial regression with log-odds link function was used.

Negative Binomial regression is used for over-dispersed count data. The variance was higher than the mean, thus suggesting over-dispersion. In addition, the data had excess zeros, which can contribute to the over-dispersion. Unlike Poisson regression, negative binomial regression does not require the mean and the variance to be equal (Ardiles et al., 2018). The dependent variable represents count data, which asked for the number of minutes spent on physical activity in the past week. The dependent variables lacked negative values as required by negative binomial regression (Schober & Vetter, 2021). The distribution of the dependent variable was skewed, and O'Hara and Kotze (2010) suggested that over-dispersed count data should not be transformed; instead, a negative binomial regression should be used. Furthermore, Sroka and Nagaraja (2018) emphasized that a better estimate can be derived when using the log-odds link function for count data.

SPSS used last as the reference category. The reference category for sex is female, age is ≥ 70 years, education is post-secondary degree or diploma, income is ≥ $80,000 per year, and occupation: NOC Code first digit: 8, 9.

The following inferential analysis output was used to explain the model outcome: standard error, incidence rate ratio Exp(B), 95% confidence interval (CI), degree of freedom (df), chi-square test of statistical significance.

**Wald and Significance**: The Wald chi-squared significance was used to test the null hypothesis.

**Statistical Significance**: The p-value, also known as probability value, was used to determine if the model is statistically significant; $p < 0.05$ is regarded as the rule of thumb for statistically significance, indicating that there is less than a 5% probability of occurrence due to chance or random occurrence.

**Standard Error (SE):** The standard error was used to test how the sample mean differs from the existing mean of a population.

**Degree of freedom (df):** This is the maximum number of independent variables that are free to vary in the model.

**Incidence Rate Ratio (Exp (B)):** This is the exponentiation of the coefficients. It was used to measure the increase or decrease in the dependent variable when the independent variable increases by one unit.

When IRR is 1, there is no association between the independent variable and dependent variable.

When IRR > 1, increases in the independent variable are associated with increases in the dependent variable.

When IRR < 1, increases in the independent variable are associated with decreases in the dependent variable.

**Confidence Interval**: 95% confidence intervals were used to determine the accuracy and precision of the estimates.

## Validity and Reliability

Validity refers to study accuracy, while reliability refers to the consistency of the study result. Validity and reliability are essential in research to ensure quality results are produced (Heale & Twycross, 2015). To establish validity and reliability in this research, I checked for consistency and ensured that accurate results were produced. To ensure a valid

questionnaire, CCHS used quality control measures such as on-site observation of interviews, response rate evaluation, reported and non-reported data evaluation and improved collection tools for interviewers were undertaken to minimize non-sampling error (Statistics Canada, 2018). CCHS sample is representative of the Canadian population, thus it increases generalizability. A potential limitation of CCHS is the use of self-report data which are vulnerable to recall, response, and social desirability biases. In addition, CCHS excluded full-time members of the Canadian Forces and workers living in indigenous settlements.

## Research Ethics

CCHS performed the initial research security according to rules and regulations of ethical practices. Ethics approval for my study was obtained from the Human Research Committee of the University of Lethbridge. Personal identification codes were made unavailable to me before I was given access to secondary data.

# CHAPTER 4: RESULTS

***Descriptive Statistics*.**

Descriptive statistics were used to describe the properties of the study data. Table 1 shows the demographic characteristics of the study participants with their respective weighted percentages. Age was categorized into six groups, ages 18-29 had the highest percentage (23%). Sex was categorized into male (52.7%) and female (47.3%). The majority of the respondents had post-secondary education (68%). Most respondents (40%) belonged to the occupational group NOC Code first digit: 0, 2, 3, 4, 5. This occupation category consists of management occupations, law, art, recreation, education, health, natural sciences, applied sciences, social, community and government services.

**Table** 1**.** Descriptive statistics for socio-demographics

| Variables | Weighted Percentage % |
|---|---|
| **Age** | |
| 18-29 | 23.0 |
| 30-39 | 21.9 |
| 40-49 | 20.2 |
| 50-59 | 20.3 |
| 60-69 | 10.4 |
| 70-74 | 1.5 |
| **Sex** | |
| Male | 52.7 |
| Female | 47.3 |
| **Education** | |
| Less than secondary school graduation | 8.5 |
| Secondary school graduation | 23.5 |
| Post-secondary diploma or university graduation | 68.0 |
| **Personal Income** | |
| No income or income loss | 0.8 |
| Less than $20,000 | 22.3 |
| $20,000 to $39,000 | 28.7 |
| $40,000 to $59,000 | 17.9 |
| $60,000 to $79,000 | 12.2 |

| | |
|---|---|
| 80,000 or more | 18.0 |
| **Occupation Group** | |
| National Occupation Classification (NOC) | |
| NOC code: 0,2,3,4,5 | 40.0 |
| NOC code: 1 | 16.3 |
| NOC code: 6 | 23.8 |
| NOC code: 7 | 13.9 |
| NOC code: 8,9 | 6.0 |

Table 2 shows the mean and standard deviation of the physical activity variables.

**Table 2.** Descriptive statistics for the dependent variables.

| Physical Activity | Mean | Standard Deviation |
|---|---|---|
| Recreational | 11.11 | 47.21 |
| Active transport | 14.44 | 54.35 |
| Work and household physical activity | 6.13 | 53.63 |

**Note.** The standard deviation showed overdispersion due to the presence of higher variability.

Table 3 shows the mean and standard deviation of the independent variables.

**Table 3.** Descriptive statistics for independent variables

| Variables | Mean | Standard Deviation |
|---|---|---|
| Work Hours | 39.17 | 13.95 |
| Social Relationships | 1.50 | 0.45 |

**Note.** The units are in minutes per week.

## Regression Results

### *Work Hours and Active Transport*

Table 4 reported a negative binomial regression model used to examine the association between work hours and active transport among 21,251 participants. The independent variable (work hours) accounted for a significant amount of variance in the dependent variable (active transport) with a likelihood ratio $X^2(1) = 6.91$, $p < 0.01$. As shown in Table 4, the study results indicated that each unit increase in work hours is associated with a 0.2% lower rate of active transport (IRR: incidence rate ratio) (*IRR* = 0.998, 95% CI (0.997, 1.000)), $p < 0.01$. After adjusting for confounders in the regression model, the study results indicated a 0.4% lower rate of active transport for every unit increase in work hours (*IRR* = 0.996, 95% CI (0.995, 0.997)), $p < 0.001$.

**Table 4.** Negative binomial regression showing association between work hours and active transport.

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Work Hours | -0.002** | 0.001 | 0.998 | 0.997 | 1.000 |

*p < 0.05, **p < 0.01, ***p < 0.001

**Table 5.** Negative binomial regression model of work hours and active transport when adjusting for confounders.

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| **Work Hours** | -0.004*** | 0.001 | 0.996 | 0.995 | 0.997 |
| **Occupation Group** | | | | | |
| NOC Code first digit: 0, 2, 3, 4, 5 | 0.740*** | 0.043 | 2.10 | 1.927 | 2.282 |
| NOC Code first digit: 1 | 0.908*** | 0.046 | 2.48 | 2.264 | 2.717 |

| | | | | | |
|---|---|---|---|---|---|
| NOC Code first digit: 6 | 0.616*** | 0.044 | 1.85 | 1.698 | 2.018 |
| NOC Code first digit: 7 | 0.182*** | 0.047 | 1.20 | 1.095 | 1.315 |
| NOC Code first digit: 8, 9 (Reference) | | | | | |
| **Personal Income** | | | | | |
| No income or income loss | 0.093 | 0.099 | 1.10 | 0.903 | 1.332 |
| Less than $20,000 | 0.090** | 0.034 | 1.09 | 1.024 | 1.170 |
| $20,000 to $39,999 | 0.042 | 0.028 | 1.04 | 0.988 | 1.101 |
| $40,000 to $59,999 | -0.214*** | 0.030 | 0.81 | 0.761 | 0.856 |
| $60,000 to $79,999 | -0.068* | 0.033 | 0.93 | 0.876 | 0.997 |
| $80,000 or more (Reference) | | | | | |
| **Age** | | | | | |
| 18-29 | 0.250*** | 0.095 | 1.28 | 1.067 | 1.546 |
| 30-39 | 0.178 | 0.093 | 1.19 | 0.993 | 1.436 |
| 40-49 | 0.107 | 0.094 | 1.11 | 0.925 | 1.338 |
| 50-59 | 0.290** | 0.094 | 1.34 | 1.111 | 1.608 |
| 60-69 | 0.001 | 0.097 | 1.00 | 0.827 | 1.211 |
| 70 or more (Reference) | | | | | |
| **Education Level** | | | | | |
| Less than secondary school graduation | -0.182*** | 0.0417 | 0.83 | 0.768 | 0.905 |
| Secondary school graduation, no | -0.124*** | 0.0229 | 0.88 | 0.844 | 0.924 |

| | | | | | |
|---|---|---|---|---|---|
| post-secondary education | | | | | |
| Post-secondary certificate diploma or university degree (Reference) | | | | | |
| **Sex** | | | | | |
| Male | -0.038 | 0.0196 | 0.96 | 0.927 | 1.001 |
| Female (Reference) | | | | | |

*p < 0.05, **p < 0.01, ***p < 0.001. Likelihood ratio $X^2(18) = 1134.33$, p < 0.001

### *Work Hours and Recreational Physical Activity*

Negative binomial regression was used to examine the association between work hours and recreational physical activity among 21,251 participants. The independent variable (work hours) accounted for a significant amount of variance in the dependent variable (recreational physical activity) with a likelihood ratio, $X^2(1) = 64.9$, p < 0.001. As shown in Table 6, the study results indicated that each unit increase in work hours is associated with a 0.5% increase in the rate of recreational physical activity (IRR = 1.005, 95% CI (1.004, 1.007)), p < 0.001. After adjusting for confounders in the regression model, the study results indicated a 0.3% increase in the rate of recreational physical activity for every unit increase in work hours (*IRR* = 1.003, 95% CI (1.002, 1.005)), p < 0.001.

**Table 6.** Negative binomial regression model of work hours and recreational physical activity without adjusting for confounders

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Work Hours | 0.005*** | 0.001 | 1.005 | 1.004 | 1.007 |

*p < 0.05, **p < 0.01, ***p < 0.001

**Table 7.** Negative binomial regression model of work hours and recreational physical activity when adjusting for confounders.

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| **Work Hours** | 0.003*** | 0.001 | 1.003 | 1.002 | 1.005 |
| **Occupation Group** | | | | | |
| NOC Code first digit: 0, 2, 3, 4, 5 | 0.374*** | 0.043 | 1.45 | 1.336 | 1.580 |
| NOC Code first digit: 1 | 0.421*** | 0.046 | 1.52 | 1.391 | 1.669 |
| NOC Code first digit: 6 | 0.363*** | 0.044 | 1.44 | 1.319 | 1.568 |
| NOC Code first digit: 7 | 0.018 | 0.047 | 1.02 | 0.929 | 1.117 |
| NOC Code first digit: 8, 9 (Reference) | | | | | |
| **Personal Income** | | | | | |
| No income or income loss | -1.312*** | 0.106 | 0.27 | 0.219 | 0.332 |
| Less than $20,000 | -0.438*** | 0.036 | 0.65 | 0.601 | 0.692 |
| $20,000 to $39,999 | -0.329*** | 0.028 | 0.72 | 0.681 | 0.761 |
| $40,000 to $59,999 | -0.262*** | 0.031 | 0.77 | 0.724 | 0.818 |
| $60,000 to $79,999 | -0.261*** | 0.033 | 0.77 | 0.721 | 0.823 |
| $80,000 or more (Reference) | | | | | |
| **Age** | | | | | |
| 18-29 | -0.901*** | 0.097 | 0.41 | 0.336 | 0.492 |
| 30-39 | -1.126*** | 0.097 | 0.32 | 0.268 | 0.392 |
| 40-49 | -1.010*** | 0.097 | 0.36 | 0.301 | 0.440 |
| 50-59 | -1.081*** | 0.097 | 0.34 | 0.281 | 0.410 |
| 60-69 | -1.225*** | 0.100 | 0.29 | 0.242 | 0.357 |

| | | | | | |
|---|---|---|---|---|---|
| 70 or more (Reference) | | | | | |
| **Education Level** | | | | | |
| Less than secondary school graduation | -0.181*** | 0.043 | 0.83 | 0.767 | 0.908 |
| Secondary school graduation, no post-secondary education | -0.292*** | 0.024 | 0.75 | 0.713 | 0.782 |
| Post-secondary certificate diploma or university degree (Reference) | | | | | |
| **Sex** | | | | | |
| Male | 0.042* | 0.020 | 1.04 | 1.003 | 1.085 |
| Female (Reference) | | | | | |

*p < 0.05, **p < 0.01, ***p < 0.001. Likelihood ratio $X^2(18) = 1042.51$, p < 0.001

### *Work Hours and Work and Household Physical Activity*

Negative binomial regression was used to examine the association between work hours and work and household physical activity among 21,251 participants. The independent variable (work hours) accounted for a significant amount of variance in the dependent variable (work and household physical activity) with a likelihood ratio, $X^2(1) = 293.67$, $p < 0.001$. As shown in Table 8, the model indicated a statistically significant association between work hours and physical activity for work and household (*IRR*=1.01, 95% CI (1.011, 1.014)), $p < 0.001$.

After adjusting for confounders in the regression model, as shown in Table 9, the model indicated a statistically significant association between work hours and physical activity for work and household. The study result indicated a 1% higher rate of work and

household physical activity for each unit increase in work hours (*IRR*=1.01, 95% CI (1.005, 1.009)), $p < 0.001$.

**Table 8.** Negative binomial regression model of work hours and work and household physical activity without adjusting for confounders.

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Work Hours | 0.013*** | 0.001 | 1.01 | 1.011 | 1.014 |

*p < 0.05, **p < 0.01, ***p < 0.001

**Table 9.** Negative binomial regression model of work hours and work and household physical activity when adjusting for confounders.

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Work Hours | 0.007*** | 0.001 | 1.01 | 1.005 | 1.009 |
| **Occupation Group** | | | | | |
| NOC Code first digit: 0, 2, 3, 4, 5 | 0.433*** | 0.047 | 1.54 | 1.407 | 1.689 |
| NOC Code first digit: 1 | 0.350*** | 0.051 | 1.42 | 1.285 | 1.567 |
| NOC Code first digit: 6 | 0.525*** | 0.048 | 1.69 | 1.539 | 1.856 |
| NOC Code first digit: 7 | 0.655*** | 0.051 | 1.93 | 1.745 | 2.124 |
| NOC Code first digit: 8, 9 (Reference) | | | | | |
| **Personal Income** | | | | | |
| No income or income loss | -0.231* | 0.105 | 0.79 | 0.646 | 0.975 |
| Less than $20,000 | -0.603*** | 0.035 | 0.55 | 0.511 | 0.586 |
| $20,000 to $39,999 | -0.094** | 0.030 | 0.91 | 0.859 | 0.965 |
| $40,000 to $59,999 | -0.154*** | 0.033 | 0.86 | 0.805 | 0.913 |
| $60,000 to $79,999 | -0.328*** | 0.035 | 0.72 | 0.672 | 0.772 |

| | | | | | |
|---|---|---|---|---|---|
| $80,000 or more (Reference) | | | | | |
| **Age** | | | | | |
| 18-29 | -0.140 | 0.103 | 0.87 | 0.711 | 1.064 |
| 30-39 | 0.050 | 0.102 | 1.05 | 0.861 | 1.285 |
| 40-49 | 0.079 | 0.103 | 1.08 | 0.885 | 1.323 |
| 50-59 | -0.044 | 0.102 | 0.95 | 0.783 | 1.169 |
| 60-69 | -0.280** | 0.106 | 0.75 | 0.615 | 0.930 |
| 70 or more (Reference) | | | | | |
| **Education Level** | | | | | |
| Less than secondary school graduation | -0.286*** | 0.044 | 1.33 | 1.222 | 1.449 |
| Secondary school graduation, no post-secondary education | -0.073** | 0.024 | 1.07 | 1.025 | 1.128 |
| Post-secondary certificate diploma or university degree (Reference) | | | | | |
| **Sex** | | | | | |
| Male | -0.098*** | 0.022 | 0.91 | 0.869 | 0.946 |
| Female (Reference) | | | | | |

*p < 0.05, **p < 0.01, ***p < 0.001. Likelihood ratio: $X^2(18) = 1161.527$, p< 0.001.

### *Social Relationships and Active Transport*

Negative binomial regression was used to examine the association between social relationships and active transport among 6,490 participants. The independent variable (social relationships) accounted for a significant amount of variance in the dependent

variable (active transport) with a likelihood ratio $X^2(1) = 39.1$, $p < 0.001$. As shown in Table 10, the result indicated a 22% lower rate of active transport for each unit increase in social relationships (IRR: 0.78, 95% CI (0.721, 0.842)), $p < 0.001$.

After adjusting for confounders in the regression model, as shown in Table 11, the result indicated a 16% lower rate of active transport for each unit increase in social relationships (IRR: 0.84, 95% CI (0.772, 0.921)), $p < 0.001$.

**Table 10.** Negative binomial regression model of social relationships and active transport without adjusting for confounders.

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Social Relationships | -0.249*** | 0.04 | 0.78 | 0.721 | 0.842 |

*p < 0.05, **p < 0.01, ***p < 0.001

**Table 11.** Negative binomial regression model of social relationships and active transport when adjusting for confounders

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Social Relationships | -0.171*** | 0.045 | 0.84 | 0.772 | 0.921 |
| **Occupation Group** | | | | | |
| NOC Code first digit: 0, 2, 3, 4, 5 | 1.050*** | 0.091 | 2.87 | 2.404 | 3.432 |
| NOC Code first digit: 1 | 0.760*** | 0.098 | 2.14 | 1.766 | 2.591 |
| NOC Code first digit: 6 | 1.006*** | 0.091 | 2.74 | 2.288 | 3.271 |
| NOC Code first digit: 7 | 0.401*** | 0.096 | 1.49 | 1.237 | 1.802 |
| NOC Code first digit: 8, 9 (Reference) | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Personal Income** | | | | | |
| No income or income loss | 0.129 | 0.238 | 1.14 | 0.714 | 1.814 |
| Less than $20,000 | 0.150* | 0.071 | 1.16 | 1.011 | 1.334 |
| $20,000 to $39,999 | -0.063 | 0.058 | 0.93 | 0.838 | 1.053 |
| $40,000 to $59,999 | 0.004 | 0.065 | 1.00 | 0.883 | 1.141 |
| $60,000 to $79,999 | -0.086 | 0.073 | 0.92 | 0.796 | 1.059 |
| $80,000 or more (Reference) | | | | | |
| **Age** | | | | | |
| 18-29 | 0.911*** | 0.204 | 2.49 | 1.666 | 3.714 |
| 30-39 | 0.915*** | 0.203 | 2.50 | 1.677 | 3.716 |
| 40-49 | 0.852*** | 0.203 | 2.34 | 1.572 | 3.493 |
| 50-59 | 0.928*** | 0.203 | 2.53 | 1.698 | 3.770 |
| 60-69 | 0.846*** | 0.211 | 2.33 | 1.542 | 3.521 |
| 70 or more (Reference) | | | | | |
| **Education Level** | | | | | |
| Less than secondary school graduation | 0.108 | 0.090 | 1.11 | 0.933 | 1.332 |
| Secondary school graduation, no post-secondary education | 0.205*** | 0.045 | 1.23 | 1.124 | 1.340 |
| Post-secondary certificate diploma or university degree (Reference) | | | | | |
| **Gender** | | | | | |
| Male | 0.064 | 0.041 | 1.07 | 0.984 | 1.155 |

| | |
|---|---|
| Female (Reference) | |

*p < 0.05, **p < 0.01, ***p < 0.001. Likelihood ratio: $X^2(18) = 358.51$, p < 0.001

### *Social Relationships and Recreational Physical Activity*

Negative binomial regression was used to examine the association between social relationships and recreational physical activity among 6,490 participants. The independent variable (social relationships) accounted for a significant amount of variance in the dependent variable (recreational physical activity) with a likelihood ratio $X^2(1) = 79.83$, p < 0.001. As shown in Table 12, the study results indicated that each unit increase in the social relationship scale was associated with a 31% lower rate of recreational physical activity (*IRR*: 0.69, 95% CI (0.636, 0.748)), p < 0.001.

After adjusting for confounders, as shown in Table 13, the study results indicated a 32% lower rate of recreational physical activity for each unit increase in social relationships (*IRR*: 0.68, 95% CI (0.622, 0.742)), p < 0.001.

**Table 12.** Negative binomial regression of social relationships and recreational physical activity without adjusting for confounders

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Social Relationships | -0.372*** | 0.041 | 0.69 | 0.636 | 0.748 |

*p < 0.05, **p < 0.01, ***p < 0.001

**Table 13.** Negative binomial regression of social relationships and recreational physical activity when adjusting for confounders

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Social Relationships | -0.387*** | 0.994 | 0.68 | 0.622 | 0.742 |

| | | | | | |
|---|---|---|---|---|---|
| **Occupation Group** | | | | | |
| NOC Code first digit: 0, 2, 3, 4, 5 | -0.063 | 0.191 | 0.94 | 0.792 | 1.113 |
| NOC Code first digit: 1 | 0.005 | 0.212 | 1.00 | 0.832 | 1214 |
| NOC Code first digit: 6 | -0.110 | 0.198 | 0.90 | 0.751 | 1.068 |
| NOC Code first digit: 7 | -0.461* | 0.204 | 0.63 | 0.526 | 0.756 |
| NOC Code first digit: 8, 9 (Reference) | | | | | |
| **Personal Income** | | | | | |
| No income or income loss | -1.424* | 0.262 | 0.24 | 0.144 | 0.403 |
| Less than $20,000 | -0.626*** | 0.070 | 0.53 | 0.466 | 0.614 |
| $20,000 to $39,999 | -0.389* | 0.567 | 0.68 | 0.607 | 0.758 |
| $40,000 to $59,999 | -0.631*** | 0.662 | 0.53 | 0.467 | 0.606 |
| $60,000 to $79,999 | -0.293*** | 0.715 | 0.75 | 0.649 | 0.858 |
| $80,000 or more (Reference) | | | | | |
| **Age** | | | | | |
| 18-29 | 0 .067 | 0.436 | 1.07 | 0.725 | 1.578 |
| 30-39 | -0.045 | 0.429 | 0.96 | 0.652 | 1.401 |
| 40-49 | 0.165 | 0.430 | 1.18 | 0.804 | 1.730 |
| 50-59 | 0.107 | 0.429 | 1.11 | 0.759 | 1.632 |
| 60-69 | 0.087 | 0.446 | 1.09 | 0.732 | 1.625 |
| 70 or more (Reference) | | | | | |
| **Education Level** | | | | | |
| Less than secondary school graduation | 0.540* | 0.097 | 0.58 | 0.482 | 0.705 |

| | | | | | |
|---|---|---|---|---|---|
| Secondary school graduation, no post-secondary education | 0.022 | 0.048 | 0.98 | 0.891 | 1.075 |
| Post-secondary certificate diploma or university degree (Reference) | | | | | |
| **Sex** | | | | | |
| Male | 0.003 | 0.091 | 1.003 | 0.925 | 1.088 |
| Female (Reference) | | | | | |

*p < 0.05, **p < 0.01, ***p < 0.001. Likelihood ratio: $X^2$ (18) = 385.56, p < 0.001

### *Social Relationships and Work and Household Physical Activity*

Negative binomial regression was used to examine the association between social relationships and work and household physical activity among 6,490 participants. The independent variable (social relationships) accounted for a significant amount of variance in the dependent variable (physical activity at work and home) with a likelihood ratio $X^2(1) = 54.30$, $p < 0.001$. A significant association was observed, and the model shown in Table 14 showed that social relationships were associated with a 28% decrease in physical activity (*IRR:* 0.72, 95% CI (0.664, 0.788)), $p < 0.001$.

After controlling for confounders, the association between social relationships and physical activity at work and home remained significant, as shown in table 15 (*IRR*: 0.80, 95% CI (0.727, 0.879)), $p < 0.001$. The model showed a 20% lower rate of physical activity for each unit increase in social relationships.

**Table 14.** Negative binomial regression model of social relationships and work and household physical activity without adjusting for confounders

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Social Relationships | -0.324*** | 0.044 | 0.72 | 0.664 | 0.788 |

*p < 0.05, **p < 0.01, ***p < 0.001

**Table 15.** Negative binomial regression model of social relationships and work and household physical activity when adjusting for confounders.

| Variables | B | SE | Exp(B) | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| Social Relationships | -0.224*** | 0.485 | 0.80 | 0.727 | 0.879 |
| **Occupation Group** | | | | | |
| NOC Code first digit: 0, 2, 3, 4, 5 | 0.928*** | 0.102 | 2.67 | 2.190 | 3.263 |
| NOC Code first digit: 1 | 0.928*** | 0.109 | 2.52 | 2.190 | 3.263 |
| NOC Code first digit: 6 | 1.093*** | 0.104 | 2.98 | 2.434 | 3.655 |
| NOC Code first digit: 7 | 0.435*** | 0.107 | 1.55 | 1.254 | 1.906 |
| NOC Code first digit: 8, 9 (Reference) | | | | | |
| **Personal Income** | | | | | |
| No income or income loss | -2.138*** | 0.326 | 0.11 | 0.062 | 0.223 |
| Less than $20,000 | -0.539*** | 0.072 | 0.58 | 0.506 | 0.672 |
| $20,000 to $39,999 | -0.430*** | 0.059 | 0.65 | 0.580 | 0.731 |
| $40,000 to $59,999 | -0.532*** | 0.068 | 0.59 | 0.514 | 0.672 |
| $60,000 to $79,999 | -0.685 *** | 0.076 | 0.50 | 0.434 | 0.585 |
| $80,000 or more (Reference) | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Age** | | | | | |
| 18-29 | 1.266*** | 0.271 | 3.54 | 2.084 | 6.030 |
| 30-39 | 1.377*** | 0.270 | 3.96 | 2.333 | 6.730 |
| 40-49 | 1.183*** | 0.270 | 3.26 | 1.919 | 5.547 |
| 50-59 | 1.385*** | 0.270 | 3.99 | 2.350 | 6.790 |
| 60-69 | 1.175*** | 0.276 | 3.24 | 1.884 | 5.566 |
| 70 or more (Reference) | | | | | |
| **Education Level** | | | | | |
| Less than secondary school graduation | 0.450*** | 0.1006 | 1.57 | 1.288 | 1.910 |
| Secondary school graduation, no post-secondary education | 0.186*** | 0.048 | 1.20 | 1.096 | 1.323 |
| Post-secondary certificate diploma or university degree (Reference) | | | | | |
| **Sex** | | | | | |
| Male | 0.112* | 0.045 | 1.12 | 1.024 | 1.221 |
| Female (Reference) | | | | | |

*p < 0.05, **p < 0.01, ***p < 0.001. Likelihood ratio: $X^2(18) = 442.24$, p < 0.001

# CHAPTER 5: DISCUSSION

This chapter examines the results in comparison with the study hypothesis and objectives, comparing the findings with the results of existing studies, discussing the policy and practical implications, stating the strengths and limitations of the study, providing recommendations for future research, dissemination of findings, and the overall conclusion.

The findings from this study agree with the hypotheses: there is an association between work hours and physical activity, and there is an association between social relationships and physical activity. It seems that the effect of work hours differs by physical activity domain whereas increases in social relationships are associated with lower rates of physical activity in all domains.

## *Work Hours and Physical Activity*

Each unit increase in weekly work hours is statistically significantly associated with a 0.2% lower rate of active transportation. After adjusting for confounders, each unit increase in weekly work hours is statistically significantly associated with a 0.4% lower rate of active transportation. A possible explanation for this finding is the perceived lack of time to engage in active transportation and the perceived convenience of motorized transportation. This observation concurred with existing studies. For example, Campbell and Wittgens (2004) found that 31% of Canadians reported they never have time for walking as a means of active transportation, and a United States cross-sectional study found that flexible working hours was associated with active transportation (Quinn et al., 2017). Workers with more flexible work hours had higher rates of active transportation than workers with less flexible hours (Quinn et al., 2017). Other possible reasons may be perceived inconveniences due to weather conditions, built environment, and safety (Winters et al., 2011). For instance, people might be less willing to walk from work after a

long day, when it is cold or dark, and when there is a lack of perceived safety, poor cycling, and walking paths.

The adjusted model indicated that individuals earning less than $20,000 per year had a higher rate of active transportation compared to individuals with a yearly income of $80,000 or above. However, people earning between $40,000 and $79,999 per year had a lower rate of active transportation than workers with a yearly income of ≥ $80,000. People with the lowest income are more likely to lack motorized transportation due to finances, indicating the need for greater active transportation. This finding corresponds with an Australian study that found that people with the lowest income (≤ $A25,999/year) are more likely to walk for transport than people with the highest income (≥ $A130,000/year). Individuals with the highest income may spend more time engaging in active transportation than middle-income workers because of proximity. For instance, people with the highest income can afford to reside in centralized areas which are close to work, markets, and businesses while middle-income workers may have longer commuting time, thus discouraging active transportation (McKim, 2014). Younger workers (< 30 years) have a higher rate of active transport than workers aged 70 years or more, and workers with lower levels of education have lower rates of active transportation compared to workers with post-secondary education. This finding corresponds with existing studies that showed that people with the highest educational level have the highest rate of active transportation (Adams, 2010; Fishman et al., 2015; Hilbrecht et al., 2014; Mitáš et al., 2019; Pucher et al., 2011; Quinn et al., 2017). Individuals in agriculture and manufacturing occupations spent less time engaging in active transportation. People in these occupations may have a greater need for motorized transportation such as transporting heavy equipment and agricultural goods. In addition, Rachele et al. (2015)'s study findings suggest that blue-collar workers

are less likely to walk for transport than professionals. Blue-collar workers consist of machine operators, labourers and manufacturing-related occupations (Rachele et al., 2015). A non-statistically significant result was obtained for sex differences in active transportation. This finding concurred with previous studies in various countries (Lee et al., 2013; Liao et al., 2015; Mathews et al., 2009; Oliver et al., 2011; Pollard & Wagnild, 2017; Van Dyck et al., 2013).

Each unit increase in weekly work hours is statistically significantly associated with a 0.5% higher rate of recreational physical activity. After adjusting for confounders, each unit increase in weekly work hours is statistically significantly associated with a 0.3% higher rate of physical activity. This present study challenges conventional opinions that the more hours spent at work, the lower the rate of physical activity. Nevertheless, this finding concurred with a previous cross-sectional study suggesting that an increase in work hours does not lower the rate of recreational physical activity. Cook and Gazmararian (2018) found that people working more hours ($\geq 45$) were more likely to fulfil the weekly physical activity recommendation of 150 minutes. This present finding suggests that working hours and lower rates of recreational physical activity might be because of the perceived lack of time by individuals to engage in recreational physical activity, meanwhile many individuals find time to engage in sedentary behaviours such as watching television and playing video games, regardless of hours spent at work (Biswas et al., 2020).

The adjusted model indicated that individuals in education, management, law, health, applied sciences, and finance occupations spend more time engaging in recreational physical activity than people in agriculture and manufacturing occupations. A potential reason for this finding is that workers in professional or white-collar occupations may have greater motivation for recreational physical activity since they are less active during work

whereas people in manual occupations may perceive that their physically active jobs will provide sufficient physical activity, and they might feel tired to participate in recreational physical activity after engaging in manual labour. This finding corresponded with existing studies, indicating that professional or white-collar workers are more likely to engage in recreational physical activity (Burton & Turrell, 2000; Cook & Gazmararian, 2018; Kirk & Rhodes, 2011; Wu & Porell, 2000). Men had higher rates of recreational physical activity than women, and this finding mirrors existing research (Kirk & Rhodes, 2011). Workers with lower income and lower educational levels had lower rates of recreational physical activity, and this result corresponds with existing studies (Beenackers et al., 2012; Cerin & Leslie, 2008). People with higher income and greater educational attainment have greater resources and better access to recreational facilities and sports clubs.

The findings of this study suggest a statistically significant association between work hours and physical activity in the work and household domain. However, the incidence rate ratio was close to 1.0 (IRR:1.01), again showing a weak association. Each unit increase in work hours was associated with a 1% higher rate of work and household physical activity. An explanation for this finding is that spending more time at work generates more physical activity in the work and household domain. Comparability with previous studies was difficult because studies focused on work hours and physical activity used leisure-time physical activity or included various domains of physical activity as one outcome variable. In Australia, Angrave et al. (2015) and Vandelanotte et al. (2015) found no association between work hours and physical activity when confounders were controlled. However, the physical activity variable in these studies was a combination of leisure time and work physical activity. Similarly, a Dutch longitudinal study found an association between working longer hours and physical activity (Taris et al., 2011).

However, the physical activity variable combined leisure time and occupation physical activity as a single measure of physical activity.

The adjusted model showed that workers with lower education levels had higher work and household physical activity rates compared to workers with post-secondary education, and this finding concurred with a systematic review that examined socioeconomic status and physical activity (Beenackers et al., 2012). Males had lower rates of work and household physical activity compared to females. A possible explanation for this result could be that women perform more household chores than men. Although men may be more physically active at work, domestic duties could generate a greater rate of physical activity in women when combined with work physical activity. This present finding corresponds with previous research examining sex and physical activity (Kirk & Rhodes, 2011; Mäkinen et al., 2010).

### *Social Relationships and Physical Activity*

Each unit increase in social relationships is associated with a 22% lower rate of active transportation, a 31% lower rate of recreational physical activity, a 28% lower rate of work and household physical activity, and the associations were significant. After controlling for confounders, each unit increase in social relationships is statistically significantly associated with a 22% lower rate of active transportation, 32% lower rate of recreational physical activity, a 20% lower rate of work and household physical activity, and the associations remained significant. The adjusted model indicated lower rates of recreational physical activity among workers with lower income than workers earning ≥ $80,000 per year, and among workers with less than secondary education than workers with post-secondary education. Higher rates of work and household physical activity were observed among younger adults and workers with lower educational attainment. Higher

rates of active transportation were observed among workers earning < $20,000 per year, and individuals with secondary school education compared to post-secondary graduates and higher-income earners (≥ $80,000 per year). Individuals in agriculture and manufacturing occupations spent less time engaging in active transportation. There is no statistically significant difference in active transportation between males and females.

The findings of this present study did not correspond with previous studies on social relationships and physical activity. Several studies have found that frequent use of active transportation by family and friends as well as social support from these physically active friends and family were positively associated with participants' active transportation (Adams et al., 2017; De Bourdeaudhuij et al., 2005; Perchoux et al., 2017). Other researchers found that relationships that provide support were positively associated with physical activity (Driver, 2005; Eyler et al., 1999; Gao et al., 2015; Kouvonen et al., 2012; Molloy et al., 2010; Sarkar et al., 2016).

Given the result of this present study, it is unclear what may be generating this association. A possible explanation for this result could be that having relationships that are not physically active or relationships that do not encourage physical activity may hinder increases in physical activity. Different results may be obtained using relationships that provide support specifically for physical activity and relationships that provide general support. For example, in a systematic review, Smith et al. (2017) found a positive association between relationships that provided social support specific to physical activity and physical activity levels. However, no association was found between relationships that provided general social support and physical activity (Smith et al., 2017). Other studies that had contrasting results to this present study used social relationships that provided support specific to physical activity as well as a single measure of social relationships. For instance,

Driver (2005) examined social support specific to physical activity and recreational physical activity in people with brain injury; Eyler et al. (1999) examined social support specific to physical activity and total physical activity (household, leisure and occupational) among United States minority women; Kouvonen et al. (2012) examined social support and leisure-time physical activity among office workers in the United Kingdom; Molloy et al. (2010) examined social support and leisure-time physical activity among university students. In comparison, this present study focused on a composite measure of social relationships, and the support provided by social relationships were not specific to physical activity.

Even with physically active relationships, individuals may become less motivated to increase their physical activity when they feel pressured to enhance physical activity (Martire & Franks, 2014). Studies have shown that how the support provided by social relationships is apprehended may have a distinct impact on physical activity (Martire & Franks, 2014; Scarapicchia et al., 2017). Thus, if the individual felt pressured, the outcome might be negative (Martire & Franks, 2014). In a United States prospective study, Caserta and Gillett (1998) found a negative association between relationships providing support specifically for physical activity and physical activity levels. In addition, results might differ depending on the source of social relationships. For example, Sarkar et al. (2016) found that social support from co-workers was significantly associated with workplace physical activity, whereas no significant association was found between social support from friends and workplace physical activity when confounders were adjusted. It is possible that support from friends would have been associated with higher recreational physical activity.

A systematic review acknowledged that although many studies have reported a positive association, there is still inconsistent evidence to ascertain the type of association

between relationships that provide social support and physical activity (Scarapicchia et al., 2017).

## Limitations and Strengths of the Study

This study has certain limitations. First, because this is a cross-sectional study, the temporal sequence between the dependent and independent variables cannot be established. Therefore, the assessment of time effect is not possible, and causal links cannot be ascertained. Second, CCHS made use of self-report data, and limitations may arise when using self-report data. For example, some participants may provide socially desirable responses, and they might not fully recall the details of the past week which will lead to social desirability bias and recall bias, respectively. Therefore, participants might underestimate or overestimate the time spent on physical activity. In addition, the mean time spent on physical activity across all domains was around 30 minutes per week, which is only one-fifth of the recommended level of weekly physical activity. Therefore, there is a possibility that the level of physical activity was underestimated. It would have been ideal to determine whether physical activity differed based on relationships providing support specifically for physical activity and relationships providing social support not specifically for physical activity. Unfortunately, CCHS did not provide a social relationships variable specifically for physical activity, thus limiting inferences. CCHS excluded workers living in indigenous settlements and full-time members of the Canadian Forces which is a potential limitation. People aged 75 years, or more were not asked if they are current members of the Canadian workforce, however, this is above the retirement age.

Despite the limitations of this study, it possesses strengths. Previous studies have concentrated mainly on leisure-time physical activity, while this present study included the various domains of physical activity (recreational, occupation, household, and active

transportation). To the best of my knowledge, this is the only study that examined social relationships, work hours and active transportation among Canadian workers. Furthermore, this study is among the few studies to include social relationships and work hours with work and household physical activity. The use of a population-based survey that is representative of the Canadian population enhances the generalizability of the study findings and promotes external validity.

## Implications for Policy and Practice

There are policy and practical implications that can be drawn from this research. Consider that the findings from this study suggest that social relationships were associated with less physical activity in all domains, it could be that social relationships are participating in sedentary activities. Norms and activities of social relationships are as important as the support provided by social relationships because individuals are likely to be influenced by behaviours of their social networks (Ball et al., 2010; Emmons et al., 2007). For example, workers are more likely to engage in workplace physical activity if it is a workplace norm, and people are more likely to engage in sports when they see others playing than when no one is playing (Christakis & Fowler, 2009; Moore et al., 1991). Additionally, Ball et al. (2010) findings suggest that people who often saw other people exercise participated in more leisure-time moderate to vigorous physical activity than people who did not often see other people exercise in their community. At the same time, people are more likely to engage in sedentary activities when the norms and activities of the relationships are sedentary (Ball et al., 2010). Rather than spending most time participating in sedentary activities with social relationships, it is beneficial to engage in social activities that promote physical activity. Therefore, promoting physically active social interactions and positive social norms is necessary.

## Recommendation for Future Studies

Future studies should conduct longitudinal research on work hours and physical activity using diverse physical activity domains, not just leisure-time physical activity while using accelerometers or pedometers instead of self-report. Future research should also be conducted on diverse groups such as workers living on reserves, white-collars, blue-collars, shift, part-time, and full-time workers. In addition, future studies should use both a physical activity-based measure of social relationships and a non-physical activity measure of social relationships to generate findings and compare results. This may provide a better understanding of the associations between social relationships and physical activity.

## Dissemination of Findings

The findings of this research will be published in the University of Lethbridge thesis portal, an article will be submitted to medical journals such as the Journal of Occupational Health or Public Health Journals. The findings will be presented at conferences and will also be available to health care professionals and policymakers in Canada through the thesis portal and medical journals, as mentioned above.

## Conclusions

This study concluded that work hours were associated with lower rates of active transport, higher rates of recreational physical activity, and higher rates of work and household physical activity. Meanwhile, social relationships were associated with lower rates of physical activity in all domains. This research finding highlights the need for future studies to examine work hours, social relationships and all the domains of physical activity using various measures to generate findings that will inform policy and intervention to promote physical activity.

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