PHYSICAL ACTIVITY FACILITIES AND SEDENTARY WORK: ASSOCIATIONS WITH PHYSICAL ACTIVITY AND DISABILITY CLAIMS

KATRENA MUNSCH

A THESIS SUBMITTED TO THE FACULTY OF GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER'S OF SCIENCE

GRADUATE PROGRAM IN KINESIOLOGY AND HEALTH SCIENCE

YORK UNIVERSITY,

TORONTO, CANADA

JANUARY 2011

Your file Votre référence
ISBN: 978-0-494-71299-3
Our file Notre référence
ISBN: 978-0-494-71299-3

ABSTRACT

Both physical inactivity and sedentary time are independent risk factors of chronic disease. The workplace provides an excellent venue to address these issues. Although workplace health programs [WHPs] in large corporations are well described, the majority of Canadians are employed within small-to-medium sized companies. The first study characterizes the extent to which having access to physical activity facilities [PAF(s)] at or *near* the workplace is related to physical activity [PA] in the Canadian working population. These findings provide evidence for all employers, suggesting that increasing awareness around the benefits of PA and access to resources can have a positive association on PA levels. The second analysis examined the association between job demands and disability claims associated with physical inactivity using five-year event data from a large national group insurance company. Results suggest that more sedentary occupations account for a larger proportion of longer-term claims, and a higher proportion of total expenditures.

ACKNOWLEDGEMENTS

Funding for this research was provided through the MITACS Accelerate internship program. While the research and analysis for Study 1 are based on data from Statistics Canada, the opinions expressed do not reflect the views of Statistics Canada.

The data for the second analysis were provided by a large Canadian group insurance company. The company name has been withheld as a secondary measure to further protect the confidentiality of their clients.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BMI	-Body Mass Index
CCHS	-Canadian Community Health Survey
CVD	-Cardiovascular Disease
PAF	-Physical activities – facilities at work
PA	-Physical activity
WHPs	-Workplace health programs

INTRODUCTION

It is well established that physical inactivity is related to chronic disease and disability, most notably heart disease, stroke, cancer, chronic respiratory diseases and diabetes (WHO, 2008). As of 2003, almost 80% of Ontario residents over age 45 had a chronic condition, and 70% had two or more (Preventing and Managing Chronic Disease: Ontario's Framework, 2007). Although secondary and tertiary care for many chronic diseases have improved life expectancy (Arnett, McGovern, & Jacobs, 2002; Cooper, Cutler &Desvigne-Nickens, 2000), a parallel decrease in disability rates (Gregg et al., 2005) has not occurred, and the current population is now comprised of people living with multiple chronic conditions (Alley & Chang, 2007).

Despite the potential benefits of physical activity [PA] in the prevention of chronic disease, Canadian adults who are married, parents, and employed full-time have little time to participate in leisure activities (Fast & Frederick, 1998). At present, over half of the Canadian population is currently inactive [M: 55%; F: 49%] (CFLRI, 2008). Not only has lack of time been shown to decrease our opportunities to participate in leisure activities, but having access to facilities has also been shown to reduce obesity (Weiss, O'Loughlin, Platt, & Paradis, 2007). Given the increasing prevalence of obesity, chronic disease and subsequent disability, the workplace represents one venue by which large portions of the general population can be targeted (WHO, 2008). To this end, easy access to PA facilities and health programs at or near the workplace may prove to be a practical approach to moderating the effect of physical inactivity, as it may overcome some of the noted barriers such as time pressure, and the lack of awareness of both access to facilities and the importance of PA adoption and adherence.

In addition to physical inactivity, sedentary behavior such as seated work has been shown to be an independent risk factor for chronic disease (Owen, Bauman, & Brown, 2005), with its own unique metabolic consequences (Hamilton, Hamilton, & Zederic, 2004). Even when adjusted for leisure-time PA, there appears to be a dose-response relationship between sitting time, all–cause and cardiovascular disease [CVD] mortality (Katzmarzyk, Church, Craig, & Bouchard, 2009). It is clear that even amongst individuals who are active during their leisure time, many will spend a large portion of their day engaged in sedentary behaviours (Hamilton, Healey, Dunstan, Zderic, & Owen, 2008). In fact, the amount of PA in a day can vary considerably across different levels of occupational demands. For example, those engaged in sedentary occupations [sitting >75% of the time] complete approximately 6 500 steps per day, while those in highly active jobs [moving >75% of the time] have a daily step count of approximately 10 500 per day (Chan, Ryan, & Tudor-Locke 2004). Considering that the recommended daily step count for health benefits in adults is approximately 10 000 (CANPLAY, 2010), the sedentary worker is far from meeting this recommendation. As a result, low PA in the work place may directly contribute to obesity and chronic disease (Hu, Li, Colditz, Willet & Manson, 2003;

Sisson, Camhi, Church, Martin, Tudor-Locke, & Bouchard et al., 2009; Zhang, Xie, Lee, & Binns, 2003). We can further explore this relationship by analyzing disability claims data across different levels of job demands to determine the impact of sedentary occupations on claims costs.

LITERATURE REVIEW

Physical Inactivity and Chronic Disease

According to the World Health Organization (2009), physical inactivity is one of the five leading global risk factors for mortality, responsible for at least 1.9 million deaths per year, while another 2.6 million people die every year as a result of being overweight or obese. It is also well known that physical inactivity is related to chronic disease and disability, most notably heart disease, stroke, cancer, chronic respiratory diseases and diabetes (WHO, 2007). Although secondary and tertiary care for many chronic diseases have improved life expectancy (Arnett, McGovern, & Jacobs, 2002; Cooper, Cutler & Desvigne-Nickens, 2000), a parallel decrease in disability rates (Gregg et al., 2005) has not occurred, and the current population is now comprised of people with multiple chronic conditions (Alley & Chang, 2007). As of 2003, almost 80% of Ontario residents over age 45 had a chronic condition, and 70% had two or more (Preventing and Managing Chronic Disease: Ontario's Framework, 2007). Similarly, in the U.S. over 90 million had one chronic condition, and 39 million had two or more (Hoffman, Rice, & Hai-Yen, 1996). It would therefore appear that the risk of disability within the working age population is an important consideration beyond the rate of morbidity and mortality, as people with chronic conditions are now living longer with greater levels of disability.

Canada's Physical Activity Guidelines currently recommend that adults 20 to 55 y should engage in 30 to 60 minutes of moderate-to-vigorous activity daily, while trying to limit the time they spend sitting (CSEP, 2010). However, over half of the Canadian population is inactive [M: 55%; F: 49%] (CFLRI, 2008), and as of 2009, it was estimated that 21 to 25% of breast and colon cancers, 27% of diabetes, and 30% of ischemic heart disease were attributable to inactivity (WHO, 2009). As in most other developed countries, cardiovascular disease is the leading cause of premature death in Canada (responsible for 79,000 deaths per annum; Public Health Agency of Canada, 2007). Therefore, it is worth noting that even modest levels of PA can reduce the risk of high blood pressure, stroke, type II diabetes, and coronary artery disease by as much as 50% (Public Health Agency of Canada, 2007).

In a meta-analysis by Katzmarzyk et al. (2003), physical inactivity and adiposity were independently related to premature mortality. Physically active overweight and obese individuals tend to have a lower risk of premature mortality, a concept referred to as the 'fit but fat' paradox (Lee, Blair, & Jackson, 1999). PA has also been found to have a protective effect on heart failure at any weight, and moderate or high levels of PA are associated with a reduced risk of heart failure (Hu, Jousilahti, Antikainen, Katzmarzyk, & Tuomilehto, 2010).

After 20 years of follow-up from the Canada Fitness Survey, musculoskeletal fitness was associated with higher odds of weight gain in excess of 10 kg [OR = 1.78, 95% CI: 1.14 – 2.79], even after adjusting for potential confounders such as age, sex, baseline BMI, PA, cardiorespiratory fitness, smoking, alcohol consumption and income (Mason, Brien, Craig, Gauvin, &

Katzmarzyk, 2007). Similarly, in a study of 459 Canadian adults, it was concluded that both cardiorespiratory fitness and previous Body Mass Index [BMI; kg/m^2] were significant predictors of weight gain (Brien, Katzmarzyk, Craig, & Gauvin, 2007). Taken together, these studies highlight the importance (and independent effects) of PA, physical fitness, and excess adiposity on health and premature mortality.

In addition to the impact on one's quality of life, chronic disease has a considerable impact on Canada's health care and economic output. Between 2005 and 2015, it is estimated that $8.5 billion [$USD] will be lost in national income for Canada, due to the burden of the five major chronic diseases associated with physical inactivity (WHO, 2008). Previous estimates suggest that the direct and indirect health care costs associated with inactivity in Canada is approximately 2.6% of the healthcare expenditure [$5.3 billion dollars ($1.6 billion direct, $3.7 billion in indirect costs)] (Katzmarzyk & Jansen, 2004), while the cost of absenteeism is $15 billion dollars per year (Public Health Agency of Canada, 2001). In the United States, physical inactivity, overweight and obesity has been shown to account for as much as 27% of national health care charges [95% CI: 10% - 37%] (Anderson et al., 2005), while in the U.K., inactivity is estimated to cost £8.2 billion per year (Fox & Hillsdon, 2007). On the other hand, even modest changes in health behaviours such as reducing the prevalence of physical inactivity in Canada by 10% are projected to reduce health care expenditures by $150 million per year (Katzmarzyk, Gledhill, & Shephard, 2000).

Unfortunately, data from the 1981 Canada Fitness Survey and 2007-8 Canadian Health Measures Survey suggest that further *increases* in health care costs and *reductions* in productivity can be expected, given current national trends in physical fitness (Tremblay, Shields, Laviolette, Craig, Janssen, & Grober, 2010).

The Workplace as a Venue for Health Promotion

Despite the potential benefits of PA, barriers to increasing PA levels persist. Fast and Frederick (1998) interviewed 10 749 Canadian respondents from 1998 to 1999 to determine their time use over the life cycle. A marked "time squeeze" was observed for adults [25 – 69 y] who were employed and married with children, which manifested itself in a decrease in leisure time. Specifically, in 2006, 42% of Canadians cited work as the reason for their inability to engage in PA (CLFRI, 2010). Not only has lack of time been shown to decrease opportunities to participate in leisure activities, but access to facilities has also been shown **to be associated** with obesity. Not surprisingly, in a longitudinal study of 765 adults between 1992 and 1997, Weiss et al. (2007) demonstrated that accessing a neighborhood facility for PA was a significant predictor of remaining physically active [OR = 1.61; 95% CI: 1.02 – 2.14].

Welch, McNaugton, Hunter, Hume and Crawford (2008) conducted a cross-sectional survey of 3 101 women on their self-reported food intake, PA and perceived causes of time pressure. Overall, 41% indicated that time pressure was a barrier to healthy eating, while 73% noted time pressure to be a barrier to PA. Specific time barriers included long hours of work/study, inflexible and unpredictable hours of work/study, unusual work hours [shift work & weekend], commitments to children, family, friends/relatives and volunteer and community work. In 2001, the Canadian Fitness and Lifestyle Research Institute (CFLRI) examined barriers to participating in PA through the workplace and found that the prevailing reasons were: lack of time due to work and the pressure of tight deadlines, followed by busy roads near the work place, and lack of places to be active near work. Although there are many barriers to participating in routine PA, workplace health programs [WHPs] represent an increasingly popular venue to target these issues through education, increasing opportunities for PA, as well as increasing the awareness of available PA resources at or near the workplace, and increasing the availability of healthy food options.

The workplace has become an internationally recognized setting for health promotion, as a considerable amount of the population can be targeted through this medium (WHO, 2008). By implementing health programs in the workplace, risk factors for chronic disease such as overweight and obesity may be targeted (WHO, 2008). In Canada, there are several excellent examples of WHPs. In 1988, BC Hydro implemented an employee lifestyle program that included components of nutritional counseling and PA. After 12 years BC Hydro found a $1.2 million decrease in annual sick leave costs as well as productivity gains of $919,000 [with a 1:2.74 benefit yield for every dollar spent] (Public Health Agency of Canada, 2001). Even greater benefits were reported by Canada Life with respect their lifestyle program in the workplace, with a yield of $6.85 for every dollar spent [combining increased productivity, reduced turnover, and decreased medical claims] (Public Health Agency of Canada, 2001). Several other Canadian case studies exist where similar outcomes are observed (Public Health Agency of Canada, 2001), and the range in benefits is even greater in some U.S. studies (Aldana, Merrill, Price, Hardy, and Hager, 2004). A study of WHPs by Chapman (2005), found a 25 to 30% reduction in medical and absenteeism costs over an average period of 3.6 y. As a consequence, these programs are likely to benefit employers by increasing employment and reducing work limitations (Tuncelli & Willimans, 2006), enabling greater participation in the workforce (Klarenbac, Padwal, Chuck, & Jacobs, 2006), decreasing occurrences of both short-term and long-term disability (Arena, Padiyar, Burton, Schwerha, 2006; Laaksonen, Piha, & Sarlio-Lahteenkorva, 2007; Neovius, K., Johannson, Kark & Neovius, M., 2009; Serxner, Gold, Anderson & Williams, 2001; Van Duijvenbode, Hoozemans, vanPoppel, & Proper, 2009) and decreasing workplace injuries (Maniscalo, Welke, Mitchell, & Husting, 1999), as well as saving on worker's compensation costs (Musich, Napier, & Eddington, 2001). Overall, workplace health initiatives appear to be a modest financial investment when compared to the costs associated with treating chronic disease.

The Workplace and Disability

Employers' costs associated with managing disability are rising; between 1961 and 1998, Canada Pension Plan, Employment Insurance and Worker's

Compensation costs have increased by 8%, and now represent 12% of the overall payroll costs (Public Health Agency of Canada, 2007). During the same period, employer sponsored insurance, pensions, paid leave, profit and stock option plans were also observed to increase by 13% so they now account for 36% of payroll costs, whilst incidental absenteeism, short-term disability and long-term disability now account for 1.5%, 1.65% and 0.85% of payroll costs respectively (Public Health Agency of Canada, 2007).

The Canadian workforce is also aging, and it is estimated that by year 2021, approximately 11.7 million Canadians will be over the age of 55, compared to just 7 million in 2001 (Public Health Agency of Canada, 2007). Moreover, in 2003, full time employees over the age of 55 had twice as many absences compared to those aged 15 to 24 [10.5 versus 5.2 days] (Public Health Agency of Canada, 2007). As a result of an aging workforce, businesses can expect to observe increased utilization of benefit programs, while concurrently experiencing a loss in productivity.

In 2001, in a study of 79 070 U.S. adult workers, Jacobsen and Aldana found that after adjusting for adjusting for age, gender, education level, smoking, alcohol use, blood pressure, total cholesterol, BMI and stress, there was a significant positive relationship between absenteeism and exercise [$\chi^2 = 280.37$, $p<0.05$]. In a review of 43 studies, Aldana and Pronk (2001) reported that employees who had high levels of stress, or were overweight and those who failed to participate in fitness and health promotion programs had higher rates of absenteeism. In a further study by Pronk et al. (2004), it was observed that employees who participated in regular moderate-to-vigorous PA had better overall quality of work performed [$\beta = 0.0574$; $p = 0.0017$] and job performance [$\beta = 0.0517$; $p = 0.0017$]; the same relationship was observed for cadriorespiratory fitness [quality of work performed; $\beta = 0.0118$; $p = 0.0454$], whereas severe obesity was associated with a higher number of days absent from work [$\beta = 1.0155$; $p = 0.032$]. In 2004, the Canadian Fitness and Lifestyle Research Institute (CFLRI) estimated a 4 to 25% increase in productivity for physically active employees.

Both modifiable risks factors and certain prognostic factors have been identified to assist in targeting high-risk groups, which may be at an increased risk of disability. In a three year study of 46 026 employees [18 – 64y] who were enrolled in self-insured and fee-for-service health care plans, employees with high blood glucose levels, extremely high or low body weight, high blood pressure, and those with a sedentary lifestyle had 35%, 21%, 12%, and 10% higher healthcare costs, respectively (Goetzel et al., 1998). Furthermore, a recent literature review found that heavy manual work, perceived health complaints, limitation in daily PA caused by disease, and female gender were the factors most predictive of work disabilities related to rheumatoid arthritis, asthma, chronic obstructive pulmonary disease, diabetes mellitus and ischemic heart disease (Detaille, Heerkens, Engels, van der Gulden, & van Dijk, 2009). In a nationally representative study of 2 074 adults [25 – 54y], it was found that allsite cancer had the greatest prevalence of 30 day work impairment [66.2%] and the highest number of impairment days per month [16.4], whereas the most commonly occurring chronic conditions were asthma [14.6%], arthritis [12.6%], and high blood pressure [12.4%] (Kessler, Greenberg, Mickelson, Meneades, & Wang, 2001). In addition to ascertaining specific individual characteristics that identify high risk groups within the working population, those that are employed in sedentary occupations may be at an increased risk of chronic disease.

Sedentary Behaviour as an Independent Risk Factor

In the majority of developed countries over the past century, advances in technology have been implicated in a considerable increase in sedentary behaviours such as sitting time (Owen, Leslie, Salmon, & Forherighan, 2000). Although the deleterious effects of physical inactivity are well described, sedentary behaviour is an emerging area of study that has been shown to be an independent risk factor for developing chronic disease (Owen, Bauman, & Brown, 2005). Research has shown that prolonged sitting has its own unique metabolic consequences, which are not physiologically the same as being physically inactive (Hamilton, M., Hamilton, D., & Zderic, 2004). Even when adjusted for leisure-time PA, there appears to be a dose-response relationship between sitting time, all–cause and cardiovascular disease [CVD] mortality (Katzmarzyk, Church, Craig, & Bouchard 2009).

It is clear that even amongst individuals who are active during their leisure time and may exceed the current recommendations for PA, many spend a large portion of their day engaged in sedentary behaviours (Hamilton, Healey, Dunstan, Zderic, & Owen, 2008). Currently, one quarter of adults in the Netherlands are employed in sedentary occupations (Smulders, Andries, & Otten, 2001), while data from both Australia and the Netherlands report that employed adults spend half of the working day seated (Brow, Miller, Y., & Miller, R., 2003; Jans, Proper, & Hilderbradt, 2007). In Canada 16 million adults spend half their day at work [waking hours] (Public Health Agency of Canada, 2001). Miller and Brown (2004) found that occupational sitting was the greatest contributor to total weekday sitting and accounted for 52% of total sitting during the week. When seated, the large skeletal muscles in our legs, trunk, and back that support us while standing and walking, are largely inactive (Hamilton, Hamilton, & Zderic, 2004), and as such, sedentary behaviour requires little energy expenditure [1.0 – 1.8 metabolic equivalents] (Jans, Proper, Vincent, & Hilderbrandt, 2007).

Two separate studies of Dutch workers found that those engaged in policy or higher executive functions were least active at work, while those engaged in agricultural occupations were most active at work, accounting for 19.5% and 55.1% of total PA [per day], respectively. Employees with computerized occupations had the highest work-related share of total sitting [45%], while the lowest amount of work-related sitting [19%] was observed amongst service workers (Jans, Proper, & Hilderbrandt, 2007; Proper & Hilderbrandt, 2006). It was further shown by Jans et al. (2007) that workers who spent the majority of their workday in a seated position did not compensate for this sedentary behaviour by increasing their level of activity during their leisure time. A study using objective data gathered by accelerometers found that adults spent between 1 to 5% of their day engaged in moderate to vigorous PA, and of this activity only 0.5% to 1% was sustained for a period greater than 10 minutes (Hangstromer, Oja, & Sjostrom, 2007).

Several studies have documented the adverse effects of prolonged sitting. For example, Mummery et al. (2005) found that males who sat for more than six hours per day had almost twice the odds [OR: 1.92, CI: 1.17-3.17] of obesity than those who sat for less than forty-five minutes per day (Mummery et al., 2005). In an Australian study [n = 714] designed to analyze sitting time and work patterns, sitting more than 7.4 hours per day was associated with a 68% higher odds of overweight or obesity [OR = 1.68, 95% CI: 1.16 – 2.42], when compared to those that sat less than 4.7 hours per day (Brown, Miller, & Miller, 2003). Similarly, those who engaged in more than four hours of sedentary behaviour per day [compared to less than one hour] were much more likely to experience the metabolic syndrome [M: OR = 1.95, 95% CI: 1.24 – 3.03; F: OR = 1.54, 95% CI: 1.00 – 2.37] (Sisson et al., 2009). For every two hour increase in sitting at work, Hu et al. (2003) demonstrated a 7% increase in type II diabetes and a 5% increase in obesity in women, whereas Zhang et al. (2003) reported that prolonged sitting was also associated with higher odds of ovarian cancer [OR = 1.96, CI: 1.0-3.1]. Conversely, occupations with high levels of activity have been associated with lower metabolic and CVD risk (Carnethon et al., 2004; Hu et al., 2006).

When examining the job demands of various occupations, it is clear that the average energy expenditure can vary considerably. For example, seated work with no option of moving requires approximately 300-700 kcal/day, whereas seated work with some option of moving requires roughly 1 000-1 400 kcal/day, and approximately 2 300 kcal/day is needed for occupations involving more strenuous tasks (Black, Coward, Cole, & Prentice, 1996). With respect to steps per day, those engaged in sedentary occupations [sitting >75% of the time] complete approximately 6 500 steps per day while those in highly active jobs [moving >75% of the time] have a daily step count of approximately 10 500 (Chan, Ryan, & Tudor-Locke, 2004). Considering that the recommended daily step count for health benefits in adults is 10 000 (CANPLAY, 2010), this variation in occupational activity level is likely to have a profound positive association on health. A 2005 study of 158 women found that those who were insufficiently active and had sedentary occupations had significantly higher BMI and significantly lower mean steps per day, when compared to women that were active and had sedentary occupations (Tudor-Locke, Burton, & Brown, 2008).

On the basis of the literature reviewed above, the workplace is an important avenue for PA promotion, as reductions in physical inactivity and sedentary time (particularly sitting time at work) are likely to have profound impacts on both individual health risk, and healthcare expenditures for Canadian employers.

OBJECTIVES

To examine how access to physical activity facilities [PAF(s)] and sedentary work impact the workplace by quantifying i) the association between PA levels and access to PAF(s), and ii) the association of sedentary work on disability claims.

Specific Aims: 2 Different Manuscripts

Manuscript 1: Canadian Community Health Survey, cycle 4.1

Aim 1: To determine if having access to PA facilities at or near the work place (either alone or with access to a health program at work) is associated with higher levels of regular PA.

Hypothesis: PA levels will vary according to access to PAF(s).

Manuscript 2: Large Canadian Group Insurance Company

Aim 2: To describe the distribution of disability claims for chronic diseases associated with physical inactivity across different levels of job demands in a national group insurance company.

Hypothesis: Individuals in sedentary occupations will have poorer health outcomes compared to individuals that are engaged in light or heavy occupations.

REFERENCES

Aldana, S.G., Merrill, R.M., Price, K., Hardy, A., Hager, R. (2004) Financial impact of a comprehensive multisite workplace health promotion program. Preventative Medicine, 40, 131-137.

Aldana, S.G., Pronk, N. (2001). Health Promotion Programs, Modifiable Health Risks, and Employee Abenteeism. Journal of Occupational and Environmental Medicine, 43(1), 36-46.

Alley, D.E., & Chang, V.W. (2007). The Changing Relationship of Obesity and Disability, 1998 -2004. JAMA, 298(17), 2020-2027.

Anderson, L.H., Martinson, B., Crain, L., Pronk, N.P., Whitebird, R.R., Fine., L.J., et al. (2005). Health Care Charges Associated with Physical Inactivity, Overweight, and Obesity. Preventing Chronic Disease, Public Health Research, Practice, and Policy, 2(4), 1 – 12.

Arena, V.C., Padiyar, K.R., Burton, W.N., Schwerha, J.J. (2006). The Impact of Body Mass Index on Short-Term Disability in the workplace. Journal of Occupational and Environmental Medicine, 48, 1118-1124.

Arnett, D.K., McGovern, P.G., Jacobs, D.R., et al. (2002). Fifteen-year trends in cardiovascular risk factors (1980 – 1982 through 1995 – 1997): the Minnesota Heart Survey. American Journal of Epidemiology, 156, 929 – 935.

Bertera, R.L. (1990). The effects of workplace health promotion on absenteeism and employment costs in a large industrial population. American Journal of Public Health, 80, 1101 – 1105.

Black, A.E., Coward, W.A., Cole, T.J., Prentice A.M. (1996). Human energy expenditure in affluent societies: an analysis of 574 doubly-labelled water measurements. European Journal of Clinical Nutrition, 50(2), 72-92.

Blank, H.M., McCullough, M.L., Patel, A.V., Gillespie, C., Calle, E.E., Cokkinides, V.E., et al. (2007). Sedentary Behaviour, Recreational Physical Activity, and 7-year Weight Gain among Postmenopausal U.S. Women. Obesity, 15(6), 1578 – 1588.

Brien, S.E., Katzmarzyk, P.T., Craig, C.L., Gauvin, L. (2007). Physical Activity, Cardiorespiratory Fitness and Body Mass Index as Predictors of Substantial Weight Gain and Obesity. Canadian Journal of Public Health, 98(20), 121 – 124.

Brown W.J., Miller, Y.D., Miller, R. (2003). Sitting time and work patterns as indicators of overweight and obesity in Australian adults. International Journal of Obesity and Related Metabolic Disorders, 27(11) 1340 – 1346.

Canadian Fitness and Lifestyle Research Institute. (2008). Physical Activity Levels Among Adult Canadians. Retrieved August 5, 2010, from http://www.cflri.ca/eng/levels/adult_levels.php

Canadian Fitness and Lifestyle Research Institute. (2008). Survey Statistics Summaries. Retrieved from http://www.cflri.ca/eng/statistics/index.php

Canadian Fitness and Lifestyle Research Institute. (2010). CAN PLAY. Retrieved October 5, 2010, from http://www.cflri.ca/eng/programs/canplay/index.php

Canadian Society for Exercise Physiology. (2010). Fact Sheet – New Physical Activity Recommendations. Retrieved from http://www.participaction.com/ecms.ashx/PressReleases/en/CSEP_PAC-FactSheet-FINAL-EN.pdf

Carnethon, M.R., Loria, C.M., Hill, J.O., Sidney, S., Savage, P.J., Liu, K. (2004). Risk Factors for the Metabolic Syndrome The Coronary Artery Risk Development in Young Adults (CARDIA) study 1985 – 2001. Diabetes Care, 27(11), 2707 – 2715.

Chan, C.B., Ryan, D.A., Tudor-Locke, C. (2004). Health benefits of pedometer-based physical activity intervention in sedentary workers. Preventative Medicine, 39, 1215 – 1222.

Chapman, L.S. (2005). Meta-evaluation of Worksite Health Promotion Economic Return Studies: 2005 Update. The Art of Health Promotion, 10-15.

Cooper, R., Cutler, J., Desvigne-Nickens, P., et al. (2000). Trends and disparities in coronary heart disease, stroke and other cardiovascular diseases in the United States. Circulation, 102, 3137 – 3147.

Detaille, S.I., Heerkens, Y.F., Engels, J.A., van der Gulden, J.W., van Dijk, F.J. (2009). Common prognostic factors or work disability among employees with a chronic somatic disease: a systematic review of cohort studies. Scandinavian Journal of Work and Environmental Health, 35(4), 261 – 281.

Ells, L.J., Lang, R., Shield, J.P.H., Wilkinson, J.R., Lidsotne, J.S.M., Coulton S., Summerbell, C.D. (2006). Obesity and disability - a short review. Obesity reviews, 2, 341-345.

Fast, J., Frederick, J. (1998). The time of our Lives: Juggling work and leisure over the life cycle. Statistics Canada, http://www.statcan.ca/cgi-bin/downpub/research.cgi

Fox, K.R., Hillsdon,M. (2007). Physical activity and obesity. Obesity Reviews, 8(Suppl.1), 115-121.

Goetzel, R.Z., Anderson, D.R., Whitmer, R.W., Ozminkowski, R.J., Dunn, R., et.al. (1998). The Relationship Between Modifiable Health Risks and Health Care Expenditures: An Analysis of the Multi-Employer HERO Health Risk and Cost Database. Journal of Occupational & Environmental Medicine, 40(10), 843 – 854.

Gregg, E.W., Cheng, Y.Y., Cadwell, B.L., Imperatore, G., Willimans, D. E., Flegal, K.M., et al. (2005). Secular trends in Cardiovascular Disease Risk Factors according to Body Mass Index in US Adults. JAMA, 293(15), 1868-1874.

Grillo, C.M. (1994). Physical Activity and Obesity. Biomedicine & Pharmacotherapy, 48 (3-4), 127 – 136.

Hangstromer, M., Oja, P., Sjostrom, M. (2007). Physical activity and inactivity in an adult population assessed by accelerometry. Medicine & Science in Sports & Exercise, 39, 1502 – 1508.

Hamilton, M.T., Hamilton, D., Zderic, T. (2004). Exercise Physiology versus Inactivity Physiology: An Essential Concept for Understanding Lipoprotein Lipase Regulation. Exercise and Sports Sciences Reviews, 34(4), 161-166.

Hamilton, M.T., Healy, G.N., Dunstan, D.W., Zderic, T.W., Owen, N. (2008). Too Little Exercise and Too Much Sitting: Inactivity Physiology and the Need for New Recommendations on Sedentary Behaviour. Current Cardiovascular Risk Reports, 2, 292-298.

Health Canada. Healthy Living. Retrieved May 25, 2010, from http://www.hc-sc.gc.ca/hl-vs/physactiv/index-eng.php

Healy, G.N., Dunstan, D.W., Salmon, J., Cerin, E., Shaw, J.E., Zimmet, P.Z., Owen, N. (2007). Objectively Measured Light-Intensity Physical Activity Is Independently Associated with 2-h Plasma Glucose. Diabetes Care, 30, 1384-1389.

Hoffman, C., Rice, D., Sung, H. (1996). Persons with Chronic Conditions Their Prevalence and Costs. JAMA, 276, 1473 – 1479.

Hu, F.B., Li, T.Y., Colditz, G.A., Willet, W.C., Manson, J.E. (2003). Television Watching and Other Sedentary Behaviours in Relation to Risk of Obesity and Type 2 Diabetes Mellitus in Women. JAMA, 289(14), 1785 – 1791.

Hu,G., Jousilahti, P., Antikainen, R., Katzmarzyk, P.T., Tuomilehto, J. (2010). Joint Effects of Physical Activity, Body Mass Index, Waist Circumference, and Wait-to-Hip Ration on the Risk of Heart Failure. Circulation, 121(2), 237 - 244.

Hu, G., Jousilahti, P., Borodulin, K., Barengo, N., Lakka, T.A., Nissinen, A., et al. (2006). Occupational, commuting and leisure-time physical activity in relation to coronary heart disease among middle-aged Finish men and women. Atherosclerosis, 194, 490-497.

Ifedi, F. (2008). Sport participation in Canada, 2005. Culture, Tourism and the Centre for Education Statistics. Vol. Catalogue no. 81-595-MIE – No. 060: Statistics Canada.

Institute for Work & Health. Primary, Secondary and Tertiary Prevention. Retrieved from, http://www.iwh.on.ca/primary-secondary-and-tertiary-prevention

Jacobson, B.H., Aldana, S.G. (2001). Relationship Between Frequency of Aerobic Activity and Illness-Related Absenteeism in Large Employee Sample. Journal of Occupational and Environmental Medicine, 43(12), 1019-1025.

Jannique, G.Z., Wong, J., Chau, J.Y., van der Ploeg, H.P., Riphagen, I., Gilson, N.D., & Burton, N.W. et al. (2010). Occupational Sitting and Health Risks A Systematic Review. American Journal of Preventative Medicine, 39(4), 379-388.

Jans, M.P., Proper, K.I., Hilderbradt, V.H. (2007). Sedentary Behaviour in Dutch Workers Differences Between Occupations and Business Sectors. American Journal of Preventative Medicine, 33(6), 450-454.

Jiang, Y., Chen, Y., Manuel, D., Morrison, H., Mao, Y., Obesity Working Group. (2006). Quantifying the Impact of Obesity Category on Major Chronic Diseases in Canada. The Scientific World Journal, 7, 1211-1211.

Katzmarzyk, P.T., Church, T.S., Craig, C.L., Bouchard, C. (2009). Sitting Time and Mortality from All Causes, Cardiovascular Disease and Cancer. Medicine & Science in Sports & Exercise, 41(5), 998-1005.

Katzmarzyk, P.T., Gledhill, N., Shephard, R.J. (2000). The economic burden of physical inactivity in Canada. Canadian Medical Association Journal, 163(11), 1435 – 1440.

Katzmarzyk, P.T., Janssen, I. (2004). The Economic Costs Associated With Physical Inactivity and Obesity in Canada: An Update. Canadian Journal of Applied Physiology, 29(1), 90 – 115.

Katzmarzyk, P.T., Janssen, I., Ardern, C.I. (2003). Physical inactivity, excess adiposity and premature mortality. Obesity Reviews, 4, 257 – 290.

Kessler, R.C., Greenber, P.E., Michelson, K.D., Meneades, L.M., Wang, P.S. (2001). The Effects on Chronic Medical Conditions on Work Loss and Work Cutback. Journal of Occupational and Environmental Medicine, 43(3), 218-255.

Klarenback, S., Padwal, R., Chuck, A., & Jacobs, P. (2006). Population-Based Analysis of Obesity and Workforce Participation. Obesity, 14(5), 920-927.

Krause, N., Dasinger, L.K., Neuhauser, F. (1998). Modified Work and Return to Work: A Review of the Literature. Journal of Occupational Rehabilitation, 8(2), 113-140.

Laaksonen, M., Piha, K., Sarlio-Lahteenkorva, S. (2007). Relative Weight and Sickness Absence. Obesity, 15(2), 465-472.

Lee, C.D., Blain, S.N., Jackson, A.S. (1999). Cardiorespiratory fitness, body composition,and call-cause mortality in men. American Journal of Clinical Nutrition, 69, 373 – 380.

Maniscalo, P., Lane, R., Welke, M., Mitchell, J.H., Husting L. (1999). Decreased rate of back injuries through a wellness program for offshore petroleum employees. Journal of Occupational and Environmental Medicine, 41, 813 – 820.

Mason, C., Brien, S., Craig, C., Gauvin, L., Katzmarzyk, P. (2007). Musculoskeletal Fitness and Weight Gain in Canada. Medicine & Science in Sports & Exercise, 39(1), 38 – 43.

Miller, R., Brown, W., (2004). Steps and Sitting in a Working Population. International Journal of Behavioural Medicine, 11(4), 219-224.

Ministry of Health and Long Term Care. (2007). Preventing and Managing Chronic Disease: Ontario's Framework. Retrieved April 21, 2010 from http://www.health.gov.on.ca/english/providers/program/cdpm/index.html

Mokdad, A.H., Bowman, B.A., Ford, E.S., Vinicor, F., Marks, J.S., Koplan, J.P. (2001). The Continuing Epidemics of Obesity and Diabetes in the United States. JAMA, 286(10) 1995-1200.

Mummery, W.K., Schofiel, G.M., Steele, R., Eakin, E.G., Brown, W.J. (2005). Occupational Sitting Time and Overweight and Obesity in Australian Workers. American Journal of Preventative Medicine, 29(2), 91-97.

Musich, S., Napier, D., Eddington, D.W. (2001). The association of health risks with workers' compensation costs. Journal of Occupational and Environmental Medicine, 43, 534 – 541.

Neovius, K., Johannson, K., Kark, M., Neovius, M. (2009). Obesity status and sick leave: a systematic review. Obesity reviews, 10, 17-27.

Owen, N., Leslie, E., Salmon, J., Fortheringham, M.J. (2000). Environmental determinants of physical activity and sedentary behaviour. Exercise and Sport Sciences Reviews, 28, 153 – 158

Owen, N., Bauman, A., & Brown, W. (2009). Too much sitting: a novel and important predictor of chronic disease risk. British Journal of Sports Medicine, 43, 81-83.

Pronk, N.P., Martinson, B., Kessler, R.C., Beck, A.L., Simon, G.E., Wang, P. (2004). The Association Between Work Performance and Physical Activity, Cardiorespiratory Fitness, and Obesity. Journal of Occupational and Environmental Medicine, 46(1), 19-25.

Proper, K.I., Hilderbrandt, V.H. (2006). Physical activity among Dutch Workers – Differences between occupations. Preventative Medicine, 43, 42-45.

Public Health Agency of Canada (2001). Business Case for Active Living at Work. Retrieved August 12, 2010 from http://www.phac-aspc.gc.ca/alw-vat/index-eng.php

Public Health Agency of Canada (2007). Trends & Impact: The Basis for Investment Decisions. Retrieved August 12, 2010 from http://www.phac-aspc.gc.ca/alw-vat/trends-tendances/index-eng.php

Serxner, S., Gold, D., Anderson, D., Williams, D. The Impact of worksite health promotion program on short-term disability usage. Journal of Occupational and Environmental Medicine, 43, 25-29.

Sisson, S.B., Camhi, S.M., Church, T. S., Martin, C.K., Tudor-Locke, C., Bouchard, C., et al., (2009). Leisure Time Sedentary Behaviour, Occupational/Domestic Physical Activity, and Metabolic Syndrome in U.S. Men and Women. Metabolic Syndrome and Related Disorders, 7(6), 529-536.

Smulders, P.G., Andries, F., Otten, F.W. (2001) How do Dutch people think about their work? Design, quality and first results of the TNO Work situation survey. TNO work and employment.

Statistics Canada. Component of Statistics Canada Catalogue no. 82-221-XWE. (2009). Health Indicators: Adult Body Mass Index. Retrieved from http://www.statcan.gc.ca/pub/82-221-x/2009001/tblstructure/1hs/1hc/hc1abm-eng.htm

Tremblay, M.S., Shields, M., Laviolette, M., Craig, C.L., Janssen, I., Grober, S.C. (2010). Fitness of Canadian children and youth: Restulst form the 2007-2009 Canadian Health Measures Survey. Statistics Canada, Health Reports 21 (1), Catalogue no. 82-003-XPE)

Tudor-Locke, C., Burton, N.W., Brown, W.J. (2009). Leisure-time physical activity and occupational sitting: Associations with steps/day and BMI in 54-59 year old Australian women. Preventative Medicine, 48, 64-68.

Tunceli, K., Li, K., & Willimans, K. (2006). Long-Term Effects of Obesity on Employment and Work Limitations Among U.S. Adults, 1986 to 1999. Obesity, 14(9),1637-1646.

Van Duijvenbode,D.C. Hoozemans, M.J.M., vanPoppel, M.N.M, Proper, K.I. (2009). The relationship between overweight and obesity, and sick leave: a systematic review. International Journal of Obesity, 33, 807-816.

Weiss, D.R., O'Loughlin, J.L., Platt, R.W., Paradis, G. (2007). Five-year predictors of physical activity decline among adults in low-income communities: a prospective study.

World Health Organization. (2008). Preventing noncommunicable diseases in the workplace through diet and physical activity: WHO/World Economic Forum Report of a Joint Event. REF: 150108. Geneva, Switzerland: WHO Press.

World Health Organization. (2009). Global health risks: Mortality and burden of disease attributable to selected major risks. Retrieved from http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf

Zhang, M., Xie, X., Lee, A.H., Binns, C.W. (2003). Sedentary behaviours and epithelial ovarian cancer risk. Cancer Causes and Control, 15, 83 - 89.

Associations between perceived access to physical activity facilities in the workplace and physical activity levels: Results from the Canadian Community Health Survey

Katrena Munsch, B.Sc.

School of Kinesiology and Health Science, York University, Toronto, Ontario.

Running Title: Physical activity resources in the workplace

Word Count: 3,816

Abstract: 328

Number of Tables: 3

Number of Figures: 2

ABSTRACT

Objective: To quantify the extent to which access to physical activity facilities [PAF(s)] at or near the work place is associated with physical activity [PA].

Methods: Data for this study was from the Canadian Community Health Survey [CCHS] cycle 4.1 (2007/2008; n = 62 575). Only those participants between the ages of 18 – 64y, had a BMI ≥18.5 kg/m² [excluding pregnant women], had complete data for PA, and worked or were absent from a job or business in the past week was included in the analysis. These participants were asked a series of seven questions about access to PAF(s) at or near their place of work. The questions were summed to create a composite score from which two further variables were derived, that determined both the degree and type of access. Multivariate Logistic regression was used to estimate [OR = 95% CI] between access to PAF(s) and PA level and were weighted to be representative of the Canadian population.

Results: Compared to those with no PAF(s) at or near work [OR=1.00, referent], participants who had access to at least 'one or more PAF(s)' were 84% more likely to be at least moderately active [OR: 1.84; CI: 1.71 – 1.97], whereas those with access to three or more PAFs were over twice as likely [OR: 2.16; CI: 2.0 – 2.33]. It was further observed that the odds of being at least moderately active varied according to access to 'one or more PAF(s)' [OR: 1.59; CI: 1.47 – 1.73], 'health program at work' [OR: 1.45; CI: 1.08 – 1.95], or both [OR: 2.21; CI: 2.03 – 2.39], which had double the effect.

Conclusion: The findings demonstrate that increased access to facilities at or near the workplace is associated with low to moderate-levels of PA and that coupling a health program in the workplace in conjunction with access to resources yields even greater activity levels. Taken together, this study highlights the potential impact of workplace-based interventions for the promotion of PA.

Keywords: physical activity, work place

1. Introduction

According to the World Health Organization (2009), at least 1.9 million deaths are attributable to physical inactivity. It is well known that physical inactivity is related to chronic disease and disability, most notably heart disease, stroke, cancer, chronic respiratory diseases and diabetes (WHO 2008). In 2003, almost 80% of Ontario residents over age 45 had a chronic condition, and 70% had two or more (Ministry of Health and Long Term Care, 2007). Although secondary and tertiary care for many chronic diseases have improved life expectancy (Arnett, McGovern, & Jacobs, 2002; Cooper, Cutler, & Desvigne-Nickens, 2000), a parallel decrease in disability rates (Gregg et al., 2005) has not occurred, and the current population is now comprised of people with multiple chronic conditions (Alley & Chang, 2007). It would therefore appear that the risk of disability within the working age population is exceeding the morbidity or mortality risk, since people with chronic conditions are now are living longer and experience greater levels of disability.

In addition to the impact on one's quality of life, chronic disease has a considerable impact on Canada's health care and economic output. It is estimated that between 2005 and 2015 $8.5 billion [$USD] will be lost in national income for Canada, due to the burden of the five major chronic diseases associated with physical inactivity (WHO, 2008), while the cost of absenteeism in Canada is $15 billion dollars per year (Public Health Agency of Canada, 2001). Additionally, the direct and indirect health care costs associated with inactivity in

Canada is approximately 2.6% of the healthcare expenditure [$5.3 billion dollars ($1.6 billion direct, $3.7 billion in indirect costs)] (Katzmarzyk & Jansen, 2004). Even modest changes in health behaviours can evoke positive change. Katzmarzyk, Gledhill, & Shephard (2000) projected that reducing the prevalence of physical inactivity by only 10% had the potential to reduce health care expenditures by $150 million per year.

Despite the potential benefits of physical activity [PA] in the prevention of chronic disease, over half of the Canadian population is currently inactive [M: 55%; F: 49%] (CFLRI, 2008). However, there are many noted barriers to adopting a physically active lifestyle, most notably time pressure (Fast & Frederick, 1998). Specifically, 42% of adult Canadians report an inability to participate in PA because of lack of time due to work constraints (CFLRI, 2008). Not only has lack of time been shown to decrease our opportunities to participate in leisure activities, but having access to facilities has been shown to reduce obesity (Weiss, O'Loughlin, Platt, & Paradis, 2007).

In more recent years, the workplace has become an internationally recognized setting for health promotion, as a considerable amount of the population can be targeted through this medium (WHO, 2008). In 2004, the Canadian Fitness and Lifestyle Research Institute [CFLRI] estimated a 4 to 25% increase in productivity for physically active employees. By implementing health programs in the workplace, risk factors for chronic disease such as overweight and obesity may be targeted (WHO, 2008). As a consequence, these programs are likely to benefit employers by increasing employment and reducing work limitations (Tuncelli, Li & Willimans, 2006), enabling greater participation in the workforce (Klarenback, Padwal, Chuck, & Jacobs, 2006), decreasing occurrences of both short-term and long-term disability (Arena, Padiyar, Burton, & Schwerha, 2006, Laaksonen, Piha, & Sarlio-Lahteenkorva, 2007; Neovius, K., Johannson, Kark, & Neovius, M., 2009; Serxner, Gold, Anderson, & Williams, 2001; Van Duijvenbode, Hoozemans, vanPoppel, & Proper, 2009) and decreasing workplace injuries (Maniscalo, Lane, Welke, Mitchell, & Husting, 1999), as well as saving on worker's compensation costs (Musich, Napier, & Eddington, 2001).

By constructing work environments that influence health behaviours, employers are likely to benefit from a decrease in health plan costs, disability costs, and worker's compensation costs, while concurrently experiencing an increase in productivity when presenteeism is limited (Schultz, & Edington, 2007). Although these findings have been well described in larger corporations in Canada as well as the Unites States (Aldana, Merrill, Price, Hardy, & Hager, 2004; Public Health Agency of Canada, 2001), the vast majority of Canadian employers [86%] have less than 20 employees (Canadian Labour and Business Center, 2002). Therefore, workplace health programs [WHPs] run in large corporations would likely prove to be impractical and unlikely cost effective for smaller organizations, as the demographics of these small corporations will likely vary considerably.

Given the increasing prevalence of obesity, chronic disease and subsequent disability, layered with a lack of time for PA, the workplace represents a valuable forum in which health initiatives can be delivered. To this end, easy access to PA facilities at or near the workplace combined with access to a work place health program may prove to be a practical solution in moderating the effect of physical inactivity for all employers, as it may overcome some of the noted barriers to PA adoption and adherence. Therefore, the purpose of this study was to determine if having access to PA facilities at or near the work place [either alone or with access to a health program at work] would be associated with higher levels of regular PA. PA was measured in kilocalories/kilogram/day [KKD], where KKD is calculated using the following formula: energy expenditure = {(metabolic equivalent of the activity performed) x (basal metabolic rate / 24 hours) x (duration of activity in hours)}.

2. Methods

Data from Cycle 4.1 of the Canadian Community Health Survey [CCHS] were used. The CCHS is a voluntary cross-sectional survey [January 2007 to December 2008], of the health status, health determinants and health care utilization of the Canadian population, gathered both in person and by telephone. Data was collected from all residents 12 years of age and older, excluding those living on Indian reserves, Armed Forces bases, and certain remote locations.

From an initial sample of 131 958 respondents, the dataset was limited to individuals age 18 to 64 y [n = 89 832] and had a body mass index [BMI] ≥ 18.5 kg/m² [n = 83 432] (underweight individuals were excluded from the analysis since health risks are different in underweight populations versus excess weight groups), complete data for PA [82 766], and those who had worked at a job or business in the past week or had a job or business from which they were absent in the past week [n = 62 575]. Individuals that responded "no", "permanently unable to work", "refusal", "don't know" or "not applicable" to these questions were deleted from the sample [n = 20 191]. Participants meeting these inclusion requirements were subsequently asked to respond to a subset of questions about PAF(s) at or near their place of employment. The final sample consisted of 62 575 participants [M: 32 375; F: 30 500].

2.1 Main Outcome and Exposure Variables

Physical Activity Facilities [PAF(s)]: Respondents were asked a series of seven questions pertaining to access to PAF(s) at work. "At or near your place of work, do you have access to: 1. A pleasant place to walk, jog, bicycle or rollerblade? 2. Playing fields or open spaces for ball games or other sports? 3. A gym or physical fitness facilities? 4. Organized fitness classes? 5. Any organized recreational sports teams? 6. Showers and/or change rooms? 7. Programs to improve health, physical fitness or nutrition?" Responses were dichotomized [yes, no] and summed to create a composite score [0 to 7] for total number of PAF(s), which was subsequently classified as no access [0], low access [1], moderate access [2], and high PAF access [3 or more]. In addition, as second variable was derived with four levels which looked at the type of access, specifically those with: no access, access to one or more PAF(s) only (not including a WHP), access to a WHP only, and access to both on or more PAF(s) and a WHP.

2.2 Covariates and Demographic Variables

Leisure time PA in the CCHS was gathered using a modified Minnesota Leisure Time Questionnaire (Taylor et al., 1978). This variable was derived from self-reported frequency and duration of a variety of recreational activities, as well as the duration of walking or cycling to and from work or school in the past three months. Daily PA energy expenditure was subsequently separated into three categories 'active' [>3 kcal/kg/day], 'moderately active' [1.5–3.0 kcal/kg/day], and 'inactive' [<1.5 kcal/kg/day]. Self-reported height and weight was used to calculate BMI [kg/m^2] and classify participants as 'underweight' [<18.5], 'normal weight' [18.5-24.9], 'overweight' [25.0-29.9], or 'obese' [≥30.0]. Because less than 3% of the population is clinically underweight (Statistics Canada, 2006), only cases with a BMI ≥ 18.5 were retained for the current analysis. Total number of hours per week [5 to 45 hours or more] spent engaging in screen time sedentary behaviour [watching television, using a computer or playing video games] was reported and subsequently dichot omized as ‘high’ [>20 h/wk] or ‘low’ [≤ 20 h/wk]. For chronic conditions, respondents were asked whether they had physician-diagnosed chronic disease [asthma, arthritis or rheumatism, high blood pressure, diabetes, heart disease, cancer, or stroke]. A dichotomous variable was derived where respondents were classified as having either ‘one or more’ of these chronic conditions, or having ‘none’. While the CCHS includes information about other conditions, only those related to physical inactivity and obesity were included in the present analysis.

The following variables have been shown to be associated with PA and health (Haskell, Lee, & Pate, 2007) and will be considered as covariates for the current analysis: age [18-29, 30-39, 40-49 and 50-64 y], annual personal income [‘low’ (<$20,000 per year), ‘moderate’ ($20-$59,999 per year), or ‘high’ (≥$60,000 per year)], educational attainment [‘less than secondary school’, ‘secondary grad and other post-secondary’ and ‘post-secondary graduate’], number dependents under 12 y [‘none’: 0; ≥1], daily fruit and vegetable consumption [‘low’: <5 or ‘adequate’: ≥ 5]., smoking habits [‘never’, ‘occasional’, ‘former daily’, ‘former occasional’, and ‘greater than two to three times per week’], and alcohol consumption [‘once per month’, ‘once per week’, and ‘everyday’].

2.3 Statistical Analysis

All analyses were conducted using SPSS® v.17. Chi-square analyses were used to assess differences in the prevalence of chronic diseases, sedentary time, BMI and access to PAF(s) by age, sex, and PA level. Age and sex adjusted [model 1] and multivariate-adjusted [model 2] logistic regressions were used to estimate the odds ratio [OR] and 95% confidence intervals [CIs] between access to PAF(s) at or near the workplace and PA level. To assess the influence of potential confounders, analyses were stratified by sex and PA level and statistical significance was set at $p<0.05$. All analyses were weighted to be representative of the Canadian population using the sample weights provided by Statistics Canada and the complex samples procedure in SPSS. This type of weighting will account for the unequal probability of being selected both at the population and household levels.

3. Results

Characteristics of participants are shown in **Table 1**. Overall, 48.7% of the sample was female, and 26.1% of respondents had one or more dependents under the age of 12 y. In general, males tended to be more active than females and report higher incomes, but have poorer health risk profiles for alcohol, fruit and vegetable consumption, and regular cigarette smoking. As expected, more healthful behaviours also tended to cluster within moderately active and active individuals, whereas smoking and high levels of sedentary activities were more common amongst inactive individuals.

Table 2 presents the prevalence of '1 or more chronic conditions', BMI and PAF availability, by sex and level of PA. Approximately 71.3% of men and 75.6% of women had access to at least one PAF at or near their place of work. Of the seven resources measured, participants were most likely to have access to 'a pleasant place to walk, bike, jog, or rollerblade' [F: 64.6%, M: 54.8%], however, males and females differed with respect to those facilities they were least likely to have access to. Females were least likely to have access to 'recreational organized sports teams' [F: 30.4%; M: 31.3%;] while males were least likely to have access to 'organized fitness classes' [M: 30.8%; F: 38.7%]. In age and sex adjusted models, the odds of being at least moderately active [≥1.5 KKD] was related to number and type of PAF resources in a dose-dependent manner [**Figure 1**; Panel A and B]. Compared to those with no PAF at or near work [OR=1.00, referent], those that had access to at least one PAF were 84% more likely to be at least moderately active [OR: 1.84; CI: 1.71 – 1.97; Figure A], whereas those with access to three or more PAFs were over twice as likely [OR: 2.16; CI: 2.0 – 2.33]. It was further observed that the odds of being at least moderately active varied according to access to 'one or more PAF(s)' [OR: 1.59; CI: 1.47 – 1.73], 'health program at work' [OR: 1.45; CI: 1.08 – 1.95], or both [OR: 2.21; CI: 2.03 – 2.39; Figure B].

In fully adjusted models [**Table 3**], odds of at least moderate PA remained associated with access to PAF(s) at work [M: 1.77, 1.55 – 2.01; F: 1.61, 1.36 – 1.92]. Although a dose-response relationship persisted in males [≥3 PAF: 2.02, 1.76 – 2.32; ≥2 PAF: 1.32, 1.09 – 1.59], results were more mixed for females [≥3 PAF: 1.40, 1.17 – 1.67; ≥2 PAF: 0.88, 0.70 – 1.11]. Again, individuals with access to 'one or more PAF(s)' and a 'health program at work' had higher odds of being at least moderately active [M: 2.07, CI: 1.79 – 2.38; F: 1.85, CI: 1.54 – 2.22], when compared to only having access to one or the other. More specifically, compared to the other five types of PAFs and the health program, having access to showers and or change rooms was associated with the greatest likelihood of PA for males [OR = 1.67; CI: 1.50 – 1.86], whereas for females, the greatest likelihood was amongst those with access to organized sports teams [OR = 1.56; CI: 1.38 – 1.76], although the differences across the seven categories measured was negligible. Finally, those who had access to PAF(s) had lower odds of being inactive compared to those that did not have any access [M: 0.59; CI: 0.48 – 0.59; F: 0.66; CI: 0.58 – 0.75].

4. Discussion

The present study focused on the importance of having access to PAF(s) at or near the workplace for working adults. In general, greater access to PAFs was associated with higher odds of being physically active, although a stronger relationship was observed for males. Individuals who had access to both a ‘health program at work’ and ‘one or more PAF(s)’ had a higher odds of being physically active compared to those with access to either ‘one or more PAF(s)’ only or a ‘health program at work’ only. Again, a stronger relationship was detected for males compared to females.

Married, employed Canadians, with children between the ages of 25 to 69y have observed a marked ‘time squeeze’, which manifested itself in a decrease in leisure time (Fast & Frederick, 1998). Specifically, 42% of adult Canadians report an inability to participate in PA because of lack of time due to work constraints (CFLRI, 2008). In women, specific time barriers to PA included long hours of work/study, inflexible, unpredictable, and unusual hours at work/study, family commitments to children, family, and volunteer and community work (Welch, McNaugton, Hunter, Hume, & Crawford, 2008). The Centre for Work-Life Policy found that in 2009, women were working on average 49 hours per week, compared to 40 hours in 2004. In Canada, it has been shown that barriers to participating in PA through the work place are lack of time due to work and the pressure of tight deadlines, followed by busy roads near the work place, and lack of places to be active near work (CFLRI, 2008).

4.1 Physical Activity and Inactivity by Physical Activity Facilities

To account for those individuals that would be physically active regardless of access to PAF(s) and a WHP, models were run with inactivity as the outcome measure, to determine if having access to PAF(s) was in fact associated with lower odds of being *in*active. Fully adjusted models found a similar inverse dose-response relationship for inactive participants across both sexes, the greater the access to PAFs, the lower the odds of being inactive. Overall, odds of being physically inactive were lowest amongst those that had access to both 'one or more PAF(s) and a 'health program at work' combined, with few sex differences in the relationships.

4.2 Chronic Conditions and BMI ≥ 25.0 kg/m² by Physical Activity Facilities

Fully adjusted models assessing the odds of having a BMI ≥ 25.0 kg/m² and the odds of acquiring an obesity-related chronic disease by the degree and type of access to PAF(s) at or near the work place were run. Given the association between PAFs and PA participation, by extension, it was expected that those who had greater access to PAF(s) would have a lower odds of overweight and other obesity-related chronic conditions. However, the results for these analyses were mixed in men and women, and none of the models produced significant results [Appendix A].

4.3 Implications

Findings from this study indicate that access to PAF(s) at or near the workplace was associated with a higher likelihood of being physically active. It was shown that having access to 'one or more PAF(s)' and a 'health program at work' was associated with the greatest likelihood of being physically active. This finding points to the need for a workplace culture that not only eliminates barriers to PA participation through infrastructure, but also promotes a culture whereby primary prevention strategies in the workplace are readily available. This serves as valuable information for Canadian employers, since it demonstrates that implementing a health program in conjunction with access to facilities provides optimal results.

It is important to note that access to resources in this study included both those located physically within the workplace, and those "near" the workplace. As a result, employers who do not have the financial means or the space to implement facilities may also be served by a health promotion campaign that promotes the use of facilities in the surrounding area, such as negotiating a corporate rate at a local gym, creating a lunch time walking club that utilizes local park space, encouraging employees to take the stairs, or creating awareness about public health programs [for example the YM/YWCA, and so forth]. In Canada, for the companies with 50 employees or more, 70% report access to walking or biking trails, 50% have open spaces where they can participate in PA, while 56% have access to community facilities, and 76% of employed Canadians report that there are easily accessible stairs at work (CFLRI, 2008).

In 2004, CFLRI estimated a 4 to 25% increase in productivity for physically active employees and there are many working examples of workplace health and wellness programs in Canada with further positive outcomes. A report from the

Canadian Labour and Business Centre highlights examples of innovative workplace health initiatives (Canadian Labour and Business Center, 2002). For example, Dofasco Inc., Irving Paper, and American Express Canada all offer access to facilities in conjunction with a health program. Subsequently, Dofasco observed a decrease in Workplace Safety and Insurance Board [WSIB] premium rates, musculoskeletal injuries and lost time injury rates [63%, 70% and 66% respectively], which translated into millions of dollars in savings over a ten year period. Similarly, Irving Paper has seen decreases in costs for monthly Worker's Compensation Board [WCB; 60% reduction] and short-term disability [50% reduction], with a total accrued WCB savings of $800 000 [and an 80% reduction in grievances]. In examples from the public sector, The City of Regina Transit Department and the Moose Jaw – Thunder Creek Health District both provide their employees with gym subsidies as well as a health program. The City of Regina reported $500 000 in savings on WCB claims, and days lost fell from 597 to 337 per annum. The Moose Jaw -Thunder Creek Health District saw decreases in both employee sick days and accident rates. The Vancouver shipyards have offered their employees access to fitness facilities only and in turn have seen claim costs fall by $1.7 million when comparing costs from 1998 to 2001, and WCB claims decreased by 70%. While a complete cost-benefit analysis of these programs is not yet available, a study of WHPs found a 25-30% reduction in medical and absenteeism costs over an average period of 3.6 y (Chapman, 2003). It is clear that from a retention standpoint, these initiatives are valued components of the workplace, however 76% of Canadian employers do not yet offer comprehensive WHPs (Public Health Agency of Canada, 2001).

4.4 Limitations and Strengths

There were several limitations to this study. The PAF series of questions were only asked to employed individuals. Therefore, if someone was recently unable to work due to a chronic condition, they would not be captured in this analysis since the data is cross-sectional. Furthermore, prior research has shown that obese individuals have lower odds of workforce participation (Tuncelli, Li, & Williams, 2006), and given that data for this study are largely collected by telephone survey, and participation is voluntary, individuals who are ill may not be as likely to participate. In addition, the information collected is self-reported and may be subject to a healthy responder bias, such as over-reporting of PA. Since the CCHS is a cross sectional sample, we do not know about the duration of access to PAF(s) at or near the workplace so it is difficult to ascertain if they are associated with both BMI and chronic conditions. Moreover, individuals who are more likely to be physically active in their leisure time may also be more aware of their surroundings and opportunities for PA. A longitudinal study would prove useful in accounting for these limitations. In addition, future studies measuring workplace health should consider sedentary time as a potential confounder of the association between PA on chronic disease, since both PA and sedentary behaviour have their own independent negative effect on chronic disease and mortality.

There were also strengths to this study. The findings are representative of the Canadian population and demonstrate the importance of health promotion in the workplace and its association with PA. Although the benefits of health and wellness programs in larger corporations are well described, this is the first time that the CCHS has incorporated questions about access to PA resources. Furthermore, the analysis has shown that coupling a health program in the workplace with access to resources may yield greater activity levels. This finding suggests that even subtle changes with modest investment may improve the health of employees for all Canadian employers, including the majority that have fewer than 20 employees. Moreover, efforts to understand how to promote more active lifestyles are of great importance, as increasing PA levels would have a positive impact on the Canadian economy by reducing the incidence of chronic disease, which in turn has an impact on health care costs, lost income and absenteeism (Katzmarzyk et al., 2000; Public Health Agency of Canada, 2001; WHO, 2008).

REFERENCES

Aldana, S.G., Merrill, R.M., Price, K., Hardy, A., Hager, R. (2004) Financial impact of a comprehensive multisite workplace health promotion program. Preventative Medicine, 40, 131-137.

Alley, D.E., & Chang, V.W. (2007). The Changing Relationship of Obesity and Disability, 1998 -2004. JAMA, 298(17), 2020-2027.

Arnett, D.K., McGovern, P.G., Jacobs, D.R., et al. (2002). Fifteen-year trends in cardiovascular risk factors (1980 – 1982 through 1995 – 1997): the Minnesota Heart Survey. American Journal of Epidemiology, 156, 929 – 935.

Canadian Fitness and Lifestyle Research Institute. (2008). Survey Statistics Summaries. Retrieved from http://www.cflri.ca/eng/statistics/index.php

Canadian Labour and Business Center. (2002). Twelve Case Studies on Innovative Workplace Health Initiatives. Retrieved from http://www.clbc.ca/print/research_and_reports/case_studies.asp

Chapman, L.S. (2005). Meta-evaluation of Worksite Health Promotion Economic Return Studies: 2005 Update. The Art of Health Promotion, 10-15.

Cooper, R., Cutler, J., Desvigne-Nickens, P., et al. (2000). Trends and disparities in coronary heart disease, stroke and other cardiovascular diseases in the United States. Circulation, 102, 3137 – 3147.

Fast, J., Frederick, J. (1998). The time of our Lives: Juggling work and leisure over the life cycle. Statistics Canada, http://www.statcan.ca/cgi-bin/downpub/research.cgi

Gregg, E.W., Cheng, Y.Y., Cadwell, B.L., Imperatore, G., Willimans, D. E., Flegal, K.M., et al. (2005). Secular trends in Cardiovascular Disease Risk Factors according to Body Mass Index in US Adults. JAMA, 293(15), 1868-1874.

Gregg, E.W., Guralnik, J.M. (2007). Is Disability Obesity's Price of Longevity. JAMA, 298(17) 2066-2067.

Haskell, W.L., Lee, I.M., Pate, R.R., et al. (2007).Physical activity and public health. Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Circulation,116, DOI: 10.1161/circulationaha.107.185649. Institute for Work & Health. Primary, Secondary and Tertiary Prevention. Retrieved from, http://www.iwh.on.ca/primary-secondary-and-tertiary-prevention

Health Canada. Physical Activity. Retrieved from http://www.hc-sc.gc.ca/hl-vs/physactiv/index-eng.php

Katzmarzyk, P.T., Gledhill, N., Shephard, R.J. (2000). The economic burden of physical inactivity in Canada. Canadian Medical Association Journal, 163(11), 1435 – 1440.

Katzmarzyk P.T., Janssen I. (2004). The economic costs associated with physical inactivity and obesity in Canada: an update. Canadian Journal of Applied Physiology, 29(1), 90-115.

Klarenback, S., Padwal, R., Chuck, A., & Jacobs, P. (2006). Population-Based Analysis of Obesity and Workforce Participation. Obesity, 14(5), 920-927.

Laaksonen, M., Piha, K., Sarlio-Lahteenkorva, S. (2007). Relative Weight and Sickness Absence. Obesity, 15(2), 465-472.

Maniscalo, P., Lane, R., Welke, M., Mitchell, J.H., Husting L. (1999). Decreased rate of back injuries through a wellness program for offshore petroleum employees. Journal of Occupational and Environmental Medicine, 41, 813 – 820.

Ministry of Health and Long Term Care. (2007). Preventing and Managing Chronic Disease: Ontario's Framework. Retrieved April 21, 2010 from http://www.health.gov.on.ca/english/providers/program/cdpm/index.html

Musich, S., Napier, D., Eddington, D.W. (2001). The association of health risks with workers' compensation costs. Journal of Occupational and Environmental Medicine, 43, 534 – 541.

Neovius, K., Johannson, K., Kark, M., Neovius, M. (2009). Obesity status and sick leave: a systematic review. Obesity reviews, 10, 17-27.

Public Health Agency of Canada. (2001). The Business Case for Active Living at Work. Retrieved from http://www.phac-aspc.gc.ca/alw-vat/index-eng.php

Serxner, S., Gold, D., Anderson, D., Williams, D. The Impact of worksite health promotion program on short-term disability usage. Journal of Occupational and Environmental Medicine, 43, 25-29.

Schultz, A. B, Edington, D. W. (2007). Employee health and presenteeism: a systematic review. Journal of occupational rehabilitation, 17(3), 547-79.

Statistics Canada, Ottawa. (2006). CANSIM Table 105-0409. Retrieved from http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=6

Taylor, H.L., D.R. Jacobs Jr., B. Schucher, J.Knudsen, A.S. Leon, & G. Debacker. A questionnaire for the assessment of leisure-time physical activities. Journal of Chronic Disease. 31: 741-755, 1978.

Tunceli, K., Li, K., & Willimans, K. (2006). Long-Term Effects of Obesity on Employment and Work Limitations Among U.S. Adults, 1986 to 1999. Obesity, 14(9),1637-1646.

Van Duijvenbode,D.C. Hoozemans, M.J.M., vanPoppel, M.N.M, Proper, K.I. (2009). The relationship between overweight and obesity, and sick leave: a systematic review. International Journal of Obesity, 33, 807-816.

Weiss, D.R., O'Loughlin, J.L., Platt, R.W., Paradis, G. (2007). Five-year predictors of physical activity decline among adults in low-income communities: a prospective study.

Welch, N., McNaughton, S.A., Hunter, W., Hume, C., Crawford, D. (2008). Is the perception of time pressure a barrier to healthy eating and physical activity among women? Public Helath Nutrition, 12(7), 888-895.

World Health Organization. (2005). Preventing Chronic Diseases - a vital investment. World Health Organization: Geneva 2005, Part Two - The Need for Action.

World Health Organization. (2008). Preventing noncommunicable diseases in the workplace through diet and physical activity: WHO/World Economic Forum Report of a Joint Event. REF: 150108. Geneva, Switzerland: WHO Press.

FIGURE LEGEND

Figure 1A. Odds on Physical Activity (≥1.5 KKD) by Number of PAF Resources
Age and Sex adjusted
$^*p < 0.05$

Figure 2A. Odds of Physical Activity (≥1.5 KKD) by Type of PAF Resources
Age and Sex adjusted
$^*p < 0.05$

Table 1A. Demographic Characteristics of CCHS Participants by Physical Activity Level and Sex

	MALE				FEMALE			
NON-MODIFIABLE CHARACTERISTICS	Mean PA KKD	Active >3.0 KKD	Moderate 1.5 - 3.0 KKD	Inactive <1.5 KKD	Mean PA KKD	Active >3.0 KKD	Moderate 1.5 - 3.0 KKD	Inactive <1.5 KKD
AGE (%)		M: 32,075				F:30,500		
18-29	3.09	39.0%	25.5%	35.5%	2.48	31.2%	26.1%	42.6%
30-39	2.23	28.0%	25.8%	46.2%	2.04	24.0%	26.7%	49.3%
40-49	2.06	25.0%	26.4%	48.6%	1.94	22.8%	27.2%	50.0%
50-64	1.91	22.4%	25.9%	51.7%	1.77	19.7%	26.8%	53.5%
TOTAL		28.3%	25.9%	45.7%		24.2%	26.8%	49.1%
ANNUAL PERSONAL INCOME (%)		M:28,424				F:26,818		
low (<$20,000)	2.92	35.7%	23.5%	40.8%	2.00	22.8%	25.9%	51.3%
moderate ($20-59,999)	2.08	24.5%	25.7%	49.8%	1.96	23.0%	26.9%	50.0%
high (>= 60,000)	2.42	31.0%	28.0%	41.0%	2.40	30.4%	29.6%	40.0%
TOTAL		28.3%	26.3%	45.4%		24.3%	27.1%	48.6%
HIGHEST LEVEL OF EDUCATION (%)		M:29,596				F:28,735		
< than secondary	1.57	18.2%	17.7%	64.2%	1.45	14.5%	22.7%	62.8%
secondary grad. & other post-sec.	2.01	23.3%	25.3%	51.4%	1.77	19.7%	24.0%	56.3%
post-sec grad.	2.38	29.5%	27.0%	43.5%	2.11	25.5%	27.4%	47.2%
TOTAL		28.1%	26.4%	45.5%		24.4%	26.8%	48.9%
# DEPENDENTS < 12 YEARS OLD (%)		M:32,075				F:30,500		
no children < 12 yrs. in household	2.36	29.0%	26.6%	44.4%	2.09	24.7%	27.7%	47.7%
>= 1 children < 12 yrs. in household	2.15	26.5%	24.2%	49.3%	1.93	23.0%	24.3%	52.7%
TOTAL		28.3%	25.9%	45.7%		24.2%	26.8%	49.1%
MODIFIABLE CHARACTERISTICS								
SMOKING (%)		M:31,985				F:30,421		
never smoked	2.53	31.2%	26.3%	42.4%	2.08	25.0%	25.6%	49.5%
occas., former daily, former occas.	2.35	29.4%	27.0%	43.6%	2.17	26.3%	28.7%	45.1%
Daily	1.88	21.9%	23.1%	55.0%	1.65	17.4%	25.0%	57.6%
TOTAL		28.3%	25.9%	45.7%		24.2%	26.8%	49.0%
ALCOHOL CONSUMPTION (%)		M: 28,004				F:25,805		
once per month or less	2.05	24.4%	23.8%	51.8%	1.82	19.4%	26.4%	54.2%
2 - 3 times per month - once per week	2.49	31.0%	25.8%	43.2%	2.22	26.9%	27.7%	45.4%
2 - 3 times per week - everyday	2.39	29.7%	28.0%	42.3%	2.33	30.0%	29.0%	41.0%
TOTAL		29.1%	26.4%	44.5%		25.4%	27.7%	47.0%
FRUIT & VEG. CONSUMPTION (%)		M:31,118				F:29,859		
< 5 servings per day	2.00	23.4%	25.5%	51.1%	1.63	17.1%	24.1%	58.8%
> 5 - 10 servings per day	2.90	37.8%	27.0%	35.2%	2.47	31.6%	29.6%	38.9%
TOTAL		28.5%	26.0%	45.5%		24.3%	26.8%	48.8%
SEDENTARY BEHAVIOURS (%)		M:31,976				F:30,417		
low (<=19 hours per week)	2.36	29.3%	26.3%	44.4%	2.13	25.8%	26.9%	47.3%
moderate (20-29 hours per week)	2.16	26.2%	26.0%	47.8%	1.83	20.0%	26.9%	53.1%
high (>=30 hours per week)	2.30	27.3%	22.1%	50.7%	1.75	18.9%	24.2%	57.0%
TOTAL		28.3%	26.0%	45.7%		24.2%	26.7%	49.0%

Table 2A. Prevalence of Chronic Diseases, BMI and Access to Physical Activity Facilities at or Near the Workplace in Men and Women

	MALE					FEMALE				
	Mean PA	Active >3.0 KKD	Moderate 1.5 - 3.0 KKD	Inactive <1.5 KKD	Total	Mean PA	Active >3.0 KKD	Moderate 1.5 - 3.0 KKD	Inactive <1.5 KKD	Total
1 or More Chronic Diseases			**M: 31, 800**					**F: 30,358**		
No	2.41	29.9%	26.0%	44.1%	22 521	2.11	25.2%	27.0%	47.8%	20 176
Yes	2.03	24.3%	25.8%	50.0%	9 279	1.90	21.9%	26.2%	51.8%	10 182
Body Mass Index			**M: 32, 075**					**F: 30,500**		
normal (18.5 - 24.9)	2.47	30.9%	25.0%	44.1%	11 928	2.27	28.4%	27.4%	44.2%	16 314
overweight (25.0 - 29.9)	2.33	28.8%	27.1%	44.1%	13 433	1.87	20.7%	27.1%	52.2%	8 470
obese (>= 30.0)	1.87	21.4%	25.2%	53.4%	6 714	1.49	14.1%	23.9%	62.0%	5 716
Pleasant place to walk, bike, jog or rollerblade			**M: 26,611**					**F: 26,350**		
No	1.96	22.9%	24.3%	52.8%	12 921	1.76	19.4%	25.4%	55.2%	9 287
Yes	2.61	32.8%	27.4%	39.8%	15 690	2.23	27.2%	27.6%	45.1%	17 063
Playing fields or open spaces			**M: 28,293**					**F: 26,105**		
No	2.06	24.8%	24.6%	50.6%	16 604	1.85	21.0%	25.5%	53.5%	14 093
Yes	2.71	33.7%	28.3%	38.0%	11 689	2.33	28.9%	28.4%	42.7%	12 012
Gym or fitness facilities			**M: 28,195**					**F: 26,072**		
No	2.02	23.9%	24.3%	51.7%	16 534	1.81	20.3%	25.6%	54.1%	13 407
Yes	2.74	34.5%	28.4%	37.1%	11 661	2.32	28.8%	28.0%	43.2%	12 665
Organized fitness classes			**M: 27,830**					**F: 25783**		
No	2.02	23.9%	24.3%	51.7%	19 254	1.81	20.3%	25.6%	54.1%	15 804
Yes	2.80	35.3%	29.0%	35.6%	8 576	2.40	30.2%	28.8%	41.0%	9 979
Recreational organized sports teams*			**M: 24, 410**					**F: 22,598**		
No	2.09	25.3%	24.3%	50.4%	17 451	1.86	20.8%	26.4%	52.7%	15 730
Yes	2.82	35.1%	28.5%	36.3%	7 959	2.49	31.6%	27.3%	41.1%	6 868
Showers &/or change rooms*			**M: 25,649**					**F: 23,051**		
No	1.99	23.3%	24.2%	52.5%	13 183	1.80	19.8%	26.0%	54.2%	12 629
Yes	2.68	33.9%	27.2%	38.9%	12 466	2.34	29.0%	27.6%	43.4%	10 422
Work prog. to improve health, physical fitness & nutrition*			**M: 25,303**					**F: 22,843**		
No	2.05	24.6%	24.6%	50.8%	16 254	1.84	20.6%	25.9%	53.5%	13 245
Yes	2.79	35.1%	27.4%	37.4%	9 049	2.32	28.7%	28.0%	43.2%	9 598
PAF TOTAL (access to ≥ 1 PAF)*			**M: 25,541**					**F: 21,804**		
No	1.76	19.8%	22.4%	57.8%	7 053	1.60	16.9%	23.9%	59.2%	4 952
Yes	2.56	32.0%	27.0%	41.0%	18 488	2.17	26.0%	27.6%	46.4%	16 852

***PAF (not incl. those that work at home; n = 2,366)**

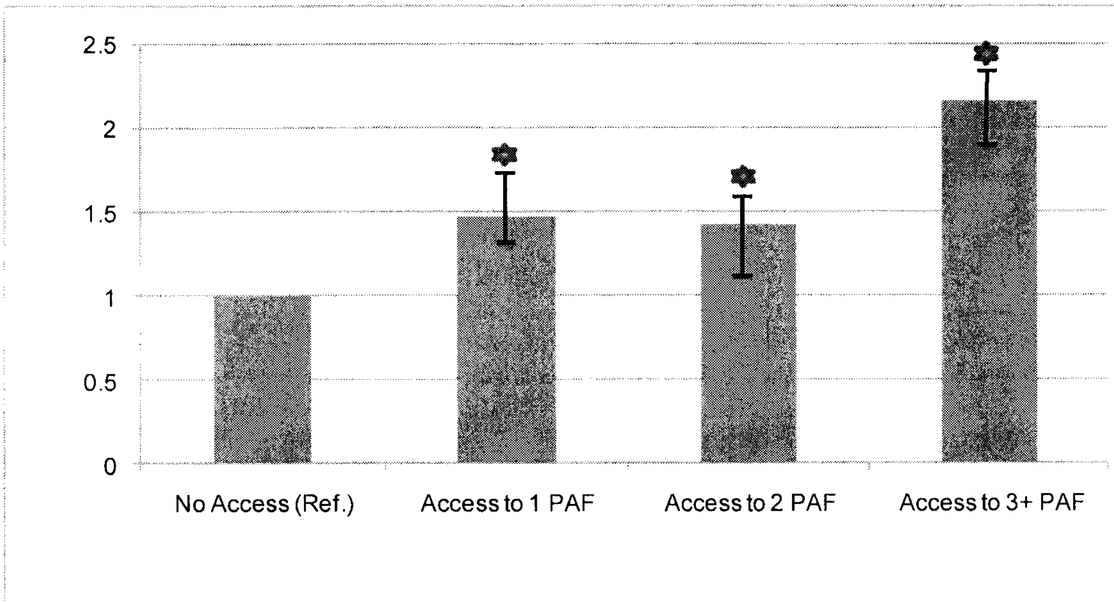
Table 3A. Odds of Being Physically Active by Access to Physical Activity Facilities, Degree of Access and Type of Access by Sex

	MALE		FEMALE	
	Active ≥1.5 kcal/kg/day	Inactive <1.5 kcal/kg/day	Active ≥1.5 kcal/kg/day	Inactive <1.5 kcal/kg/day
PAF Access (to one or more PAFs)				
Yes (CI)	1.77 (1.55 - 2.01)	0.59 (0.48 - 0.59)	1.61 (1.36 - 1.92)	0.66 (0.58 - 0.75)
A pleasant place to walk, bike, jog or rollerblade				
Yes (CI)	1.53 (1.38 - 1.70)	0.62 (0.56 - 0.68)	1.46 (1.29 - 1.64)	0.76 (0.67 - 0.84)
Playing fields or open spaces				
Yes (CI)	1.38 (1.25 - 1.53)	0.64 (0.58 - 0.70)	1.47 (1.32 - 1.64)	0.71 (0.65 - 0.79)
Gym or fitness facilities				
Yes (CI)	1.55 (1.40 - 1.72)	0.60 (0.54 - 0.66)	1.45 (1.30 - 1.62)	0.73 (0.66 - 0.81)
Organized fitness classes				
Yes (CI)	1.44 (1.29 - 1.60)	0.62 (0.59 - 0.69)	1.50 (1.34 - 1.67)	0.68 (0.61 - 0.75)
***Recreational organized sports teams**				
Yes (CI)	1.46 (1.31 - 1.63)	0.63 (0.57 - 0.70)	1.56 (1.38 - 1.76)	0.72 (0.64 - 0.80)
***Showers and/or change rooms**				
Yes (CI)	1.67 (1.50 - 1.86)	0.61 (0.56 - 0.67)	1.52 (1.35 - 1.71)	0.74 (0.67 - 0.82)
***Work prog. to improve health, physical fitness & nutrition**				
Yes (CI)	1.55 (1.39 - 1.73)	0.59 (0.48 - 0.59)	1.45 (1.29 - 1.63)	0.74 (0.67 - 0.83)
# of PAF Resources				
access to "1" PAF (CI)	1.46 (1.21 - 1.76)	1.67 (1.44 - 1.95)	0.76 (0.61 - 0.95)	0.76 (0.64 - 0.91)
access to "2" PAF's (CI)	1.32 (1.09 - 1.59)	1.2 (0.99 - 1.43)	0.88 (0.70 - 1.11)	0.75 (0.62 - 0.91)
access to "3+" PAF's (CI)	2.02 (1.76 - 2.32)	0.79 (0.68 - 0.91)	1.40 (1.17 - 1.67)	0.65 (0.52 - 0.70)
Access to PAF's Only, Health Program Only or Both				
access to PAF(s) only (CI)	1.53 (1.32 - 1.77)	0.61 (0.54 - 0.69)	1.41 (1.17 - 1.70)	0.72 (0.62 - 0.83)
access to health prog. Only (CI)	1.36 (0.71 - 2.59)	0.62 (0.39 - 1.01)	0.69 (0.39 - 1.23)	0.92 (0.57 - 1.47)
access to PAF(s) & health prog. (CI)	2.07 (1.79 - 2.38)	0.46 (0.40 - 0.51)	1.85 (1.54 - 2.22)	0.60 (0.52 - 0.69)

Referent = "No" (1.00) for all categories

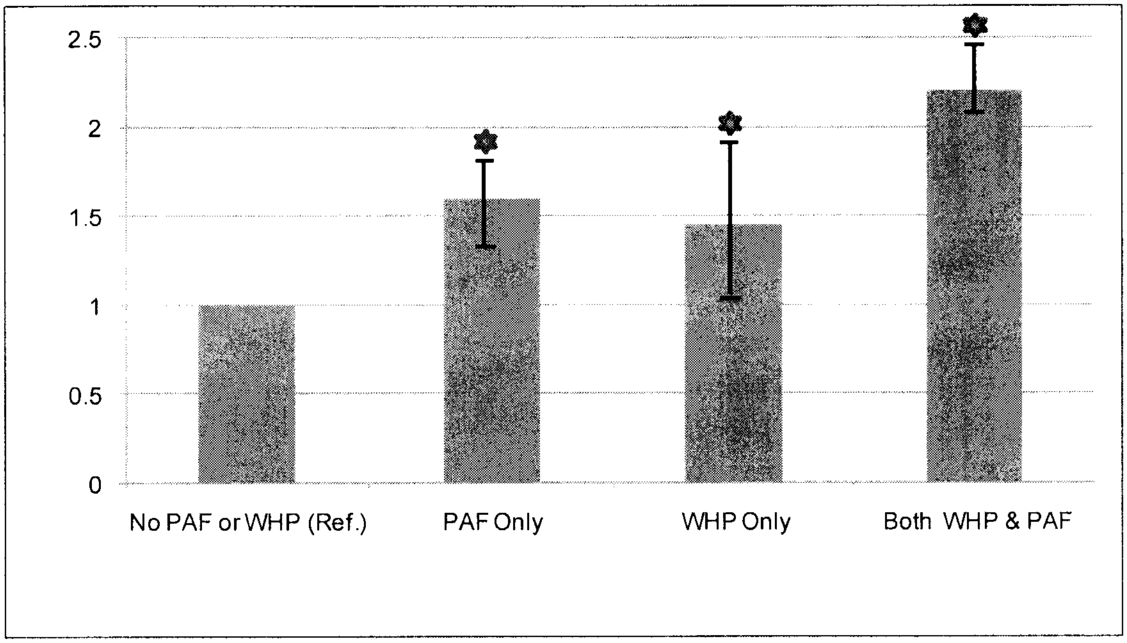
***PAF=Physical Activity Facilities (not incl. those that work from home)**

Figure 1A.



✱ = p<0.05

Figure 2A.



✱ = $p<0.05$

An Analysis of Disability Claims By Level of Job Demands: Results from a Large Canadian Group Insurance Company

Katrena Munsch, B.Sc.

School of Kinesiology and Health Science, York University, Toronto, Ontario.

Running Title: Disability Claims by Level of Job Demand

Word Count: 2,283

Abstract: 270

Number of Tables: 3

ABSTRACT

Introduction: Sedentary behaviours such as seated work have been shown to be independent risk factors for chronic disease.

Purpose: The aim of this study was to explore the variation in disability claims by level of physical job demand.

Methods: Data for this study consist of incidence data provided by a large Canadian group insurance company over a five year period [January 1, 2005 to December 31, 2009], which include a total of 54,182 disability claims [both short-term and long-term disability]. Disability claims with either a primary or secondary diagnosis of a chronic disease associated with physical inactivity were kept in the final sample [n = 6 008] and sorted into eight different chronic disease categories [cancer, heart disease, arthritis/osteoporosis, metabolic disease, high blood pressure, stroke, respiratory diseases, and sleep apnea]. For each claim, the level of job demand was classified as either 'sedentary' [primarily sitting, occasional physical requirement ≤11 lbs.]; 'light' [combination of sitting and standing, occasional/frequent physical requirements ≤22lbs.]; or 'heavy' [standing and walking; frequent/constant physical requirements ≥22lbs.].

Results: Compared to those employed in light or heavy work, sedentary occupations were observed to have the highest total claims costs, number of deaths, average days lost and absences greater than one year, as well as the highest number of claims open by the end of the five year period of collection.

Conclusion: Taken together, these data highlight the importance of addressing sedentary behaviours in the workplace, as well as establishing the relevance of generating new insurance products that address the costs associated with this emerging health issue.

Keywords: physical inactivity, chronic disease, job demands, work disability, short-term disability, long-term disability

1. Introduction

Technology has advanced in all aspects of our lives. In modern society with the advent of computers, televisions, video games, and motorized vehicles, changes in the workplace, domestic tasks, transportation trends and leisure time have been observed (Hamilton, Hamilton, & Zderic, 2007). As a result, in the majority of developed countries over the past century, a substantial decrease in physical activity [PA] levels has occurred and as a consequence, a considerable increase in sedentary behaviours [sitting time] (Mummery, Schofield, Steele, Eakin, & Brown, 2005). When seated, the large skeletal muscles in our legs, trunk, and back that support us while standing and walking, are largely inactive (Hamilton, Hamilton, & Zderic, 2004), and as such, sedentary behaviour requires little energy expenditure; 1.0 – 1.8 metabolic equivalents (Jans, Proper, Vincent, & Hilderbrandt, 2007). Although the deleterious effects of physical inactivity are well described, sedentary behaviour is an emerging area of study that has been shown to be an independent risk factor for developing chronic disease (Owen, Bauman & Brown, 2005). Moreover, research suggests that prolonged sitting has its own unique metabolic consequences that are not physiologically the same as being physically inactive (Hamilton et al., 2004). Even when adjusted for leisure-time PA, there appears to be a dose-response relationship between sitting time, all–cause and cardiovascular disease [CVD] mortality (Katzmarzyk, Church, Craig, & Bouchard 2009).

It is clear that even amongst individuals who are active during their leisure time and may exceed the current recommendations for PA, many will spend a large portion of their day engaged in sedentary behaviours (Hamilton, Healey, Dunstan, Zderic, & Owen, 2008). Indeed, full-time working adults will spend half of their waking hours at work. In Canada, 16 million people spend half of their waking hours at work (Public Health Agency of Canada, 2001). Miller and Brown (2004) found that occupational sitting was the greatest contributor to total weekday sitting and accounted for 52% of total sitting time during the week.

Energy expenditure across different levels of job demands, it can vary considerably from one occupation type to the next. For example, seated work with no option of moving requires approximately 300-700 kcal/day, while seated work with some option of moving requires roughly 1 000-1 400 kcal/day, and approximately 2300 kcal/day are needed for occupations involving more strenuous tasks (Black, Coward, Cole, & Prentice, 1996). With respect to steps per day, those engaged in sedentary occupations [sitting >75% of the time] complete approximately 6 500 steps per day while those in highly active jobs [moving >75% of the time] have a daily step count of approximately 10 500 (Chan, Ryan, & Tudor-Locke, 2004). Considering that the recommended daily step count for health benefits in adults is 10 000 (CANPLAY, 2010), this variation in occupational activity level is likely to have a profound impact on health. To this end, the sedentary workplace is a potentially adverse environment as it appears to contribute to obesity and chronic disease (Hu, Li, Colditz, Willet, & Manson, 2003; Sisson et al., 2009; Zhang, Xie, Lee, & Binns, 2003). On the other hand, it has been shown that occupations with high levels of activity have been associated with lower metabolic and CVD risk (Carnethon et al., 2004; Hu et al., 2006). In an effort to extend this literature, the current analysis will use incidence data from a large group insurance company to explore variation in disability claims by level of occupational demand as well as establishing a foundation for the development of new insurance products that account for the association of both physical inactivity and prolonged sitting on chronic disease.

2. Methods

Data for this analysis were provided by a large Canadian national group insurance company. The data consisted of new disability claims, for both short and long term disability, over a five year period from January 1, 2005 to December 31, 2009. All disability claims consisted of a medical diagnosis made by a licensed physician, and were submitted to the insurance company in the form of an Attending Physicians Statement. All claims were medically validated and assessed to determine if the individual was precluded from working; specifically disability was defined as being unable to perform the essential and material duties of their own occupation. Over the five year period of collection, a total of 54 182 new claims were approved and disability benefits were subsequently paid.

All claims were reviewed by diagnosis. Any chronic conditions associated with physical inactivity were sorted into the following eight categories: cancer, heart disease, arthritis/osteoporosis, metabolic disease, high blood pressure, stroke, respiratory disease, and sleep apnea. If a claim had either a primary or secondary diagnosis that fell into one of the eight categories, they were included in the final sample and each claim was only counted once. From the initial sample of 54 182 claims, the dataset was limited to disability claims that had a primary or secondary diagnosis of a chronic disease associated with physical inactivity, which consisted of approximately 11.1% of total claims volume; n = 6 008.

2.1 Main Outcome and Exposure Variables

Level of Job Demands: All occupations were classified as either sedentary, light or heavy. These classifications were based National Occupational Classification [NOC] [Appendix C]. At the time of claim, a job description or physical demands analysis provided by the employer determined the level of physical job demands. 'Sedentary' work included occupations that require prolonged sitting throughout the day and have minimal physical requirements [such as lifting, carrying, pushing/pulling less than 11 lbs on an occasional basis, for instance office work]. 'Light' work occupations consist of a combination of sitting and standing and have a physical component that could consist of lifting, carrying, and pushing/pulling on an occasional or frequent basis of up to 22 lbs. [for example, store clerk or bank teller]. 'Heavy' work [which is 'medium' strength demands as per the NOC and higher] is comprise d of primarily standing and walking throughout the day and typically have a large physical component which could include the frequent lifting, carrying, pushing/pulling of materials that are greater than 22 lbs. [for example, agricultural or industrial work].

2.2 Statistical Analysis

Analyses were conducted using SPSS® v.17. Chi-square [for categorical variables] and One-way Anova [for continuous variables] analyses with statistical significance set at $p<0.05$ were used to assess differences in the incidence of chronic diseases, level of job demands, total claims costs, number of deaths, average days lost and absences greater than one year. Total claims costs, number of deaths, average days lost, absences greater than one year, and the number of claims open at the end of the five year period of collection by level of job demand were then presented by sedentary, light, and heavy occupational class.

3. Results

Characteristics of participants are shown in **Table 1**. Overall, 42.1% of the sample was female, 60.2% of claims were from individuals between the ages of 50 – 64 y, and 60.7% of claims were closed due to return to work. Cancer and heart disease accounted for 38.7% and 23.2% of total claims volume, respectively. In general, males tended to earn more money, had a higher frequency of heart disease, and had heavier job demands, while women had higher levels of sedentary work, along with higher incidences of cancer.

Total costs for inactivity-related new disability claims are shown in **Table 2**. In total, over a five year period, almost $108 million dollars was paid out in disability claims. Cancer and Heart Disease accounted for 61.0% of total costs, followed by Arthritis and Osteoporosis [combined] at 11%, with the five other chronic conditions accounting for the remaining 28% of costs. At the end of the five year period, 25.2% of disability claims remained open and active and would therefore continue to receive ongoing disability benefits.

Table 3 provides a comparison of inactivity-related chronic disease claims, by job demand. Although disability claims were highest in the light category (41.7%), sedentary workers had the highest total claims costs, the greatest number of deaths, the longest average duration of absence, the most absences longer than one year, and the highest percentage of claimants still disabled at the end of the five year collection.

4. Discussion

The present study utilized incidence data to examine the nature of disability claims across different levels of job demands, and to determine the association of sedentary occupations on the outcomes of such claims. Across all categories measured, sedentary workers had the poorest outcomes, despite volume of claims being the highest for individuals engaged in light work.

These observations are consistent with previous research, which has shown that individuals who engage in long periods of sedentary behaviour have higher odds of obesity and chronic disease, for instance four recent studies may be used to further illustrate the relationship between sitting time and health risk. In the first study, Mummery et al. (2005), found that males who sat for more than six hours per day had almost twice the odds [OR: 1.92, CI: 1.17-3.17] of obesity than those who sat for less than forty-five minutes per day (Mummery et al., 2005). Similarly, those who engaged in more than four hours of sedentary behaviour per day [compared to less than one hour] were more likely to experience the metabolic syndrome [M: OR = 1.95, 95% CI: 1.24 – 3.03; F: OR = 1.54, 95% CI: 1.00 – 2.37] (Sisson et al., 2009). Prolonged sitting has also been linked to an increase in ovarian cancer [OR = 1.96, CI: 1.0-3.1] (Zhang, Xie, Lee, & Binns, 2003). Finally, in a study of American women, Hu et al. (2003) reported that for every two hour increase in sitting at work, there was an associated 7% increase in type II diabetes and a 5% increase in obesity. These results notwithstanding, it has also been shown that occupations with high levels of activity are associated with relatively low incidence of obesity, as well as lower metabolic and CVD risk (Carnethon et al., 2004; Hu et al., 2006; Proper et al., 2006).

The outcomes measured [namely total claims costs, number of deaths, average days lost, absences greater than one year, and the number of open claims after 5 years], all translate into increased costs for the employer in a variety of ways. The longer an employee is absent from work, the less likely they are to return to work (Krause, Dasinger, & Neuhauser, 1998). Additionally, once an employee is absent from the workplace, the employer will either observe a decrease in productivity, or will incur the cost of finding, training, and paying a new employee, whilst incurring the cost of insurance premiums for this new employee and experiencing a concurrent increase in disability premiums for the disabled employee. In the case of death, the same costs would be incurred by the employer as outlined above, as well as a direct cost to the insurer, as the majority of group disability policies have a conjoined life policy payable at the time of death.

4.1 Implications

Findings from this study suggest that sedentary occupations have a negative association on disability claims, and provide valuable information for both employers and insurers to increase awareness surrounding the adverse effects of prolonged sitting. In the workplace, obesity is associated with lower productivity (Ells et al., 2006; Neovius et al., 2009), reduced employment, work limitations (Tunceli et al., 2006), and greater occurrences of both short-term and long-term disability (Arena, Padiyar, Burton, & Schwerha, 2006; Jans, Proper, &

Hilderbrandt, 2007; Klarenback, Padwal, Chuck, & Jacobs, 2006; Laaksonen, Piha, & Sarlio-Lahteenkorva, 2007; Neovius, K., Johannson, Kark, & Neovius, M., 2009; Van Duijvenbode, Hoozemans, vanPoppel, & Proper, 2009). Although we were unable to assess obesity directly in this study, in light of previous literature on the impact of PA on obesity, results of this descriptive analysis suggest that there may be a double burden of inactivity and excess weight for insurers and employers alike. As such, these data highlight the importance of addressing sedentary behaviours in the workplace, and the opportunity for new insurance products to address this emerging health issue.

4.2 Limitations

There were several limitations to this study. All of the diagnoses were captured at the time of the *initial* claim, and for many disability claims, the primary and secondary diagnosis will change as the length of absence persists [for example a claim for hypertension that develops into CVD]. These subsequent changes are not captured in the data, since the diagnosis fields are not updated throughout the duration of the claim. Additionally, the study looked at claims by either the primary or secondary diagnosis of a chronic disease, even though many people with chronic disease have multiple conditions (Preventing and Managing Chronic Disease: Ontario's Framework, 2007). Therefore, if the primary or secondary condition was not one of the eight chronic conditions measured, the claim would not be captured in the final sample. It also stands to reason that these relationships may differ for males and females, and only through the analysis of more complete incident claims data can these gender effects be studied alongside other effect modifiers and lifestyle-related factors. Finally, as height, weight, and leisure time PA were not routinely captured, the estimates for multiple chronic conditions and the association with metabolic disorders may be an underestimate of the actual claims.

4.3 Conclusion

These limitations notwithstanding, the use of incidence claim data to quantify the relationship between sedentary behaviour and chronic disease is unique, and provides valuable information to group insurance providers on the effects of prolonged sitting, and the high cost of managing chronic disease in the workplace. Employers who are seeking to improve the health of their organization and ultimately reduce the incidence and cost of disability, must consider ways in which to decrease prolonged sitting in the day-to-day work environment.

REFERENCES

Arena, V.C., Padiyar, K.R., Burton, W.N., Schwerha, J.J. (2006). The Impact of Boday Mass Inex on Short-Term Disability in the workplace. Journal of Occupational and Environmental Medicine, 48, 1118-1124.

Black, A.E., Coward, W.A., Cole, T.J., Prentice A.M. (1996). Human energy expenditure in affluent societies: an analysis of 574 doubly-labelled water measurements. European Journal of Clinical Nutrition, 50(2), 72-92.

Blanck, H.M., McCullough, M.L., Patel, A.V., Gillespie, C., Calle, E.E., Cokkinides, V.E., Galuska, D.A., Khan, L.K., Serdula, M.K. (2007). Obesity, 15, 1578 – 1588.

Brown, W.J., Miller, Y.D., Miller, R. (2003). Sitting time and work patterns as indicators of overweight and obesity in Australian adults. International Journal of Obesity, 27, 1340 – 1346.

Carnethon, M.R., Loria, C.M., Hill, J.O., Sidney, S., Savage, P.J., Liu, K. (2004). Risk Factors for the Metabolic Syndrome The Coronary Artery Risk Development in Young Adults (CARDIA) study 1985 – 2001. Diabetes Care, 27(11), 2707 – 2715.

Chan, C.B., Ryan, D.A., Tudor-Locke, C. (2004). Health benefits of pedometer-based physical activity intervention in sedentary workers. Preventative Medicine, 39, 1215 – 1222.

Ells, L.J., Lang, R., Shield, J.P.H., Wilkinson, J.R., Lidsotne, J.S.M., Coulton S., Summerbell, C.D. (2006). Obesity and disability - a short review. Obesity reviews, 2, 341-345.

Gregg, E.W., Cheng, Y.Y., Cadwell, B.L., Imperatore, G., Willimans, D. E., Flegal, K.M., et al. (2005). Secular trends in Cardiovascular Disease Risk Factors according to Body Mass Index in US Adults. JAMA, 293(15), 1868-1874.

Hamilton, M.T., Hamilton, D., Zderic, T. (2004). Exercise Physiology versus Inactivity Physiology: An Essential Concept for Understanding Lipoprotein Lipase Regulation. Exercise and Sports Sciences Reviews, 34(4), 161-166.

Hamilton, M.T., Healy, G.N., Dunstan, D.W., Zderic, T.W., Owen, N. (2008). Too Little Exercise and Too Much Sitting: Inactivity Physiology and the Need for New Recommendations on Sedentary Behaviour. Current Cardiovascular Risk Reports, 2, 292-298.

Healy, G.N., Dunstan, D.W., Salmon, J., Cerin, E., Shaw, J.E., Zimmet, P.Z., Owen, N. (2007). Objectively Measured Light-Intensity Physical Activity Is

Independently Associated with 2-h Plasma Glucose. Diabetes Care, 30, 1384-1389.

Hu, F.B., Li, T.Y., Colditz, G.A., Willet, W.C., Manson, J.E. (2003). Television Watching and Other Sedentary Behaviours in Relation to Risk of Obesity and Type 2 Diabetes Mellitus in Women. JAMA, 289(14), 1785 – 1791.

Hu, G., Jousilahti, P., Borodulin, K., Barengo, N.C., Lakka, T.A., Nissinen, A., Tuomilehto, J. (2006). Occupational, commuting and leisure-time physical activity in relation to coronary heart disease among middle-aged Finnish men and women. Atherosclerosis, 194, 490 – 497.

Jans, M.P., Proper, K.I., Hilderbradt, V.H. (2007). Sedentary Behaviour in Dutch Workers Differences Between Occupations and Business Sectors. American Journal of Preventative Medicine, 33(6), 450-454.

Jiang, Y., Chen, Y., Manuel, D., Morrison, H., Mao, Y., Obesity Working Group. (2006). Quantifying the Impact of Obesity Category on Major Chronic Diseases in Canada. The Scientific World Journal, 7, 1211-1211.

Katzmarzyk, P.T., Church, T.S., Craig, C.L., Bouchard, C. (2009). Sitting Time and Mortality from All Causes, Cardiovascular Disease and Cancer. Medicine & Science in Sports & Exercise, 41(5), 998-1005.

Klarenback, S., Padwal, R., Chuck, A., & Jacobs, P. (2006). Population-Based Analysis of Obesity and Workforce Participation. Obesity, 14(5), 920-927.

Krause, N., Dasinger, L.K., Neuhauser, F. (1998). Modified Work and Return to Work: A Review of the Literature. Journal of Occupational Rehabilitation, 8(2), 113-140.

Laaksonen, M., Piha, K., Sarlio-Lahteenkorva, S. (2007). Relative Weight and Sickness Absence. Obesity, 15(2), 465-472.

Maniscalo, P., Lane, R., Welke, M., Mitchell, J.H., Husting L. (1999). Decreased rate of back injuries through a wellness program for offshore petroleum employees. Journal of Occupational and Environmental Medicine, 41, 813 – 820.

Miller, R., Brown, W., (2004). Steps and Sitting in a Working Population. International Journal of Behavioural Medicine, 11(4), 219-224.

Mokdad, A.H., Bowman, B.A., Ford, E.S., Vinicor, F., Marks, J.S., Koplan, J.P. (2001). The Continuing Epidemics of Obesity and Diabetes in the United States. JAMA, 286(10) 1995-1200.

Mummery, W.K., Schofiel, G.M., Steele, R., Eakin, E.G., Brown, W.J. (2005). Occupational Sitting Time and Overweight and Obesity in Australian Workers. American Journal of Preventative Medicine, 29(2), 91-97.

Musich, S., Napier, D., Eddington, D.W. (2001). The association of health risks with workers' compensation costs. Journal of Occupational and Environmental Medicine, 43, 534 – 541.

Neovius, K., Johannson, K., Kark, M., Neovius, M. (2009). Obesity status and sick leave: a systematic review. Obesity reviews, 10, 17-27.

Owen, N., Bauman, A., & Brown, W. (2009). Too much sitting: a novel and important predictor of chronic disease risk. British Journal of Sports Medicine, 43, 81-83.

Proper, K.I., Hilderbrandt, V.H. (2006). Physical activity among Dutch Workers – Differences between occupations. Preventative Medicine, 43, 42-45.

Public Health Agency of Canada. (2001). The Business Case for Active Living at Work. Retrieved from http://www.phac-aspc.gc.ca/alw-vat/index-eng.php

Sisson, S.B., Camhi, S.M., Church, T. S., Martin, C.K., Tudor-Locke, C., Bouchard, C., Earnest, C.P., Smith, S.R., Newton, R.L., Rankinen, T., Katzmarzyk, P.T. (2009). Leisure Time Sedentary Behaviour, Occupational/Domestic Physical Activity, and Metabolic Syndrome in U.S. Men and Women. Metabolic Syndrome and Related Disorders, 7(6), 529-536.

Serxner, S., Gold, D., Anderson, D., Williams, D. The Impact of worksite health promotion program on short-term disability usage. Journal of Occupational and Environmental Medicine, 43, 25-29.

Statistics Canada. Component of Statistics Canada Catalogue no. 82-221-XWE. (2009). Health Indicators: Adult Body Mass Index. Retrieved from **http://www.statcan.gc.ca/pub/82-221-x/2009001/tblstructure/1hs/1hc/hc1abm-eng.htm**

Tudor-Locke, C., Burton, N.W., Brown, W.J. (2009). Leisure-time physical activity and occupational sitting: Associations with steps/day and BMI in 54-59 year old Australian women. Preventative Medicine, 48, 64-68.

Tunceli, K., Li, K., & Willimans, K. (2006). Long-Term Effects of Obesity on Employment and Work Limitations Among U.S. Adults, 1986 to 1999. Obesity, 14(9),1637-1646.

Van Duijvenbode,D.C. Hoozemans, M.J.M., vanPoppel, M.N.M, Proper, K.I. (2009). The relationship between overweight and obesity, and sick leave: a systematic review. International Journal of Obesity, 33, 807-816.

Zhang, M., Xie, X., Lee, A.H., Binns, C.W. (2003). Sedentary behaviours and epithelial ovarian cancer risk. Cancer Causes and Control, 15, 83 - 89.

Table 1B. Demographic Characteristics of Disability Claims by Level of Job Demand and Sex

	MALE N = 3,280 (58%)			FEMALE N = 2,582 (42%)		
	Sedentary 741 (21.3%)	**Light 1,664 (47.8%)**	**Heavy 1,075 (30.9%)**	**Sedentary 1,423 (56.3%)**	**Light 839 (33.2%)**	**Heavy 266 (10.5%)**
Age (y)						
≤29	15 (0.4%)	48 (1.4%)	35 (1.0%)	42 (1.7%)	30 (1.2%)	3 (0.1%)
30-39	53 (1.5%)	144 (4.1%)	68 (2.0%)	180 (7.1%)	77 (3.0%)	30 (1.2%)
40-49	160 (4.6%)	422 (12.1%)	317 (9.1%)	434 (17.2%)	253 (10.0%)	80 (3.2%)
50-64	513 (14.7%)	1 050 (30.2%)	655 (18.8%)	767 (30.3%)	479 (19.0%)	153 (6.1%)
Annual Salary						
<$20,000	30 (0.9%)	97 (2.8%)	30 (0.9%)	52 (2.1%)	105 (4.2%)	20 (0.8%)
$20,000 - $39,999	164 (4.7%)	745 (21.5%)	502 (14.5%)	639 (25.3%)	492 (19.5%)	187 (7.4%)
$40,000 - $59,999	271 (7.8%)	646 (18.7%)	444 (12.8%)	468 (18.5%)	172 (6.8%)	48 (1.9%)
≥$60,000	269 (7.8%)	166 (4.8%)	94 (2.7%)	261 (10.3%)	70 (2.8%)	10 (0.4%)
Chronic Disease						
Cancer	252 (7.2%)	457 (13.1%)	280 (8.0%)	823 (32.6%)	389 (15.4%)	124 (4.9%)
Metabolic Disease	50 (1.4%)	152 (4.4%)	92 (2.6%)	102 (0.4%)	59 (2.3%)	23 (0.9%)
Stroke	48 (1.4%)	98 (2.8%)	45 (1.3%)	67 (2.7%)	26 (1.0%)	12 (0.5%)
Heart Disease	223 (6.8%)	564 (16.2 %)	394 (11.3%)	115 (4.5%)	82 (3.2%)	23 (1.0%)
High Blood Pressure	58 (1.7%)	114 (3.3%)	78 (2.2%)	95 (3.8%)	63 (2.5%)	24 (0.9%)
Chronic Respiratory Disease	27 (0.8%)	103 (3.0%)	61 (1.8%)	80 (3.2%)	67 (2.7%)	19 (0.8%)
Sleep Apnea	40 (1.1%)	49 (1.4%)	42 (1.2%)	16 (0.6%)	9 (0.4%)	0 (0.0%)
Arthritis/Osteoporosis	43 (1.2%)	127 (3.6%)	83 (2.4%)	125 (4.9%)	144 (5.7%)	41 (1.6%)
Reason for Closing						
Death	79 (2.3%)	130 (3.7%)	87 (2.5%)	148 (5.9%)	67 (2.7%)	17 (0.7%)
Returned to work	426 (12.2%)	1 026 (32.4%)	696 (20.0%)	865 (33.9%)	504 (19.9%)	132 (5.2%)
Maximum reached	28 (0.8%)	66 (1.9%)	38 (1.1%)	22 (0.9%)	31 (1.2%)	12 (0.5%)
Still disabled	202 (5.8%)	333 (9.6%)	252 (7.2%)	390 (15.4%)	233 (9.2%)	104 (4.1%)
Other	6 (0.2%)	9 (0.3%)	2 (0.1%)	7 (0.3%)	4 (0.2%)	1 (0.0%)

Table 2B. Disability Claims Costs by Chronic Condition

Total Claims Cost (over five years) = $107,812,000		
	Cost in millions ($)	**Percentage**
Cancer	$46.5	43%
Heart Disease	$19.7	18%
Arthritis/Osteoporosis	$11.7	11%
Metabolic Disease	$8.2	8%
High Blood Pressure	$7.1	7%
Stroke	$6.8	6%
Chronic Respiratory Disease	$4.8	4%
Sleep Apnea	$3.0	3%

Table 3B. Disability Claims by Level of Job Demands

	Sedentary 36.00%	Light 41.70%	Heavy 22.30%	Total
Total Claim Costs	41.30%	38.80%	21.90%	$107,812,000
Number of Deaths	43.00%	37.30%	19.70%	528
Average Days Lost	412.3	323.3	376.1	367.15
Absence > 1 year	40.50%	36.60%	22.90%	1975
Still Disabled	9.90%	9.40%	5.90%	1514

CONCLUSION AND FUTURE DIRECTIONS

The results of the first study provide insight into the importance of having access to physical activity facilities [PAF(s)] at or near the work place, as well as the potential benefits of a workplace health program in increasing physical activity [PA] levels. On the other hand, results of the second study highlight the need for awareness of the association of sedentary work on disability claims costs. This information provides a foundation for the development of new insurance products that account for the association between both physical inactivity and prolonged sitting on chronic disease. For example, those workplaces whose benefit plan is operating in a surplus, a percentage of premiums could be refunded into a workplace health program [WHP] to encourage healthy behaviours in the workplace.

Future studies measuring workplace health must also consider sedentary time as a potential confounder of the association between PA on chronic disease claims. As both PA and sedentary behaviour have their own independent negative effect on chronic disease and mortality, studies on the sedentary workplace that create opportunities for standing and moving would prove valuable in determining the amount of light intensity PA required to ward off the adverse effects of sitting time in sedentary work. In addressing the issue of workplace health, it is essential that both components are considered. These studies point to the need for a workplace culture that not only eliminates barriers to PA participation through infrastructure, but also promotes primary prevention strategies in the workplace as readily available. Additionally, increasing the awareness of the deleterious effects of sedentary time in business sectors that are largely sedentary is vital in maintaining a healthy workforce and keeping costs associated with chronic illness in the workplace low.

Since the majority of Canadian employers companies have less than 20 employees, demographics can vary considerably from one employer to the next. Therefore, research that examines the association of the different types of PAF(s) on increasing PA levels could prove useful by determining which facilities have the strongest positive association with PA. Moreover, longitudinal or intervention studies that measure the duration of access are necessary to infer cause and effect, and to truly understand the potential impact of long-term changes in access to recreational facilities in the workplace setting.

Overall, it appears the workplace is both a cause and a potential point of intervention for PA and related health issues. Based on the results of Study 1, even increasing awareness around health and access to facilities at or near the workplace in Canadian companies' may have a positive association with PA levels. This finding can serve as a catalyst to encourage the 76% of Canadian employers that currently do not have a WHP, to begin the process of improving employee health, particularly in small sized organizations that may be discouraged due to lack of funding and on-site resources. This may be especially important in sedentary work-places where disability claims for sedentary occupations have been observed to have a negative association with disability claims costs.

Appendix A - Odds of Having 1+Chronic Conditions and Being Overweight/Obese by PAF Access

	MALE		FEMALE	
	1 + Chronic Conditions	Overweight & Obese BMI ≥25.0	1 + Chronic Conditions	Overweight & Obese BMI ≥25.0
PAF Access (access to one or more PAF(s)				
Yes (CI)	1.05 (0.93 - 1.19)	1.03 (0.92 - 1.16)	0.97 (0.83 - 1.13)	1.08 (0.94 - 1.24)
Access to a pleasant place to walk, bike, jog or rollerblade				
Yes (CI)	0.98 (0.88 - 1.08)	1.03 (0.93 - 1.13)	0.99 (0.88 - 1.11)	1.07 (0.96 - 1.19)
Access to playing fields or open spaces				
Yes (CI)	0.93 (0.84 - 1.04)	0.98 (0.89 - 1.08)	0.96 (0.86 - 1.07)	1.03 (0.94 - 1.10)
Access to a gym or fitness facilities				
Yes (CI)	1.02 (0.91 - 1.14)	1.06 (0.96 - 1.18)	1.09 (0.98 - 1.22)	0.98 (0.89 - 1.08)
Access to organized fitness classes				
Yes (CI)	1.00 (0.89 - 1.13)	1.10 (0.99 - 1.23)	1.03 (0.92 - 1.15)	0.97 (0.88 - 1.07)
***Access to recreational organized sports teams**				
Yes (CI)	0.99 (0.88 - 1.12)	0.96 (0.87 - 1.07)	0.95 (0.84 - 1.07)	1.06 (0.95 - 1.18)
***Access to showers and/or change rooms**				
Yes	1.06 (0.95 - 1.19)	1.02 (0.93 - 1.13)	0.94 (0.84 - 1.06)	1.05 (0.94 - 1.12)
***Program at work to improve health, physical fitness & nutrition**				
Yes (CI)	0.99 (0.88 - 1.11)	1.08 (0.98 - 1.20)	1.03 (0.92 - 1.16)	1.09 (0.98 - 1.22)
Access to # of PAF Resources				
access to "1" PAF	1.09 (0.91 - 1.29)	1.00 (0.86 - 1.17)	0.98 (0.80 - 1.20)	1.07 (0.89 - 1.29)
access to "2" PAF's	1.04 (0.87 - 1.26)	1.06 (1.09 - 1.25)	0.92 (0.75 - 1.13)	1.02 (0.84 - 1.29)
access to "3+" PAF's	1.04 (0.91 - 1.20)	1.04 (0.91 - 1.17)	0.98 (0.83 - 1.16)	1.10 (0.95 - 1.28)
Access to PAF's Only, Health Program Only or Both				
access to PAF(s) only	1.08 (0.94 - 1.24)	0.98 (0.88 - 1.13)	0.95 (0.80 - 1.12)	1.04 (0.89 - 1.21)
access to Health Program only	0.73 (0.42 - 1.27)	1.18 (0.73 - 1.93)	1.22 (0.77 - 1.95)	1.22 (0.75 - 1.96)
access to PAF(s) & Health program	1.04 (0.90 - 1.20)	1.07 (0.94 - 1.22)	0.99 (0.83 - 1.17)	1.12 (0.96 - 1.31)

Referent = "No" (1.00) for all categories

***PAF (not incl. those that work from home)**

Appendix B - Canadian Community Health Survey Questions

Physical Activity Level Variables for Study 1

These variables were derived from the daily energy expenditure variable; a sum of both leisure and transportation physical activity indices. Respondents self-reported frequency and duration of the following physical activities in the past three months:

- Walking
- gardening or yard work
- swimming,
- bicycling popular or social dance
- home exercises
- ice hockey, ice skating, inline skating or rollerblading
- jogging or running
- golfing
- exercise classes or aerobics
- downhill skiing or snowboarding
- bowling, baseball or softball
- tennis weight training
- fishing
- volleyball basketball soccer or any other activity

*Respondents were further asked about the frequency and duration of walking or bicycling to and from work or school in the past three months.

Appendix C - NATIONAL OCCUPATIONAL CLASSIFICATION (NOC)

Physical Demand Characteristics of Work

PHYSICAL DEMANDS	STRENGHT REQUIREMENT
LIMITED (SEDENTARY)	up to 5 kg. (11 lbs.)
LIGHT	5 kg. (11 lbs.) but less than 10 kg. (22 lbs.)
MEDIUM	10 kg. (22 lbs.) but less than 20 kg. (44 lbs.)
HEAVY	greater than 20 kg. (44 lbs.)

Human Resources and Skills Development Canada:

http://www5.hrsdc.gc.ca/noc/english/noc/2006/welcome.aspx