Sedentary Behaviour and Diet Quality in Emerging Adults

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ABSTRACT

SEDENTARY BEHAVIOUR AND DIET QUALITY IN EMERGING ADULTS

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Background: Sedentary behaviour has unique physiological effects on the body, independent of physical activity levels, and has been associated with increased chronic disease risk. Little is known about the relationship between time spent sitting and diet quality, especially during the emerging adult life stage.

Objective: To examine the relationship between total sedentary time and diet quality, body composition and physical activity in emerging adults.

Methods: 85 female participants were recruited from a first year undergraduate nutrition course at the University of Guelph, Ontario, in winter 2013. Body composition, health behaviours, total sitting time (min/day) and diet quality (Healthy Eating Index – Canadian Adaptation; HEI-C) were measured. Descriptive statistics and linear regression analyses were performed to examine associations between sedentary time and diet quality, fruit and vegetable intake and fibre intake. Relationships between sedentary time and physical activity, and body fat % were also tested. Independent t-tests were performed to compare differences between low vs. high sedentary reporters.

Results: Mean total sedentary time was 706.3 ± 201.4 min/day. Total sedentary time did not significantly predict HEI-C (p=.07). Total sedentary time was negatively associated with fibre (p<.05) and F&V intake (p<.01). HEI-C score, fibre (g/d) and F&V intake (serv/d) were significantly higher in “low” sedentary reporters while physical activity level and TV viewing were significantly greater in “high” sedentary reporters. Total sedentary time was not associated with physical activity level or body fat %.
**Conclusion:** A non-significant inverse relationship between total sedentary time and diet quality was found, with significant inverse relationships between sedentary time and fruit and vegetable intake and fibre intake, suggesting that diet may be a contributing factor to the negative health consequences that have been observed in people who spend most of their day sedentary.
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ABBREVIATIONS

BF% - Body Fat Percentage

BMI – Body Mass Index (kg/m²)

CSEP - The Canadian Society for Exercise Physiology

FITT - Frequency, Intensity, Time and Type (of Physical Activity)

F&V Intake – Fruit and Vegetable Intake (servings/day)

HEI-C – Canadian adaptation of Health Eating Index

IPAQ-SF - International Physical Activity Questionnaire – Short Form

METs – Metabolic Equivalents

MVPA – Moderate to Vigorous Physical Activity
1.0 Introduction

Sedentary physiology is an emerging field of study in which the detrimental effects of too much time spent engaging in sedentary behaviours are examined. Research has shown that sedentary behaviour has unique physiological effects on the human body and can no longer be thought of as simply a lack of physical activity. People in both developed and developing countries are becoming increasingly sedentary with increased usage of screen-based entertainment and as dependence on labour-saving technologies becomes the norm (Owen, Leslie, Salmon & Fotheringham, 2000). Canadian adults and children are spending over half their day engaged in sedentary activities (Statistics Canada, 2013). This global trend is likely to continue as technological advances continue to make daily tasks less physically demanding (Hamilton, Hamilton & Zderic, 2007).

It is well established that sedentary behavior, namely sitting or lying down, has a negative impact on cardio-metabolic risk factors (Tremblay, Colley, Saunders, Healy & Owen, 2010). Direct relationships have been observed between sitting time and elevated serum glucose levels and adiposity (Hu, Li, Colditz, Willett & Manson, 2003). These negative health effects persist even after controlling for physical activity, suggesting that the protective effects of regular exercise are nullified by excessive sedentary behavior (Owen, Healy, Matthews & Dunstan, 2010).

Despite the growing body of evidence identifying the negative health consequences of too much sedentary activity, there is a paucity of research on the association between sedentary behaviour and diet quality. When researching the role of diet in chronic disease risk, it is more useful to assess dietary patterns such as diet quality and food group intake, rather than intake of a single nutrient. Diet quality is a measure of
overall nutritional adequacy and a diet quality score is a global assessment tool that takes into account several aspects of dietary intake (Garriguet, 2009; Murray et al., 2013).

Another gap in the literature is examining sedentary behaviour in emerging adults as a unique life stage group. Evidence shows that this age group is distinct demographically and experiences significant development such as identity exploration as they transition from adolescence into young adulthood (Arnett, 2000). Health behaviors developed during this stage, such as activity levels and diet, track strongly into adulthood and hence make this an at-risk group in terms of chronic disease risk (Nelson, Story, Larson, Neumark-Sztainer & Lytle, 2008).

The proposed study will address these gaps by examining the relationship between sedentary behaviour and diet quality and food group intake in young women.
2.0 Review of the Literature

2.1 Sedentary Behavior

2.1.1 Sedentary Behavior: Definition and Prevalence

Physical activity has long been recognized as an important factor in optimizing health and is associated with a lower risk of cardiovascular disease, type 2 diabetes mellitus, obesity and some cancers (Warburton, Charlesworth, Ivey, Nettlefold & Bredin, 2010; Hamilton, Healy, Dunstan, Zderic & Owen, 2008). Since 1998, Canadian public health guidelines have included recommendations on the frequency, intensity, duration and type of purposeful exercise required for chronic disease prevention in adults (Health Canada and the Canadian Society for Exercise Physiology, 1998) and since 2002, in children and adolescents (Health Canada & Canadian Society for Exercise Physiology, 2002). These recommendations include 150 minutes per week of moderate to vigorous physical activity in adults and 60 minutes per day in children. The Canadian Society for Exercise Physiology (CSEP) defines physical activity as bodily movement that increases heart and breathing rate. Physical activity ranges from light to vigorous intensity and includes activities that require energy expenditure above 1.5 metabolic equivalents (METs) (Tremblay et al., 2010).

Originally the belief was held that sedentary behaviour was merely the absence of physical activity. However, recent advances in research have shown that physical inactivity or sedentary behaviour has unique, independent effects on health, and as such should be treated as a separate construct (Must & Tybor, 2005; Hamilton et al., 2008). Sedentary behaviour is considered any activity performed while sitting or lying down at low levels of energy expenditure such as screen-based entertainment, sitting at a desk and
travelling in automobiles (Owen et al., 2010). Operationally, sedentary activities are in
the energy expenditure range of 1.0 to 1.5 METs (Pate et al., 2008; Newton, Han, Zderic
& Hamilton, 2013) and do not increase respiration or heart rate.

This new definition of sedentariness and related health risks means more
Canadians are at increased chronic disease risk than previously thought. Not only are
15% of Canadian adults meeting the current physical activity guidelines, but results from
the Canadian Health Measures Survey (2007 to 2011) show that Canadian adults spend
an average of 10 hours per day sitting or lying down, not including sleep time. Even more
concerning, Canadian children and youth are spending approximately 9 hours per day
(64% of their wakeful hours) being sedentary, while less than 10% are meeting the
recommended 60 minutes of daily physical activity (Statistics Canada, 2013).

2.1.2 Measuring Sedentary Behaviour

Similar to the FITT formula (frequency, intensity, time and type) used to describe
physical activity, sedentary behaviour is measured across four domains: frequency of
sedentary behaviours, interruptions in sedentary time, time spent engaging in the
behaviour and the type of behaviour (SITT formula) (Tremblay et al., 2010). To date,
only a few methods of measuring sedentary behaviour have been described. These
include objective measures such as accelerometry, as well as subjective self-report
methods such as questionnaires and diaries.

Historically, research studies that used accelerometers largely focused on
quantifying time spent engaged in activities requiring energy expenditures of 3 METs or
more (Owen et al., 2010). However, more recently accelerometry has been used to
objectively measure both physical activity and inactivity levels in free-living subjects (Tremblay et al., 2010). Accelerometers are “small electronic devices worn on the hip, which provide an objective record of the volume, intensity, and frequency of activity between and within days” (Owen et al., 2010). Accelerometers are able to capture the frequency, time and interruptions in sedentary behaviours (Tremblay et al., 2010). Accelerometry measures the entire range of movement along the activity continuum, from completely sedentary to very vigorous. This allows researchers to determine the cumulative time spent each day in activity at all intensity levels (Pate et al., 2008).

With this objective method, researchers are able to understand in greater detail the relationships between activity (and inactivity) levels and the physiological effects of both. For example, in the The Australian Diabetes, Obesity and Lifestyle (AusDiab) study, accelerometers were used to assess sedentary time in a sub-sample of participants (Caucasian adults aged 30-87). Researchers determined that sedentary time was associated with a larger waist circumference, elevated 2-hour plasma glucose and triglyceride profiles and increased metabolic risk. The data showed sedentary time and light-intensity activity time were highly negatively correlated ($r=-0.96$, $p<0.05$). Light-intensity activity is inversely related to several cardio-metabolic biomarkers. These findings could be used in public health messaging about reducing sedentary time in addition to promoting the benefits of increasing light-intensity activities, which is arguably more feasible for many than increasing moderate-to-vigorous activity levels (Owen et al., 2010).

The advancement of accelerometry allows researchers to reduce measurement error related to subjective measurement tools such as self-report measures (Owen et al.,
Objective measures can also be used to validate self-report measures. However, a limitation of accelerometry is that it cannot capture contextual information on the type of sedentary behaviour. Accelerometers are unable to differentiate between lying down, sitting or standing still whereas self-report measures can. This becomes a problem when the aim is to distinguish between types of sedentary activities to determine if some types are more detrimental to health than others. In addition, accelerometers are expensive, involve complex data processing and analysis, and are not as easy to administer to large sample sizes as self-report measures. Finally, use of accelerometers introduces problems of compliance and burden on participants (Lynch, Friedenreich, Khandwala, Liu, Nicholas & Csizmadi, 2012).

Self-report measures of inactivity have traditionally used television viewing or screen-time as a representation of total sedentary time. In a systematic review conducted by Must & Taylor in 2005, it was found that most studies examining sedentary behaviour used self-reported screen time (television and video) as a proxy measure for sedentary behaviour. The authors noted that new measurement approaches are essential to properly capture the effects of all types of sedentary behaviours. By using a proxy measure, or assuming sedentary by default if not engaging in moderate to vigorous physical activity, researchers are not capturing a full picture of the degree of sedentariness. In other words, they are not actually measuring sedentary behaviour, as it is operationally defined. It therefore becomes difficult to make accurate conclusions about the impact of sedentary behaviour on health. If proxy measures or surrogate behaviours are used to study sedentary activities, then the conclusions drawn should be stated in terms that are limited to those particular behaviours (Pate et al., 2008).
It is clear that there is a need for a more comprehensive self-report tool that accurately measures all types of sedentary behaviours performed in a given timeframe. The development of one such tool, the SIT-Q, addresses many of these concerns. The SIT-Q is easy to administer, cost-effective and provides behavioural context to non-exercise activities. The SIT-Q assesses adult sedentary behaviour across multiple domains including occupation, transportation, household and leisure-time (Lynch et al., 2012). It is divided into 7 sections, with each section asking about sitting or lying down in a different setting. There are a total of 17 items. For example, section 1 asks about time spent sleeping or napping: “Think about how many hours you usually slept each night over the past 12 months. Please record how long you usually slept on weekdays and weekends. This may include time you spent lying quietly while waiting to fall asleep, or after awakening.” The items were designed to capture total time spent in low-activity pursuits as well as the type of activity. An example of an item in the transportation section is “How long did you usually spend sitting during transport per day? ___hr ___min (weekday) ___hr ___min (weekend)”. This questionnaire was developed using expert review, cognitive interviewing and pilot testing using a convenience sample of 82 Canadian adults. The SIT-Q exhibited good face validity and acceptability, test-retest reliability (administered 1 month apart) showed good correlation in total daily sitting time (ICC=0.65, 95% CI: 0.49, 0.78) and moderate correlation with 7-day activity diaries (p=0.53, <0.01) (Lynch et al., 2012).
2.1.3 Health Risks Associated with Sedentary Behaviour

The concept of sedentary behaviour and the understanding that it is disadvantageous to health is not novel; in 1956, it was first postulated that physical inactivity may have more of an impact on the development of obesity than diet alone (Johnson, Burke & Mayer, 1956). By the 1990’s, researchers recognized the importance of considering both physical activity and inactivity in regards to health outcomes. More recent studies show associations between screen based media use and negative health behaviors such as smoking, alcohol use and aggression (Iannotti, Kogan, Janssen & Boyce, 2009), depression and anxiety (de Witt, van Straten, Lamers, Cuijpers & Penninx, 2011), obesity (Must & Tybor, 2005), metabolic syndrome (Mark & Janssen, 2008) abnormal glucose metabolism (Hu et al., 2003) and cardiovascular disease (Hamilton et al., 2008). Today, empirical findings suggest sedentary behaviour has physiologically distinct effects on health, independent of meeting physical activity recommendations (Hamilton et al., 2007; Pate et al., 2008; Mark & Janssen, 2008; Hamilton et al., 2008; Owen et al., 2010; Tremblay et al., 2010).

In a large group of physically active Australian adults, a significant dose-response association was found between television viewing time and waist circumference, blood pressure, blood glucose, and serum triglyceride and HDL cholesterol levels. Despite meeting physical activity recommendations, this group of adults still experienced negative metabolic consequences with increased screen time (Hamilton et al., 2008). Similar results were found in a group of middle-aged French-Canadian adults, where television viewing was used as a proxy for sedentary behaviour time and cluster analysis was used to identify physical activity and sedentary behavior patterns and associations
with weight status. In female participants, the likelihood of overweight was decreased in a low television viewing (or low sedentary time) group, independent of type and duration of physical activity patterns (Charreire et al. 2010). In a nationally representative 12-year follow-up prospective study of Canadian adults, daily sitting time was associated with an elevated risk of all-cause and cardiovascular disease related mortality, independent of leisure-time physical activity and BMI (Katzmarzyk, Church, Craig & Bouchard, 2009). These findings clearly show that despite engaging in recommended levels of regular physical activity, these adults are still subject to the negative health consequences of excessive sedentary time. Owen et al. (2010) have termed this phenomenon the “active couch potato.” The protective effect of regular exercise can be lost when an individual spends the remainder of their day engaging in sedentary behaviour.

Hamilton and colleagues (2008) describe recent findings that illustrate specific cardio-metabolic consequences of increased sedentary time as well as the underlying biological mechanisms. For example, more time spent sitting versus standing causes muscles used for postural support to lose more than 75% of their ability to rid circulating free fatty acids in lipoproteins from the bloodstream. This leads to a 90-95% loss of lipoprotein lipase (LPL) activity. Reduced LPL is associated with increased triglyceride levels, decreased HDL cholesterol and therefore an increased risk of cardiovascular disease. This mechanism is distinct from the LPL activity increases observed during physical activity (Tremblay et al., 2010). As well, prolonged sitting means a reduction in intermittent muscular contractions resulting in reduced energy expenditure throughout the day and therefore increased risk of obesity (Hamilton et al., 2007).
Saunders et al. (2013) did not find a significant association between longitudinal changes in visceral fat mass or other markers of cardio-metabolic risk and total sedentary time in French Canadian adults, but did find a 0.13 cm increase in waist circumference for every 15-minute increase in sedentary behavior from baseline to follow-up. This study measured total sedentary time through self-report and measured a number of different sedentary behaviors rather than using a proxy measure such as screen time. In contrast, a population-based prospective study of healthy Caucasian middle-aged adults objectively measured sedentary time at baseline and found that it was significantly and positively associated with fasting insulin levels 5.6 years later. These findings were independent of age, sex, fat mass, fasting insulin, and smoking status and moderate to vigorous physical activity levels (Helmerhorst, Wijndaele, Brage, Wareham & Ekelund, 2009).

The mechanism by which sitting is associated with increased type 2 diabetes risk is a reduction in glucose tolerance by decreased levels of a muscle glucose transporter (GLUT) protein. Denervation (or under-use) of skeletal muscle, causes a rapid reduction in muscle GLUT-4 protein as well as insulin-stimulated glucose uptake (Tremblay et al., 2010). However, even minor increases in contractile activity (such as low-intensity physical activity) can dramatically increase muscle GLUT content and glucose tolerance in sedentary individuals (Tremblay et al., 2010). This effect is demonstrated in a study by Healy et al. (2008), who objectively measured physical activity levels in a group of Australian adults (67 men, 106 women) without diagnosed type 2 diabetes. Participants were administered an oral glucose tolerance test to measure fasting and 2-hour post-prandial plasma glucose, and wore accelerometers during waking hours for 7 days. There
was a positive association between sedentary time and 2-h plasma glucose levels, and a negative association between light intensity physical activity as well as moderate-to-vigorous physical activity and 2-hr plasma glucose. In another study, American women aged 30-55, without diagnosed type 2 diabetes, experienced a 5% increase in obesity and a 7% increase in diabetes with each two hour per day increment in sitting at work, while every two hour increment of standing or walking around the home was associated with a 9% reduction in obesity and a 12% reduction in diabetes (Hu, Li, Colditz, Willett & Manson, 2003).

The impact of excessive sedentary behaviour on chronic disease risk is not limited to adults. For example, in a small, randomized control trial conducted in third and fourth grade students in the United States, reducing total screen time significantly decreased students’ body mass index (BMI), triceps skinfold thickness, waist circumference and waist-to-hip ratio. Reduction in television watching was accompanied by decreases in the number of meals consumed in front of the television, suggesting that sedentary behaviour and energy consumption are associated (Robinson, 1999). Similarly, Ciccone, Woodruff, Fryer, Campbell and Cole (2013) observed that increased screen time was associated with greater evening snack portion sizes and overall poor diet quality in a group of young adolescent Canadians residing in Southern Ontario. In a study of Canadian children, television watching and video game use were both associated with an increased risk of overweight and obesity (Tremblay & Willms, 2003). Mark and Janssen (2008) examined the relationship between sedentary behaviour and metabolic syndrome in adolescents using cross-sectional data from the National Health and Nutrition Examination Surveys (NHANES) in the United States. Even after adjusting for physical activity levels, the
results showed a dose-dependent response between increased screen time and increased metabolic syndrome risk factors in 12 to 19 year olds. In nationally representative samples of both American and Canadian adolescents, screen-based media use was negatively correlated with physical health status and physical activity, quality of life, and quality of family relationships (positive health indicators) but positively correlated with physical aggression, smoking and alcohol use (negative health indicators) (Iannotti et al., 2009). These results indicate that increased sedentary time has an impact on a broad spectrum of health behaviors, beyond physiological effects, in both adults and children.

It is well documented that negative health behaviors, including those associated with chronic disease risk, developed during childhood and adolescence track into adulthood (Buckworth & Nigg, 2004; Kemper, Post, Twisk & van Mechelen, 1999; Must & Tybor, 2005). For example, childhood obesity is an important determinant of adult obesity with over 70% of obese adolescents becoming obese adults (Kemper et al., 1999). Physical inactivity tends to increase with age as illustrated in this longitudinal cohort study; in 1999, 6% of 14 year-old participants were inactive and by age 20 this number had increased to 24% (Caspersen, Pereira & Curran, 1999). In a systematic review, the strength of tracking of sedentary behaviours from childhood and adolescence was examined and findings showed TV viewing and computer use are habit-forming behaviours that tend to persist over time (Biddle, Pearson, Ross & Braithwaite, 2010). Increased time spent watching television between the ages of 5 and 15 years in New Zealand was predictive of higher BMI, poorer fitness level and raised serum cholesterol levels at age 26 years (Hancox, Milne & Poulton, 2004). This evidence clearly indicates the importance of developing interventions to reduce sedentary behaviours and improve
diet during childhood and adolescence in order to reduce metabolic syndrome precursors and prevent chronic disease in adulthood.

2.1.4 Sedentary Behaviour and Dietary Patterns

Given that sedentary behaviour is an emerging topic of study, and current research has only just begun to examine it as a unique construct, there is much to be learned about its relationships with other negative health behaviours. One such relationship that is lacking in data is that between sedentary behaviour and diet. The majority of data available uses screen time, mainly television viewing, as a proxy for sedentary behavior. It is worth noting that potential diet-related confounders exist when using television-viewing time to test for associations between sedentary behaviours and obesity or other cardio-metabolic risk factors.

Television viewing has been associated with increased energy intake. A cross-national study examined associations of TV viewing with the consumption of sweets, soft drinks, fruits and vegetables in 11-15 year olds in Europe, Canada and the U.S. The authors concluded those who watch more TV were also more likely to consume sweets and soft drinks on a daily basis and less likely to consume fruits and vegetables daily, and that television viewing plays a role in development of obesity (Vereecken et al., 2006). There is a strong body of evidence showing positive associations between screen time and increased snacking (Ciccone et al., 2013) and consumption of fast food, fried foods and soda and a decreased intake of fruits and vegetables (Utter, Neumark-Sztainer, Jeffery & Story, 2003; Scully, 2008; Vereecken, Todd, Roberts, Mulvihill & Maes, 2006). Utter et al. (2003) showed that increased screen time was associated with more
unhealthful dietary behaviours. Two proposed mechanisms exist for this relationship; during regular television programming, the viewer is exposed to numerous advertisements of food high in fat, sugar and salt which has been associated with increased intake of these types of foods (Scully, Dixon & Wakefield, 2008). In addition to this food exposure, viewers tend to mindlessly eat leading to overconsumption of calories and weight gain (Blass et al., 2006).

A limited number of studies have examined the relationship between a wider range of sedentary behaviours and diet. For example, Bauer, Friend, Graham & Neumark-Sztainer (2012) studied adolescent girls who reported engaging in a variety of sedentary behaviours including watching television, talking on the phone, socializing with peers and listening to music. These behaviours were associated with lower levels of moderate to vigorous physical activity, increased intake of fast food and soft drinks and decreased intake of fruits and vegetables. In adolescent boys and girls, increased television and video exposure was associated with more unhealthful dietary behaviours such as increased intake of snack foods, soft drinks and fried foods, whereas increased time spent studying or reading was positively associated with increased intake of fruits and vegetables (Utter et al., 2003). In a large sample of American adults, dietary fat consumption was significantly negatively associated with leisure-time physical activity (p<0.0001). However, the authors suggest that this relationship may be a result of clustering of health behaviours; people who engage in one healthy behaviour may be more inclined to engage in other healthy behaviours as well (Simoes et al., 1995).

While these studies examine the effect of sedentary behaviour on individual dietary components, such as fruit and vegetable intake, they do not consider participants’
overall diet quality and dietary patterns. Woodruff and Hanning (2010b) compared health
behaviours to a diet quality score using the Canadian adaptation of the Healthy Eating
Index (HEI-C). The average score for Ontario grade 6 students was 69.6 (diet quality
needs improvement) out of a total 100 points, with students more likely to score higher if
they walked to and from school 5 days per week. Findings of this study suggest a positive
association between diet quality and physical activity. Similar findings came from a large
cross-sectional study of adolescents in Alberta in which diet quality was compared to
nutrient intakes, meal behaviors and physical activity. These data were collected via a
self-administered Web-Survey of Physical Activity and Nutrition (Web-SPAN).
Suboptimal nutrient intakes, negative meal behaviors (i.e., skipping meals, consuming
meals away from home) and physical inactivity were all related to poor diet quality
(Storey et al., 2009). Clearly, the link between diet quality and lifestyle choices warrants
further investigation, as increased understanding of the underlying correlates of diet
quality will contribute to development of effective health interventions and prevention of
chronic disease.

2.2 Diet Quality

2.2.1 Diet Quality and Health

When examining relationships between diet and health outcomes, a strong body
of evidence has shown that it is preferable to measure the dietary patterns and overall
quality of participants’ diet as opposed to assessing diet based on a single dietary
component such as energy intake (Kant, 1996; Kant 2004; Wirt & Collins, 2009). The
human diet is complex and multi-faceted. Diet quality indexes (DQIs) assess dietary
patterns, which provide a broader representation of dietary intake and take into account the synergistic effects of whole foods, such as fruits and vegetables, in the diet (Murray et al., 2013). Shifting the focus to dietary patterns and away from specific dietary components allows for recognition of potential interactions between dietary constituents, understanding that different aspects of diet play a role in chronic disease development and appreciating the balance between protective and harmful components of the diet (McNaughton, Dunstan, Ball, Shaw & Crawford, 2009). Diet quality takes into account the adequacy of the diet based on recommended nutrient intakes, such as Dietary Reference Intakes (DRIs), and moderation of intake of nutrients negatively correlated with health (i.e. saturated and trans fatty acids, sugar and sodium). Diet quality is a measure of the overall adequacy of food or nutrient intake of an individual or population, and allows for a deeper understanding when examining the relationship between dietary intake and health outcomes.

Research has clearly shown an association between diet quality and obesity as well as other cardio-metabolic risk factors. Results from the 2004 Canadian Community Health Survey showed that 59% of Canadian children and adolescents consumed fewer than 5 servings of fruits and vegetables per day and these youth were significantly more likely to be overweight or obese than those who consumed fruits and vegetables more often (Shields, 2005). Similar findings were reported in Canadian adults (Tjepkema, 2005). McNaughton et al. (2009) analyzed the relationship between diet quality and type 2 diabetes, pre-diabetes, abdominal obesity and blood pressure in Australian adults. Their findings showed a significant association between higher diet quality and lower systolic and diastolic blood pressure in men, lower fasting plasma glucose in men and women and
lower systolic blood pressure, fasting plasma insulin, and 2-hour plasma glucose and greater insulin sensitivity in women. Diet quality was also inversely associated with abdominal obesity, hypertension and type 2 diabetes among men. The researchers observed that lack of compliance with recommended dietary guidelines was also associated with type 2 diabetes and cardio-metabolic risk factors. It is important to note that these results were found after controlling for age, education, smoking, physical activity, sedentary behaviour and BMI.

The Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study found that diet quality in adolescents was inversely related to perceived stress. This was true in both male and female participants and was observed for all dietary components that made up the diet quality score, with the exception of diet diversity in boys. This relationship held even when adjusting for sleep duration and moderate or vigorous physical activity (Vriendt et al., 2012). In addition to stress, a bidirectional relationship between diet and depressive symptoms has been observed in adolescents and adults (Lopresti, Hood & Drummond, 2013). In a group of Nova Scotian adults, those with mild to major depression had greater odds of having poor diet quality, obesity and physical inactivity (Yu, Parker & Dummer, 2014).

2.2.2 Diet Quality Indices

Indices of diet quality are multi-dimensional measures used to evaluate the combination of different nutrients, foods or dietary constituents in relation to current dietary guidelines and/or specific health outcomes (Woodruff & Hanning, 2010a). Diet quality indices are theoretically defined dietary patterns created a priori based on current
nutrition knowledge (Waijers, Feskens & Ocke, 2007). They combine recommendations about various components of nutrition into a single measure of diet quality or diet quality score (Garriguet, 2009). Diet quality scores allow the evaluation of an individual or group’s diet to be quantified. They also make it possible to evaluate the nutritional health of a population, trace trends in eating habits, make comparisons among different groups and assess the impact of other health behaviours on diet (Garriguet, 2009).

Many diet quality indices have been developed over the years in different countries (Fransen & Ocké, 2008). The Healthy Eating Index (HEI-2005) was developed in the U.S. but is based on dietary guidelines similar to Canada’s healthy eating guidelines. The HEI-2005 has been evaluated for both content and construct validity. In 2009, this index was adapted by Garriguet (2009) to meet recommendations in Eating Well with Canada’s Food Guide (Health Canada, 2007) and was validated in Canadian children and adults. The Canadian Healthy Eating Index (HEI-C) assigns a score from 0 to 100 points based on eight adequacy components (total vegetables and fruit, whole fruit, dark green and orange vegetables, total grain products, whole grains, milk and alternatives, meat and alternatives, and unsaturated fats) and three moderation components (saturated fats, sodium and “other foods”). The scores assigned are prorated linearly for each component and based on food guide servings and recommendations for healthy eating in Canada’s Food Guide (Garriguet, 2009).

2.3 Emerging Adulthood

As with the field of sedentary physiology, emerging adulthood is also an emerging topic of study. Emerging adulthood is now being recognized as a unique
developmental period and a time when individuals are at risk for a range of adverse health behaviours. This life-stage is defined as a period of development between the late teens through the twenties with a focus on ages 18 to 25 (Arnett, 2000). Demographic shifts such as increased enrollment in post-secondary education and delays in marriage and childbearing have contributed to the uniqueness of this life-stage group from previous generations (Nelson et al., 2008). With over 1.6 million Canadians attending a post-secondary institution (Statistics Canada, 2010) and over 75% of post-secondary students between the ages of 17-27, this life stage is becoming a relevant and necessary group to study.

This is a critical time for adolescents entering adulthood. It is a time for establishing independence, as many young adults are moving away from home and living on their own for the first time. It is also a time during which they adopt lifelong health behaviours such as changes in diet, which may be associated with increased risk of chronic diseases (Nelson et al., 2008). In addition, pressures of independence, faster-paced lifestyles and stress associated with demands from school and work lead to shifts in dietary and lifestyle patterns such as skipping breakfast, reliance on fast food and eating outside the home (Deshmukh-Taskar et al., 2009). In a 2010 study, a disconcerting 23% of emerging adults enrolled in a Canadian university were found to be overweight or obese (Perusse-LaChance, Tremblay & Drapeau, 2010), which is only slightly less than the 29% national average in adolescents (Statistics Canada, 2010). What is even more concerning is the prediction that if current trends continue, by 2040, 70% of Canadian adults will be either overweight or obese (Le Petit & Berthelot, 2005).
Findings from a US national survey indicate that fast food and soft drink consumption is highest among 20-39 year olds (Paeratakul, Ferdinand, Chakmpagne, Ryan & Bray, 2003) and NHANES data shows that the majority of 20-29 year olds surveyed consume less than 1 serving of fruits and vegetables per day (Cook & Friday, 2005). Pullman et al. (2009), studied a group of 108 male first year Canadian university students from the summer prior to starting their first year to the end of the winter semester of their first year. In this study, the “Freshman 15”, defined as weight gain caused by the transition from high school to university, was associated with reduced levels of physical activity and increased sedentary behaviours but not related to dietary intake. However, subjects did experience a decrease in consumption of dairy products and a switch from 1% to 2% fluid milk as well as a significant increase in weekly alcoholic beverage consumption and frequency of binge drinking, which would indicate a reduction in overall diet quality. Other studies have shown that this period favours unhealthy eating behaviours such as increased snacking on higher fat, unhealthy foods and significant increases in alcohol intake in addition to development of stress-related and disinhibited eating habits (Crombie, Ilich, Dutton, Panton & Abood, 2009).

A Canadian study (Garcia, Sykes, Matthews, Martin & Leipert, 2010) identified perceived barriers of Ontario university students to healthful eating. These barriers included cost of food, lack of time for grocery shopping and meal preparation and reliance on pre-packaged convenience foods. The students also identified several environmental barriers such as proximity of student housing to fast food restaurants, lack of clean cooking spaces (shared kitchens or no kitchens), and the stress of frequently adjusting to new living environments. Another barrier identified in the literature, is a lack
of food skills. In a sample of 115 female undergraduate students enrolled in an introductory food and nutrition course at a Southwestern U.S. university, the likelihood of preparing a particular type of food was dependent on food preparation knowledge and attitude. Less than 25% of the participants were comfortable in their ability to prepare more complicated dishes, while the majority opted for simple or pre-prepared meals. The two most cited reasons for not preparing more complicated foods were 1) never been taught and 2) no interest in learning how (Soliah, Walter & Antosh, 2006).

The transition from adolescence to adulthood is also a period of time in which physical activity levels decline and sedentary behaviour increases with more time spent sitting. In a review by Crombie et al. (2009), significant decreases in all types of physical activity were observed in U.S. college students including leisure, sport and occupational. Research has shown that lifestyle factors such as diet, sedentary behavior (television viewing in particular) and physical activity track strongly from adolescence into adulthood (Nelson et al., 2008; Biddle et al., 2010). This means that eating habits and sedentary behaviours learned during adolescence tend to persist over time and are maintained through later years, increasing risk of obesity and chronic disease.
3.0 Rationale, Objectives and Hypotheses

Sedentary behaviour is defined as activity that requires less than 1.0-1.5 metabolic equivalents of energy expenditure, typically those activities that involve sitting or lying down. Sedentary behaviour, independent of meeting physical activity recommendations, is associated with a variety of negative health risks. The physiological effects of spending too much time in a reclined or seated position are distinct from the effect of too little exercise and researchers are now learning that these behaviours must be treated as separate constructs.

As this is an emerging field of study, there exists a gap in the literature examining the relationship between time spent engaging in sedentary behaviours or total sedentary time and other lifestyle indicators such as dietary patterns. The human diet is complex and so measuring diet quality and food group intake to determine nutritional adequacy is preferred to assessing diet based on individual nutrients. The diet of emerging adults is especially complex and changes as adolescents transition into adulthood, perhaps living on their own, preparing their own meals and eating in new environments for the first time. Emerging adulthood is a unique developmental period in which lifelong health behaviours are learned. Despite the obvious health risks associated with this life-stage and the opportunity for health interventions there is limited research available examining sedentary behaviours in this group. The majority of research conducted on sedentary behaviour is done so in children or adolescents (age 2-18) and adults (age over 18). Emerging adults are “lumped” into the broader definition of adult despite very different lifestyle patterns and developmental stages. This understudied group combined with the
emerging field of sedentary physiology presents a unique opportunity for innovative research.

**Objectives**

1. The primary objective of this research is to explore the association between sedentary behaviour and diet quality in emerging adults.
2. Secondary objectives of this research study are to explore associations between sedentary behaviour and body composition and moderate to vigorous physical activity patterns.

**Hypotheses**

1. It is hypothesized that total time spent engaging in sedentary behaviour, independent of depressive symptoms and time spent engaged in moderate to vigorous physical activity, will be inversely associated with total diet quality score in emerging adults.
2. It is hypothesized that sedentary behaviour time will be positively associated with body fat percentage in emerging adults and negatively associated with moderate to vigorous physical activity patterns in emerging adults.
4.0 Methods

4.1 Study Design

Data were collected as a convenience sample from a larger research study entitled “Reaching Out Club (ROC): Support and Experiential Learning for Academically Struggling Students in Early Year Nutrition Courses.” Data were collected in the Body Composition and Metabolism Lab at the University of Guelph between September 2012 and April 2013. The University of Guelph Research Ethics Board approved the study. Participants were recruited from two undergraduate nutrition courses, NUTR*2050 (Nutrition in the Community) in fall 2012 and an introductory nutrition course, NUTR*1010 (Nutrition and Society) in winter 2013. Recruitment during the winter semester limited participation to the first 100 attendees and a waitlist was created for additional interested students. At an information session, students signed up for designated appointment times in pairs, during which they would be required to come to the lab. Consent forms were explained to students and students were asked to sign at this time (Appendix). Although offered the option, no student declined to have his or her results used in the study.

4.2 Sample

The total sample size was 175 undergraduate students (18 male, 157 female), from which a convenience sample of 100 students was drawn (15=male, 85=female), during the 2013 winter semester. Due to uneven gender distribution, the 15 males were dropped, leaving a final sample of 85 females. The sedentary behaviour questionnaire was not implemented until the winter semester, and therefore the sample could only consist of 100 students, as that was the total number of participants recruited during that
Participation was voluntary and enrollment in NUTR*1010 was the only inclusion criteria.

4.3 Procedure

At each study visit, participants underwent body composition assessment using air displacement plethysmography (BOD POD™), submitted 3-day food records and completed various health questionnaires. The lab visit took a total of one hour to complete and was facilitated by a graduate research assistant. Participants attended in pairs and were sent reminder e-mails one week prior to their lab visit in which they were provided with instructions on how to properly complete a 3-day food record. Food records were collected at the start of the lab visit and a research assistant reviewed the records to ensure completion. At a later date, an undergraduate research assistant batch-entered food records into ESHA (The Food Processor for Windows, version 10.12.0; ESHA Research, Salem, OR). Nutrient analysis results were e-mailed to participants approximately two weeks after the lab visit.

4.4 Questionnaires

4.4.1 Health Behaviour Questionnaire

Demographic and background information was collected with a health behaviour questionnaire, included in the Appendix. This questionnaire also contained questions on lifestyle factors including sleep, mood, physical activity, alcohol consumption and smoking. Physical activity items were adapted from the International Physical Activity Questionnaire – Short Form (IPAQ-SF; Craig et al., 2003). Questions pertaining to depressive symptoms were adapted from the Center of Epidemiologic Studies Depression Scale. The CESD Scale consists of 20 items, which measure symptoms of depression in
nine different groups as defined by the American Psychiatric Association Diagnostic and Statistical Manual, fourth edition. The questionnaire contained a mixture of close-ended questions with ordered response options on a continuum, partially close-ended questions with unordered options and open-ended questions.

4.4.2 SIT-Q

Sedentary behaviours and time spent engaging in each sedentary activity were determined using the SIT-Q (included in Appendix). This questionnaire was developed as a comprehensive self-report measure to assess adult sedentary behaviour across multiple domains (occupation, transportation, household and leisure-time) (Lynch et al., 2012). It is divided into 7 sections: sleeping/napping, meals, transportation, work/study/volunteering, childcare/eldercare, light leisure/relaxing, and final open-ended questions allowing the participant to add in any additional activities that were not covered in the SIT-Q. The SIT-Q measures total time spent engaging in each domain of sedentary behaviour. This recently developed questionnaire has been assessed for test-retest reliability and validity (Lynch et al., 2012(a)). Intra-class correlation coefficient (ICC) and 95% confidence intervals were calculated for results of total sitting time (h/day) measured by two administrations of the SIT-Q, one month apart (ICC 0.65, 95%CI (0.49, 0.78)). Validity was assessed by comparing sitting time measured by the SIT-Q to estimates derived from Seven-Day Activity Diaries using postural and MET-based definitions of sedentary, resulting in Spearman’s coefficients of 0.53 (p<0.01) and 0.52 (p<0.01) respectively.
4.5 Measures

4.5.1 Body Composition

Body composition, including fat-free mass and fat mass, was assessed using a BOD POD™ Air Displacement Body Composition System (software version 4.5.1, Cosmed, Concord CA). The BOD POD air displacement chamber and scale were calibrated, according to manufacturer’s guidelines, prior to each test participant. This test involves four different measurements: height, body weight, body volume, and thoracic lung volume. Participants were required to change into a bathing suit and bathing cap, and remove all jewelry, as per standard protocol for BOD POD testing. Height was measured to the nearest 0.1 cm using a wall-mounted stadiometer (Medical Scales and Measuring Devices; Seca Corp., Ontario, CA, USA). Weight was measured to the nearest 0.1 kg using the digital scale from the BOD POD. Participants then entered the BOD POD for measurement of raw body volume. They were instructed to sit quietly, limit movement, and breathe normally while in the test chamber. The final step was the measurement of thoracic gas volume used to adjust raw body volume. For this, participants were instructed to continue to sit quietly in the test chamber, and to plug their noses while breathing through a disposable tube connected to the rear of the instrument. Adjusted body volume was converted to body density and then to percent fat mass and fat free mass. The entire BOD POD procedure, undertaken by one of two trained graduate research assistants, took approximately 20 minutes per participant. Participants received a printout of their results immediately after their test.
4.5.2 Diet Quality Index

The Canadian adaptation of the Healthy Eating Index (HEI-C) was used to measure and evaluate the diet quality of the participants based on their 3-day food records. Brauer and Royall (personal communication, June 10, 2013) developed a spreadsheet to tabulate a Healthy Eating Index (HEI-C) score from two, 24-hour recalls and a HEI-C questionnaire based on the work by Garriguet (2009). Upon completion of data entry into ESHA, the number of servings per food group (Eating Well with Canada’s Food Guide, Health Canada (2007)), total unsaturated fatty acid intake, total sodium intake and total calorie intake was calculated and entered into an Excel spreadsheet. The spreadsheet was designed to calculate the total HEI-C score. The total score is based on eight adequacy components and three moderation components. Scores for each component are prorated linearly and total diet quality score is a continuous value ranging from 0 to 100, of which 60 points are derived from the adequacy components and 40 points derived from moderation components (Garriguet, 2009). The scores are based on Canada’s Food Guide recommendations for males’ aged 18-50, males 51 and over, females 18-50 and females 51 and over. A score of 0-50 is defined as “poor diet quality”, a score between 50 and 80 is defined as “needs improvement” and scores of 80 to 100 are defined as “good diet quality”.

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4.6 Data Analysis

Statistical analysis was performed using PASW Statistics for Windows (version 20.0; SPSS Inc., Chicago, IL). Statistical significance was set a priori at p-value ≤0.05. Data are expressed as mean ± standard deviation (SD). The variables HEI-C score and total sedentary time were assessed for normality, and assumptions necessary for the statistical tests performed were met.

Demographic characteristics obtained from the Health Behaviour Questionnaire were analyzed using the descriptive statistic function in SPSS. Continuous variables such as age and body fat % were reported as mean ±SD with corresponding ranges, while categorical variables such as gender and ethnicity were reported as frequencies and percentages. Physical activity levels were calculated using the IPAQ-SF Guidelines for Data Processing and Analysis and expressed as MET-minutes per day.

Self-reported sitting times collected from the SIT-Q were converted from hours per day to minutes per day. SIT-Q items pertaining to job types (work, study, volunteering), frequency of breaks in sitting time and frequency of snacking while watching TV were coded as categorical variables. Data syntax for SIT-Q results were entered manually into SPSS following the protocol in the SIT-Q Administration and Analytic Guide (Lynch, 2013). Domain-specific total sitting time was calculated (e.g., sleeping, sitting during meals, sitting during transportation, screen time and leisure time). If a participant left a section blank, these responses were entered as “0” so that summary statistics could be calculated without creating missing variables. If participants filled in answers to Section 7 (open-ended final questions), then these would be reviewed and activities listed in this section added to an existing SIT-Q domain as appropriate or added
to overall sedentary time. In the present study, no participants included additional activities in Section 7. Total sedentary time was calculated as a daily average (excluding sleeping and napping) and expressed as a continuous variable in minutes per day. Paired t-tests were performed to compare sitting time on weekdays vs. weekend days.

Total sedentary time exceeding 1080 min/day was labeled as “implausible” (Thorpe et al., 2010; Lynch, personal communication, December 10, 2013) and excluded from further analysis (n=18). Total sedentary time (min/day) was normally distributed within this population (skewness = -0.08, Z_{skewness} = -0.3; kurtosis = -0.85, Z_{kurtosis} = -1.5). Independent t-tests were performed to compare lifestyle variables between plausible reporters (total sedentary time ≤18h/day, n=67) and implausible reporters (total sedentary time >18h/day, n=18). Participants were divided into 50th percentiles based on total sedentary time and categorized into “low sedentary” (≤ 706 min/day) and “high sedentary” (≥ 707min/day) groups. Independent t-tests were performed to compare the differences between group means across the following variables: BMI, body fat %, physical activity levels, fibre intake, fruit and vegetable intake, HEI-C score and TV viewing time.

Results from 3-day food records entered into ESHA were reviewed for errors, and the nutrient analyses were printed. EWCFG food group servings per day were calculated and averaged, including intake of dark green and orange vegetables, whole fruits and whole grains. Diet quality index scores were calculated using the Canadian adaptation of the Healthy Eating Index (Garriguet, 2009). The formula used to calculate HEI-C scores was developed and programmed into an Excel spreadsheet by Brauer & Royall (personal communication, June 10, 2013). HEI-C score and all components which comprise the total score were treated as continuous variables. HEI-C scores range from 0 to 100, with
scores between 0-50 representing “poor diet quality”, 51-80 = “needs improvement”, and 81-100=”good diet quality”. HEI-C scores were normally distributed within this population, with neither values of skewness or kurtosis being significant (skewness = -0.078, Z_{skewness} = -0.3; kurtosis = -1.01, Z_{kurtosis} = -1.7).

Under- and over-reporters of energy intake were determined using the cut-off interval calculated by Garriguet (2008) based on the 2004 Canadian Community Health Survey (CCHS) data. Garriguet utilized the Goldberg Method (Goldberg et al., 1991) in the determination of this cut-off interval. Basal metabolic rate (BMR) was calculated using the Harris-Benedict equations (Harris & Benedict, 1918). If participants’ reported energy intake was less than 70% of their predicted BMR (n= 21), they were classified as “under-reporters” and if their energy intake was greater than 142% of predicted energy expenditure (n=0), they were classified as “over-reporters”. Using clinical judgment, the under-reporters’ 3-day food records were reviewed and those that were detailed, careful accounts of intake were deemed plausible and re-included into analysis (n=15). Therefore, the total sample size of usable and plausible food records was n=77.

A Pearson correlation matrix was performed to explore relationships between all measured variables. Significant associations between independent and dependent variables determined which variables would be used in linear regression analyses. A simple linear regression analysis was performed, in which average daily sedentary time was regressed against diet quality (HEI-C score). In two more subsequent linear regressions, total sedentary time was regressed against fruit and vegetable intake and fibre intake. A multiple linear regression analysis was then performed to test the strength of the predictor variable, sedentary time, in predicting diet quality while controlling for
depressive symptoms and physical activity levels. It is indicated in the literature that depression has an impact on diet and activity levels (Yu, Parker & Dummer, 2014; Lopresti, Hood & Drummond, 2013). Despite not having a strong correlation with diet quality in the Pearson correlation matrix, physical activity was included as a covariate due to established associations with diet (Storey et al., 2009; Cohen, Evers, Manske, Bercovitz & Edward, 2003) and adiposity (Henson et al., 2013).

Finally, linear regression models were used to test the predictive power of the level of sedentariness on dietary components (diet quality score, F&V intake and fibre intake). The models were stratified by high (>706 min/day, n=31) and low (≤706 min/day, n=31) sedentary time (predictor variable), while controlling for depressive symptom score and physical activity.
5.0 Results

5.1 Participants

In total, 85 F predominantly Caucasian NUTR*1010 students participated in the study. A sub-analysis by gender was not possible due to a small sample size of males and uneven gender distribution therefore the 15 males who participated were excluded from analyses. Two participants did not complete 3-day food records, while 6 were classified as under-reporters of energy intake and excluded from analysis involving diet, reducing the sample size by 8 (n=77). Eighteen of the 85 participants reported implausible sitting time (>1080min/day) and were excluded from further analyses involving SIT-Q results (n=67). Descriptive characteristics of the participants are presented in Table 5.1.

Table 5.1: Descriptive characteristics of study participants (n=62)

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>18 ± 1</td>
<td>18 – 23</td>
</tr>
<tr>
<td>BMI* (kg/m²)</td>
<td>22.5 ± 3.0</td>
<td>16.6 – 31.8</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>27.7 ± 6.4</td>
<td>14.6 – 45.7</td>
</tr>
<tr>
<td>Vigorous PA* (MET-min/wk)</td>
<td>1837.3 ± 2056.5</td>
<td>0 – 10080.0</td>
</tr>
<tr>
<td>Moderate PA (MET-min/wk)</td>
<td>546.4 ± 811.9</td>
<td>0 – 5040.0</td>
</tr>
<tr>
<td>Walking PA (MET-min/wk)</td>
<td>1619.2 ± 2258.9</td>
<td>0 – 11088.0</td>
</tr>
<tr>
<td>Total PA (MET-min/wk)</td>
<td>3735.8 ± 2761.0</td>
<td>198.0-13998.0</td>
</tr>
<tr>
<td>Sitting (min/day)</td>
<td>278.9 ± 208.2</td>
<td>0 – 720</td>
</tr>
<tr>
<td>Sleep (hrs/night)</td>
<td>7 ± 1</td>
<td>5 – 10</td>
</tr>
<tr>
<td>CESD Score</td>
<td>12 ± 8</td>
<td>1 – 36</td>
</tr>
<tr>
<td>Alcohol intake (drinks/wk)</td>
<td>5 ± 5</td>
<td>0 – 26</td>
</tr>
<tr>
<td>Caffeine intake (drinks/wk)</td>
<td>4 ± 6</td>
<td>0 – 42</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>Caucasian</td>
<td>53</td>
<td>85.5%</td>
</tr>
<tr>
<td>Black/African Canadian</td>
<td>2</td>
<td>3.2%</td>
</tr>
<tr>
<td>Asian/South Asian</td>
<td>3</td>
<td>4.8%</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>6.5%</td>
</tr>
</tbody>
</table>

Note: ★ Body Mass Index (18.5-24.9=Normal >24.9 Overweight) ◆ International Physical Activity Questionnaire (IPAQ) definitions of vigorous (8 METs), moderate (4 METs) and walking (3.3 METs) physical activity levels, expressed as MET-minutes per week ❅ The Center for Epidemiologic Studies Depression Scale (CESD) 0-38; >16 clinically significant (Eaton et al., 2004)
5.2 Primary Research Objective

The primary objective of this study was to explore the relationship between sedentary behaviour (activities performed while sitting or less than 1.5 METS) and diet quality score in our sample of female participants. We hypothesized that as time spent engaging in sedentary behaviours increased, we would observe a decrease in diet quality.

5.2.1 Sedentary Behaviour

Results from analysis of the SIT-Q are reported in Table 5.2. Participants spent an average of 11.8 ± 3.3 h/d engaging in sedentary behaviours (not including sleeping or napping) on a typical day. Independent t-tests revealed no significant differences in BMI, body fat %, physical activity levels, depressive symptoms, dietary intake or sedentary activities between implausible vs. plausible reporters of sedentary time, with the exception of total sitting time (plausible = 699 ±199 vs. implausible = 1333 ± 209 min/day, p<0.01). The most common sedentary activities were television watching, computer use and other leisure pursuits (such as listening to music, talking to friends, going to the movies, etc.). Paired sample t-tests were performed to compare differences in sitting time within each domain between weekdays and weekends. All were significantly greater on the weekends except childcare, computer use and reading. There were no significant differences in BMI or body fat% between the “low sedentary” (≤ 706 min/day) and “high sedentary” (>707min/day) groups, however fibre, fruit and vegetable, whole fruit and dark green & orange vegetable intake and HEI-C score were significantly higher in the low sedentary group (Table 5.3). Total physical activity and TV viewing time were significantly higher in the high sedentary group.
Table 5.2: Comparison of reported time (min/day +/- SD) spent in sedentary behaviours on weekdays and weekends (n=62)

<table>
<thead>
<tr>
<th>Sedentary Behaviours (min/day)</th>
<th>Weekday Mean ± SD</th>
<th>Weekend Mean ± SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleeping</td>
<td>479.3 ± 48.3</td>
<td>543.4 ± 96.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Napping</td>
<td>30.5 ± 48.4</td>
<td>30.5 ± 60.3</td>
<td>1.00</td>
</tr>
<tr>
<td>Sitting for meals</td>
<td>79.8 ± 53.6</td>
<td>101.4 ± 71.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sitting during transportation</td>
<td>26.7 ± 36.4</td>
<td>58.7 ± 58.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Childcare</td>
<td>7.8 ± 29.7</td>
<td>11.1 ± 44.2</td>
<td>0.452</td>
</tr>
<tr>
<td>Caring for elderly family member</td>
<td>0.6 ± 3.8</td>
<td>4.9 ± 19.7</td>
<td>0.072</td>
</tr>
<tr>
<td>Television time</td>
<td>82.8 ± 57.4</td>
<td>137.0 ± 90.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Computer time</td>
<td>186.0 ± 112.0</td>
<td>203.5 ± 118.3</td>
<td>0.408</td>
</tr>
<tr>
<td>Reading</td>
<td>80.0 ± 67.4</td>
<td>74.4 ± 73.1</td>
<td>0.396</td>
</tr>
<tr>
<td>Other leisure pursuits</td>
<td>112.7 ± 71.3</td>
<td>150.2 ± 102.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Total Sedentary Time</strong></td>
<td><strong>706.3 ± 201.4</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.3: Differences in lifestyle variables between low and high sedentary participants (n=62)

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD (n=62)</th>
<th>Low sedentary (≤706min/d, n=31)</th>
<th>High sedentary (&gt;706min/d, n=31)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>18.4 ± 0.88</td>
<td>18.5 ± 0.81</td>
<td>18.3 ± 0.94</td>
<td>.390</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>61.1 ± 9.5</td>
<td>60.9 ± 7.7</td>
<td>61.2 ± 11.2</td>
<td>.919</td>
</tr>
<tr>
<td>BMI (kg/m^2)</td>
<td>22.5 ± 3.0</td>
<td>22.2 ± 2.6</td>
<td>22.7 ± 3.3</td>
<td>.524</td>
</tr>
<tr>
<td>Body Fat %</td>
<td>27.7 ± 6.4</td>
<td>27.4 ± 6.3</td>
<td>27.9 ± 6.6</td>
<td>.802</td>
</tr>
<tr>
<td>MVPA (MET-min/d)</td>
<td>3735 ± 2761</td>
<td>2974 ± 1835</td>
<td>4557 ± 3345</td>
<td>.038</td>
</tr>
<tr>
<td>TV viewing (min/d)</td>
<td>98.3 ± 59.0</td>
<td>80.0 ± 42.3</td>
<td>116.6 ± 67.7</td>
<td>.014</td>
</tr>
<tr>
<td>Total HEI-C Score</td>
<td>65.0 ± 14.3</td>
<td>68.8 ± 13.2</td>
<td>61.3 ± 14.0</td>
<td>.034</td>
</tr>
<tr>
<td>Fibre (g/d)</td>
<td>20.3 ± 9.2</td>
<td>23.1 ± 12.1</td>
<td>17.2 ± 5.2</td>
<td>.016</td>
</tr>
<tr>
<td>Fruit &amp; Vegetable (serv/d)</td>
<td>5.0 ± 2.2</td>
<td>5.6 ± 2.3</td>
<td>4.2 ± 1.8</td>
<td>.011</td>
</tr>
<tr>
<td>Whole Fruit (serv/d)</td>
<td>1.5 ± 1.1</td>
<td>1.7 ± 1.0</td>
<td>1.1 ± 1.1</td>
<td>.057</td>
</tr>
<tr>
<td>Dark Green &amp; Orange Veg (serv/d)</td>
<td>0.9 ± 0.8</td>
<td>1.1 ± 0.8</td>
<td>0.7 ± 0.8</td>
<td>.044</td>
</tr>
</tbody>
</table>
5.2.2 Diet Quality

Results from the 3-day food records are presented in Table 5.4. Participants consumed a mean of 1736 ± 436 kcal/day, with 28% (±16%) of those kilocalories coming from pre-packaged, processed foods (“other kcal”). Mean intakes of EWCFG food group servings per day were all below recommendations except Meat & Alternatives (2.0 ± 1.0). Unsaturated fatty acid intake and fibre intake were also below recommendations, while mean sodium intake was above the 2300mg/day upper limit set by Health Canada.

Table 5.4: Components of diet quality and standardized diet quality score (HEI-C) measured by self-report in participants (n=62)

<table>
<thead>
<tr>
<th>Component</th>
<th>Mean ± SD</th>
<th>Range</th>
<th>DRIs•</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total HEI-C Score★</td>
<td>65.0 ± 14.0</td>
<td>36.4 – 90.7</td>
<td>---</td>
</tr>
<tr>
<td>Energy intake (Kcal)</td>
<td>1736 ± 436</td>
<td>923 – 2645</td>
<td>---</td>
</tr>
<tr>
<td>Unsaturated Fat (serv/d)◆</td>
<td>1.5 ± 1</td>
<td>0 – 5</td>
<td>2</td>
</tr>
<tr>
<td>Saturated Fat (% of total Kcal)</td>
<td>3 ± 4</td>
<td>0.5 – 16</td>
<td>&lt;7%</td>
</tr>
<tr>
<td>Sodium (mg/day)</td>
<td>2577 ± 880</td>
<td>815 – 5537</td>
<td>&lt;2300</td>
</tr>
<tr>
<td>Other Kcal (% of total Kcal)◆</td>
<td>28 ± 16</td>
<td>5 – 76</td>
<td>---</td>
</tr>
<tr>
<td>Sugar Kcal (% of total Kcal)</td>
<td>21 ± 8</td>
<td>7 – 46</td>
<td>&lt;25%</td>
</tr>
<tr>
<td>Total dietary fibre (g/d)</td>
<td>20 ± 10</td>
<td>8 – 79</td>
<td>26</td>
</tr>
<tr>
<td>Fruit &amp; Vegetable (serv/d)</td>
<td>5 ± 2</td>
<td>1 – 14</td>
<td>7-8</td>
</tr>
<tr>
<td>Grain Products (serv/d)</td>
<td>4.5 ± 1.5</td>
<td>1 – 8</td>
<td>6-7</td>
</tr>
<tr>
<td>Milk &amp; Alternatives (serv/d)</td>
<td>2 ± 2</td>
<td>0 – 15</td>
<td>3-4</td>
</tr>
<tr>
<td>Meat &amp; Alternatives (serv/d)</td>
<td>2 ± 1</td>
<td>0.5 – 6</td>
<td>2</td>
</tr>
<tr>
<td>Dark Green &amp; Orange Veg (serv/d)</td>
<td>1 ± 1</td>
<td>0 – 3</td>
<td>2</td>
</tr>
<tr>
<td>Whole Fruit intake (serv/d)</td>
<td>1.5 ± 1</td>
<td>0 – 4</td>
<td>---</td>
</tr>
<tr>
<td>Whole Grains intake (serv/d)</td>
<td>1.5 ± 1.5</td>
<td>0 – 7</td>
<td>3-4</td>
</tr>
</tbody>
</table>

Note: ★Healthy Eating Index Score – Canadian Adaptation (Garriguet, 2009) is based on a scale of 0-100, with 100 representing high diet quality ◆1 Unsaturated fat serving = 15ml ◆◆Other Kcal represents calories consumed from foods that do not fit into any of the food group categories of Canada’s Food Guide •Dietary Reference Intakes (Health Canada, 2013) ◆◆Eating Well with Canada’s Food Guide recommendations (servings/day)
Mean diet quality (HEI-C) score was 65.0 (±14.0) out of a possible 100. 18% of participants’ diet quality scores were classified as “poor”, 70.5% as “needs improvement” (score values between 51-80), while only 11.5% had diet quality scores in the “high diet quality” category (Figure 5.1).

**Figure 5.1: Categorization of participants’ HEI-C scores**

Differences between dietary under-reporters and plausible reporters were explored using independent t-tests. Weight, BMI and BF% were greater in the dietary under-reporter group, while total physical activity (MET-min/week) was greater in the plausible reporter group, however these differences were not statistically significant. Kcal, fibre and fruit & vegetable intakes as well as HEI-C scores were significantly different between the two groups (Table 5.5). Under-reporters’ mean HEI-C score fell in the “poor diet quality” category, and this group consumed approximately half of the fruit and vegetables and fibre as the plausible reporting group. There were no observed differences between under- and plausible reporters for total sedentary time, depressive symptoms or sleep.
Table 5.5: Differences between under- and plausible reporters of energy intake

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Under-reporters</th>
<th>Plausible reporters</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=83)</td>
<td>(n=6)</td>
<td>(n=77)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>18.4 ± 0.8</td>
<td>18.0 ± 0</td>
<td>18.4 ± 0.8</td>
<td>.250</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>62.1 ± 11.0</td>
<td>69.4 ± 14.6</td>
<td>61.5 ± 10.6</td>
<td>.094</td>
</tr>
<tr>
<td>BMI (kg/m^2)</td>
<td>23.0 ± 3.6</td>
<td>24.4 ± 3.4</td>
<td>22.8 ± 3.6</td>
<td>.288</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>28.4 ± 6.7</td>
<td>32.7 ± 6.7</td>
<td>28.0 ± 6.7</td>
<td>.105</td>
</tr>
<tr>
<td>Total PA (MET-min/wk)</td>
<td>3735 ± 2761</td>
<td>2277 ± 2125</td>
<td>3654 ± 2608</td>
<td>.255</td>
</tr>
<tr>
<td>Sleep (hrs/day)</td>
<td>7.8 ± 1.1</td>
<td>8.2 ± 1.4</td>
<td>7.7 ± 1.2</td>
<td>.331</td>
</tr>
<tr>
<td>CESD Score</td>
<td>12.7 ± 8.2</td>
<td>11.7 ± 8.1</td>
<td>12.7 ± 8.2</td>
<td>.772</td>
</tr>
<tr>
<td>Total Sedentary time (min/d)</td>
<td>827.9 ± 314.3</td>
<td>804.2 ± 237.5</td>
<td>829.8 ± 320.7</td>
<td>.849</td>
</tr>
<tr>
<td>Energy intake (kcal/d)</td>
<td>1728.6 ± 450.9</td>
<td>1167.5 ± 241.8</td>
<td>1772.3 ± 434.5</td>
<td>.001</td>
</tr>
<tr>
<td>HEI-C</td>
<td>64.0 ± 14.4</td>
<td>49.1 ± 6.5</td>
<td>65.1 ± 14.2</td>
<td>.001</td>
</tr>
<tr>
<td>F&amp;V intake (serv/d)</td>
<td>4.9 ± 2.2</td>
<td>2.8 ± 1.5</td>
<td>5.0 ± 2.2</td>
<td>.019</td>
</tr>
<tr>
<td>Fibre intake (g/d)</td>
<td>19.7 ± 9.2</td>
<td>11.8 ± 8.1</td>
<td>20.3 ± 9.2</td>
<td>.028</td>
</tr>
</tbody>
</table>

5.2.3 Associations Between Sedentary Behaviour and Diet Quality

Results of a Pearson correlation matrix revealed a small, negative correlation between sedentary time and diet quality (r(60) = -.23, p=.077). There was a moderate negative correlation between total sedentary time and fibre intake (r (60) = -.30, p<.05) as well as total sedentary time and fruit and vegetable intake (r(60) = -.34, p<.01), with total sitting time explaining 9% and 12% of the variation in fibre intake and fruit and vegetable intake, respectively. CESD depressive symptom score was also significantly correlated with the main outcome variables as well as total sitting time (Table 5.6).

Therefore CESD score was identified as a confounding variable and controlled for in the regression analysis. MVPA was not significantly correlated with total sitting time or TV time. Despite no statistically significant correlation with sedentary time or diet quality in
the present study, MVPA was still entered as a covariate in a linear regression analysis (due to the strong association between physical activity and diet found in the literature).

Table 5.6: Pearson correlations (r) for main study variables (n=62)

<table>
<thead>
<tr>
<th></th>
<th>Total sedentary time (min/d)</th>
<th>TV viewing (min/d)</th>
<th>MVPA (MET-min/d)</th>
<th>CESD Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEI-C Score</td>
<td>-.226</td>
<td>-.086</td>
<td>.162</td>
<td>-.316**</td>
</tr>
<tr>
<td>Fiber (g/d)</td>
<td>-.296*</td>
<td>-.236*</td>
<td>.045</td>
<td>-.253*</td>
</tr>
<tr>
<td>F&amp;V (serv/d)</td>
<td>-.335**</td>
<td>-.070</td>
<td>.096</td>
<td>-.267*</td>
</tr>
<tr>
<td>Energy intake (kcal/d)</td>
<td>-.001</td>
<td>-.204</td>
<td>-.156</td>
<td>-.028</td>
</tr>
<tr>
<td>MVPA (MET-min/d)</td>
<td>.221</td>
<td>.049</td>
<td>–</td>
<td>.033</td>
</tr>
<tr>
<td>CESD Score</td>
<td>.266*</td>
<td>-.067</td>
<td>.033</td>
<td>–</td>
</tr>
</tbody>
</table>

Note: *p ≤ 0.05; **p ≤ 0.01

A forced entry simple linear regression (Model A in Table 5.7; Figure 5.2) revealed that total sedentary time did not significantly predict HEI-C (β = -.016, SE=.009, p=.07). The regression equation was: Diet quality = 76.18 + (-0.02) x (total sedentary time min/day), p=.07. Adjusting for CESD score and physical activity (MET-min/wk) did not improve the predictive power of the model (β = -.015, SE=.010, p = .15). The prediction equation of the adjusted model was as follows: Diet quality (HEI-C) score =77.0 + (-.471 x CESD depression score) + (.009 x MVPA MET-min/d) + (-.013 x total sedentary time min/d) (Model A, Table 5.8).
A second linear regression was performed using fruit and vegetable intake as the outcome variable, as a proxy for diet quality (Model B, Table 5.7; Figure 5.3). In this model, sedentary time predicted fruit and vegetable intake and was statistically significant ($\beta = -0.004$, $SE = 0.001$, $p = 0.008$) with a regression equation: Fruit & Vegetable servings/day = 7.46 + (-0.004) x (total sedentary time min/day), $p<0.01$. A multiple linear regression analysis was repeated using fruit and vegetable intake as the outcome variable, while controlling for MVPA and CESD score. Total sedentary time was negatively associated with fruit and vegetable intake ($\beta = -0.003$, $SE = 0.002$, $p = 0.034$), and the prediction equation was as follows: F&V servings/day = 7.5 + (-0.052 x CESD depression score) + (.001 x MVPA MET-min/d) + (-.003 x total sedentary time min/d) (Model B, Table 5.8).
A third regression model was created using fibre as the main outcome variable, again, as a proxy for diet quality. This model (Model C, Table 5.7; Figure 5.4) statistically significantly predicted fibre intake (β = -0.014, SE = 0.006, p = 0.020). The predictive regression equation for Model C was: Fibre intake grams/day = 24.74 + (0.008 x (total sedentary time min/day)), p < 0.05. A final adjusted multiple linear regression analysis was performed and total sedentary time was significantly associated with fibre intake (β = -0.016, SE = 0.007, p = 0.026). The predictive equation produced was: Fibre intake (grams/day) = 31.3 + (-0.222 x CESD depression score) + (0.003 x MVPA MET-min/d) + (-0.013 x total sedentary time min/d), (Model C, Table 5.8).
Results of a final linear regression showed that sedentary time significantly predicted diet quality ($\beta = -6.76$, SE=3.70, $p=0.07$), F&V intake ($\beta = -1.49$, SE=0.65, $p<0.05$) and fibre intake ($\beta = -8.13$, SE=2.85, $p<0.01$) when stratified by low ($\leq 706$ min/day, $n=31$) and high (>706 min/day, $n=31$) sedentary time, while controlling for depressive symptom score and physical activity (Table 5.9 & 5.10).
5.3 Secondary Research Objectives

The secondary objectives of this research study were to explore associations between total sedentary time (predictor variable) and body composition (i.e. body fat %; outcome variable), and moderate to vigorous physical activity patterns (outcome variable). There were no differences in weight (kg), BMI (kg/m2) or body fat % between low or high sedentary reporters (Table 5.3). Additionally, results of a linear regression revealed no significant associations between total sedentary time (min/day) and body fat % ($\beta = -0.003$, SE=.004, $p=.492$) or physical activity ($\beta = 3.06$, SE=1.82, $p=.099$). There were significant differences in the amount of physical activity performed (MET-min/day) between low and high sedentary reporters with low sedentary reporters engaging in 2974.8 ± 1835.8 MET-min/d vs. high sedentary reporters engaging in 4557.6 ± 3345.7 MET-min/d ($p<.05$, Table 5.3).
**Table 5.7:** Summary of unadjusted linear regression models predicting diet quality (n=62)

<table>
<thead>
<tr>
<th>Model</th>
<th>Predictor Variable</th>
<th>Outcome Variable</th>
<th>Slope B</th>
<th>F</th>
<th>R</th>
<th>R^2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Intercept = 76.18</td>
<td>HEI-C</td>
<td>-0.016</td>
<td>3.24</td>
<td>.226</td>
<td>.051</td>
<td>.077</td>
</tr>
<tr>
<td></td>
<td>Total sedentary</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Intercept = 7.46</td>
<td>F&amp;V intake</td>
<td>-0.004</td>
<td>7.60</td>
<td>.335</td>
<td>.112</td>
<td>.008</td>
</tr>
<tr>
<td></td>
<td>Total sedentary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>time**</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Intercept = 24.7</td>
<td>Fibre intake</td>
<td>-0.008</td>
<td>6.66</td>
<td>.321</td>
<td>.103</td>
<td>.012</td>
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<td></td>
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<tr>
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<td>time*</td>
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</tbody>
</table>

*p≤0.05; **p≤0.01

**Table 5.8:** Summary of adjusted linear regression models predicting diet quality (n=62)

<table>
<thead>
<tr>
<th>Model</th>
<th>Predictor Variables</th>
<th>Outcome Variable</th>
<th>Slope B</th>
<th>Standardized B</th>
<th>F</th>
<th>R</th>
<th>R^2</th>
<th>p</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Intercept = 77.0</td>
<td>HEI-C</td>
<td>-0.471</td>
<td>-0.263</td>
<td>3.39</td>
<td>.398</td>
<td>.158</td>
<td>.024</td>
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<tr>
<td></td>
<td>CESD Score*</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>MVPA</td>
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<td>0.009</td>
<td>0.214</td>
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<td>Total sedentary</td>
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<td>-0.013</td>
<td>-0.193</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Intercept = 7.5</td>
<td>F&amp;V intake</td>
<td>-0.052</td>
<td>-0.189</td>
<td>3.69</td>
<td>.413</td>
<td>.170</td>
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<tr>
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<td>CESD Score</td>
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<td>Total sedentary</td>
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<td>C</td>
<td>Intercept = 31.3</td>
<td>Fibre intake</td>
<td>-0.222</td>
<td>-0.178</td>
<td>2.70</td>
<td>.361</td>
<td>.130</td>
<td>.055</td>
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<td>CESD Score</td>
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<td>MVPA</td>
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*p≤0.05; **p≤0.01
Table 5.9: Summary of unadjusted linear regression models predicting diet quality stratified by low and high sedentary time (n=62)

<table>
<thead>
<tr>
<th>Model</th>
<th>Predictor Variable</th>
<th>Outcome Variable</th>
<th>Slope B</th>
<th>F</th>
<th>R</th>
<th>R²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Intercept = 68.8</td>
<td>HEI-C</td>
<td>-7.5</td>
<td>4.69</td>
<td>.269</td>
<td>.072</td>
<td>.034</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>B</td>
<td>Intercept = 5.6</td>
<td>F&amp;V intake</td>
<td>-1.4</td>
<td>6.93</td>
<td>.322</td>
<td>.103</td>
<td>.011</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Intercept = 23.1</td>
<td>Fibre intake</td>
<td>-5.9</td>
<td>6.10</td>
<td>.304</td>
<td>.092</td>
<td>.016</td>
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<tr>
<td></td>
<td>Level of Sedentariness*</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p≤0.05; **p≤0.01

Table 5.10: Summary of adjusted linear regression models predicting diet quality stratified by low and high sedentary time (n=62)

<table>
<thead>
<tr>
<th>Model</th>
<th>Predictor Variables</th>
<th>Outcome Variable</th>
<th>Slope B</th>
<th>F</th>
<th>R</th>
<th>R²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Intercept = 71.9</td>
<td>HEI-C</td>
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<td>.392</td>
<td>.154</td>
<td>.028</td>
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<td></td>
</tr>
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<td>MVPA</td>
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<td>.004</td>
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</tr>
<tr>
<td></td>
<td>Level of Sedentariness</td>
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<td>-6.76</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Intercept = 5.7</td>
<td>F&amp;V intake</td>
<td>-.053</td>
<td>3.28</td>
<td>.416</td>
<td>.173</td>
<td>.029</td>
</tr>
<tr>
<td></td>
<td>CESD Score</td>
<td></td>
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*p≤0.05; **p≤0.01
6.0 Discussion

In recent years, research findings have revealed significant relationships between time spent sitting and negative health outcomes such as increased cardio-metabolic risk and obesity (Mark & Janssen, 2008; Hamilton et al., 2008; Hu et al., 2003; Must & Tybor, 2005). The physiological mechanisms underlying some of these associations are becoming increasingly understood (Tremblay et al., 2010). However, to date, the relationship between sedentary time and diet is vastly under studied. The main objective of this study was to examine this gap in research, and explore associations between total sedentary time and diet quality in a sample of female undergraduate students. The secondary objective of this study was to explore relationships between sedentary behaviour and other health variables such as body composition and physical activity.

Multiple linear regression models significantly predicted fibre and fruit and vegetable intake from total sedentary time, while controlling for depressive symptoms and MVPA. Sedentary time did not statistically significantly predict our main outcome variable, diet quality. However, regression analyses stratified by low and high sedentary time did exhibit strong, significant inverse associations with diet quality, F&V intake and fibre intake. Additional findings of this study showed a significant difference in moderate and vigorous physical activity levels between low sedentary reporters vs. high sedentary reporters, with high sedentary reporters participating in greater amounts of MVPA per day than low sedentary reporters. High sedentary reporters also watched significantly more TV than low sedentary reporters. No significant associations between body composition and sedentary behaviour were observed. These findings did not support our
secondary hypothesis that sedentary behaviour time is positively associated with body fat percentage and negatively associated with physical activity levels in emerging adults.

6.1 Sedentary Behaviour and Diet Quality

In this study we hypothesized that total sedentary time would be inversely related to diet quality in emerging adults, while controlling for depressive symptom score and physical activity levels. That is, as time spent being sedentary increases, we predicted that diet quality would correspondingly decrease. We found that total sedentary time did not significantly predict diet quality score. Sedentary time did significantly predict F&V intake as well as fibre intake, albeit the strength of these associations was small.

Due to inconsistencies in the literature in how sedentary behaviour is measured as well as a lack of data examining total sedentary time and measures of diet quality (specifically in emerging adults), direct comparisons between previous research and this study are limited. Ciccone et al. (2012) found a similar trend in adolescents with longer periods of after-school evening screen time (more sedentary) had poorer diet quality (OR=0.45, p< .05). A cross-sectional study by Utter et al. (2003) found that sedentary behaviour (measured by screen time) and dietary intake were significantly associated in both male and female adolescents. The authors concluded that TV viewing is associated with obesity, moderated by increased consumption of food rather than reduced activity levels.

The findings of the current study are important as they highlight a relationship between time spent engaged in sedentary behaviours and diet in emerging adults. Emerging adults may have an increased risk of developing cardio-metabolic risk factors
due to shifts in dietary and lifestyle patterns. Evidence shows that diet quality is inversely related to biomarkers of metabolic syndrome (i.e., waist circumference, serum triglycerides, plasma blood glucose and blood pressure) in U.S. young adults (Deshmukh-Taskar et al., 2009). Diets high in fruits, vegetables, whole grains and dairy are associated with lower risk of metabolic syndrome while diets higher in sugar, fried and processed foods are associated with increased risk.

The current study contributes to the growing body of evidence that suggests increased time spent being sedentary (independent of age) is associated with negative health behaviours. Understanding the factors underlying these negative health effects, such as diet, will aid in the development of interventions targeting this life-stage group.

In a second linear regression analysis, we explored the association between sedentary behaviour and fruit and vegetable intake. Frequent consumption of fruits and vegetables is an indicator of healthy eating habits (Dehghan, Akhtar-Danesh & Merchant, 2011) and is a common proxy for a nutritionally adequate diet in the literature (Alijadani, Patterson, Sibbritt, Hutchesson, Jensen & Collins, 2013; Ledoux, Hingle & Baranowski, 2011). In our study, despite being statistically significant, fruit and vegetable intake was not strongly associated with total sedentary time ($\beta = -.003$, $SE = .002$, $p<.05$). However, when stratified by low and high levels of sedentary time, this association was much stronger ($\beta = -1.49$, $SE = 0.65$, $p<.05$). These findings align with those of a study by Bauer et al. (2012) in which adolescent girls who had the highest levels of sedentariness reported the lowest fruit and vegetable intake ($F=3.6(2)$, $p=.04$). Vereecken et al. (2005) also found significant inverse associations between TV viewing time and fruit and vegetable intake in Canadian adolescents ($OR=0.862$, $p<.001$; $OR=0.881$, $p<.001$).
Population-level studies suggest that fruit and vegetable intake is low among young adults. Huang et al. (2003) found the majority of sampled U.S. college students (aged 18-27) did not consume the recommended 5 servings of fruits and vegetables while on a national level, 78% of 18-24 year-olds reported consuming less than 5 servings per day. Furthermore, from a sample of 8,182 Canadian undergraduate students, 88.5% did not consume at least 5 servings of fruits and vegetables per day (Kwan, Faulkner, Arbour-Nicitopoulos & Cairney, 2013). These findings are comparable to the mean 4.9 servings of fruit and vegetable per day reported by participants in the current study (Table 5.2). The Bogalusa Heart Study, which was a long term epidemiologic study conducted in the U.S. examining cardiovascular risk factors from childhood through adulthood, found that reduced intake of fruits and vegetables was associated with increased metabolic syndrome risk factors, independent of age, total energy intake, BMI and physical activity levels (Yoo et al., 2004). A possible explanation for this association could be that those that adopt one healthy behaviour, are more likely to adopt another healthy behaviours. This phenomenon has been observed in several randomized control trials (Spring et al, 2010; Johnson et al., 2008). In other words, those that engage in less time sitting are also more likely to make healthier choices in regards to diet (i.e. consume more fruits and vegetables).

A third linear regression analysis was performed examining the association between sedentary behaviour and fibre intake (g/day). A fibre-rich diet tends to be more plant-based and is strongly associated with reduced risk of metabolic syndrome in adolescents and young adults (Carlson, Eisenmann, Norman, Ortiz & Young, 2011). The model significantly predicted fibre intake, meaning increased sitting was inversely related
to fibre consumption, but the association was not a strong one ($\beta = -0.016$, SE=0.007, $p<0.05$). A stronger association was observed when the regression model was stratified by low and high sedentary time ($\beta = -8.13$, SE=2.85, $p<0.01$). Zabinski, Norman, Sallis, Calfas & Patrick (2007) also found a significantly higher fibre intake in a low sedentary time cluster (vs. high sedentary clusters) of a group of American adolescents. The participants in the current study consumed a mean 20g of dietary fibre per day, 6g per day less than what is recommended. These results are similar to findings from the Canadian Community Health Survey Cycle 2.2 (CCHS 2.2) conducted in 2004, in which Canadian youth were not meeting recommended fibre intake, consuming an average of 14-18g/day – much less than the recommended 26-38g/day set by Health Canada.

Research shows that a reduction in diet quality is typical for college students, especially if living away from home for the first time (Garcia et al., 2010). For example, approximately 30% of American college students were found to have poor dietary habits such as skipping breakfast, not consuming recommended intakes of fruits and vegetables and frequenting fast food restaurants more than twice a week (Buckworth & Nigg, 2004). In the present study, the participants’ mean intake was excessive for sodium ($2577 \pm 880$ mg/day) and “other” (pre-packaged/processed) foods ($28 \pm 16\%$ of total kcal). Mean sodium intake exceeded the upper limit (2300mg/day) recommended by Health Canada, increasing the risk of adverse health effects (Health Canada, 2010). The results of this study are in line with CCHS 2.2 data, which showed that 80% of Canadian youth had sodium intakes above the upper limit. Foods classified as “other” include foods high in calories, fat, sugar and salt and a higher proportion of total kcal coming from these foods is associated with poorer diet quality (Ciccone, Woodruff, Fryer, Campbell & Cole,
2013) and development of cardio-metabolic risk factors in youth, such as impaired glucose homeostasis and insulin resistance, abdominal adiposity, elevated blood pressure, and hypertriglyceridemia (Iannotti & Wang, 2013). This study has shown an association between these less than optimal dietary habits and increased time spent sitting.

In further analysis, when components of the HEI-C score were compared across low and high sedentary reporters, significant differences were observed for total HEI-C score, fibre intake, fruit & vegetable intake, whole fruit intake and dark green & orange vegetable intake. HEI-C score and intake of these food groups were higher in the low sedentary reporters (p<.05). Sedentary behaviour has been strongly associated with increased risk of obesity and metabolic syndrome, and Granados et al. (2012) suggest that the connecting factor may be increased energy intake during periods of prolonged sitting. Other studies have also suggested that reduced energy expenditure as a result of being more sedentary is not compensated by a decline in energy intake (Murgatroyd et al., 1999; Stubbs et al., 2004). This current study has shown that prolonged sitting or sedentary time may also have an effect on the types of foods being consumed, resulting in reduced diet quality. Despite not being able to prove causation, there is evidence within these results that diet is related to time spent sitting, hence playing a role in the negative outcomes already associated with sedentary behaviours.

6.2 Sedentary Behaviour and Body Composition

Secondary hypotheses of this study were that increased sedentary time would be positively associated with body fat percentage and negatively associated with physical activity level. Results revealed no significant relationship between total sedentary time
and body composition, nor was there any significant difference in body composition or BMI between “low” vs. “high” sedentary reporters. This is perhaps due to the population from which the sample was drawn – undergraduate students enrolled in a nutrition course. An interest in food and nutrition implies that a healthy lifestyle is a priority for this group, so naturally one would expect a lower rate of overweight and obesity. Compared to a sample of female undergraduate students enrolled in non-nutrition related courses, with an overweight/obesity rate of 31% (Herbert, McCarthy, Smith & Taylor, 2009), the present study sample had a lower rate at 20%. In addition, increased knowledge about food and nutrition is related to healthier food choices as well as more restricted eating and weight control practices (Korinth, Schiess & Westenhoefer, 2009), hence explaining a decreased incidence of overweight compared to the general population.

6.3 Sedentary Behaviour and Physical Activity

Contrary to what was hypothesized, this study did not find a significant inverse association between total sedentary time (min/day) and physical activity. However, a significant positive association was revealed when sedentary time was categorized into high and low reporters. Interestingly, MVPA was higher in the high sedentary group. Ottevaere et al. (2011) suggest that while there is some evidence physically active individuals are motivated to eat healthier, some people may try to compensate (consciously or subconsciously) an unhealthy behaviour with healthier behaviours and vice versa. This could explain the finding that participants engaging in high levels of MVPA also tend to sit more. According to results of this study, 96% of participants are accumulating at least 600 MET-min/week of physical activity and meeting current
guidelines of 150 min/week of MVPA (Health Canada and the Canadian Society for Exercise Physiology, 1998). This is much higher than the 19% of Canadian young adults (18-39) who are estimated to meet MVPA guidelines, according to the Canadian Health Measures Survey, 2007-2011. The present study’s results are comparable to American and Japanese college students, who participated in approximately 224 to 265 minutes of physical activity per week (Kobayashi, 2007). Despite meeting MVPA recommendations, this population still engages in high levels of sedentary behaviour, which is perhaps a result of compensatory behaviour.

6.4 Strengths and Limitations

This study is the first to our knowledge to examine the relationship between a global sedentary behaviour measure and diet quality score in a sample of emerging adults. While sedentary physiology and its impact on health is an emerging field of study, few studies have looked at its relationship to diet, and those that did used proxy measures for sedentary time such as TV viewing. The SIT-Q is a newly developed tool that measures total sitting time across several domains. The majority of studies to date have measured sedentary behaviour using proxies such as screen-time and sitting at work or having participants estimate the amount of time they spend sitting on a typical day. Using these proxies to estimate sedentary time leads to inaccurate or underestimation of total sedentary time. The SIT-Q has been tested for reliability and validity in Canadian adults by comparing to 7-day physical activity diaries and accelerometry data (Lynch et al., 2013). By using this validated self-report measure, we were able to capture contextual
information that would not otherwise have been captured if we had used objective accelerometry as a measure.

The Healthy Eating Index was recently adapted to Canadian dietary guidelines and validated in a Canadian population. Assessing dietary intake based on a global diet quality score, such as the HEI-C, is preferable to assessing diet based on specific nutrients. Dietary patterns offer a broader representation of intake and have been shown to mediate effects of diet on chronic disease risk (Murray et al., 2013).

The participants in this study were classified as emerging adults (18-25 year olds) and are a unique and highly under-studied life-stage group (Arnett, 2000). Health behaviours learned during adolescence track strongly into adulthood, when chronic disease risk is most apparent. Emerging adulthood presents an ideal time for targeted health interventions (Kwan, Faulkner, Arbour-Nicitopoulos & Cairney, 2013). Very few studies have examined health behaviours, especially sedentary behaviour, in this age group. The majority of published studies on sedentary behaviour have used samples of children, adolescents and adults.

The sample consisted of primarily Caucasian females enrolled in an undergraduate nutrition course. An interest in food and nutrition implies that a healthy lifestyle is a priority for this group. Compared to a sample of female undergraduate students enrolled in non-nutrition related courses, with an overweight/obesity rate of 31% (Herbert, McCarthy, Smith & Taylor, 2009), the present study sample had a lower rate at 20%. Compared to the average HEI-C score of 56.9 for Canadian women aged 19-30 (Garriguet, 2009), the participants’ in the present study had, on average, superior diet
quality with a mean score of 65.0 ± 14.3. 80% of Canadian women scored in the “needs improvement” category, with less than 3% categorized as “good diet quality”.

In addition, increased knowledge about food and nutrition is related to healthier food choices as well as more restricted eating and weight control practices (Korinth, Schiess & Westenhoefer, 2009), hence explaining a decreased incidence of overweight compared to the general population. However, despite having a healthy and potentially weight conscious sample, we were still able to detect significant inverse associations between sedentary time and fruit and vegetable intake as well as fibre intake. If we had a more heterogeneous sample that was more reflective of the general population, we could assume that an even stronger association would have been observed.

Despite the many strengths of this study, there were some limitations. The study had a fairly small sample size due to initially using a cross-sectional sample from a larger study that was already in progress. Data collection that included a measure of sedentary behaviour was not started until the winter semester, and so limited the maximum sample size to 100 vs. 175. In addition to this, 15 participants were male and had to be excluded due to the imbalance between genders, 6 participants were excluded for under-reporting dietary intake and 18 for reporting implausible sitting time.

Participant under- and over-reporting of energy intakes can occur deliberately or inadvertently, but regardless, introduces bias and obscures results (Garriguet, 2008). Poor validity of dietary assessments introduces error when interpreting relationships between diet and health, and for this reason it is important to identify implausible reporters (Black, 2000). In order to control for this phenomenon, we identified under- and over-reporters of energy intake by comparing reported intake to a predicted basal metabolic rate (BMR) for
each participant and applying a cut-off interval based on the Goldberg method (Goldberg, Black, Jebb, Cole, Murgatroyd, Coward & Prentice, 1991). Due to the high incidence of disordered eating, body dissatisfaction and dieting in this demographic (Wronka, Suliga & Pawlinska-Chmara, 2013; Delinsky & Wilson, 2007; Abraham, 2003), clinical judgment was necessary to determine if a participant was under-reporting versus intentionally under-eating. By doing this, elimination of kcal under-reporters was reduced from 21 to 6.

This leads to a second limitation of the study, one which applies to all studies in this area. Reliance on self-report measures for dietary intake introduced potential for inaccurate reporting and social desirability bias (Hebert, Clemow, Pbert, Ockene & Ockene, 1995). Self-reporting of socially desirable health behaviours such as physical activity using the IPAQ can lead to over-reporting as well (Esliger & Tremblay, 2007). Inaccurate reporting was likely with regards to the SIT-Q. Eighteen of the 85 participants had to be excluded due to reporting sitting more than an implausible 1080min/day. This could have been corrected if SIT-Q responses were reviewed with the participant to ensure that values summed correctly, prior to the participant leaving the lab on study day. The IPAQ asks respondents to recall physical activities over the past 7-days, which has been shown to produce more accurate responses (Craig et al., 2003). However, the IPAQ does not distinguish between weekdays or weekends. This means one might engage in 150 minutes of activity over a weekend (i.e. a sports tournament) but remain inactive the rest of the week yet would appear to meet physical activity guidelines (Esliger & Tremblay, 2007).
After data were collected in the present study, a 7-day recall SIT-Q was published and available. This would have potentially provided more accurate sitting time as it uses a 7-day recall rather than past-year recall of sedentary behaviours. Similar to the IPAQ, this short, recent recall frame makes sedentary behaviours easier to remember as it prompts participants to record specific rather than usual behaviours (Wijndaele et al., 2013). In addition, using a past 7-day recall measure for sitting time would have complemented the use of a 3-day food record as both would have measured behaviours within the same time period, and therefore eliminated error such as seasonality and changes in routine (i.e. in school vs. working during the summer months). The error caused by inaccurate reporting makes our results less generalizable to the population of study and introduces the potential for making inaccurate conclusions.

Although the gender distribution (85% female, 15% male) is not reflective of the general Canadian population, it is perhaps more reflective of student enrollment at Canadian universities. In 2012, approximately 56% of Canadians enrolled in a post-secondary degree program were female (Statistics Canada, 2012), while 60% of students enrolled at the University of Guelph were female (Council of Ontario Universities, 2013). In 2012, 97% of students enrolled in the University of Guelph’s food and nutrition undergraduate program were female, while 6% were male (Council of Ontario Universities, 2013). Our results can be generalized to female emerging adults enrolled in post-secondary institutions. In future studies, recruitment of males would be important to examine gender differences in sedentary behaviour and diet quality as well as including emerging adults that are not enrolled in a post-secondary institution.
6.5 Future Research

This study was the first, to our knowledge, to have examined the relationship between total sitting time and diet quality in a group of emerging adults. Future research can build on the current one by examining sedentary behaviour and diet in a larger, more heterogeneous sample. Using an updated past-7 day version of the self-report SIT-Q questionnaire might provide more accurate accounts of total sitting time and will provide information within the same time frame as the 3-day food record. Examining not only diet quality and types of foods consumed, but also eating behaviours (i.e. snacking, mindless eating) may shed more light on the underlying factors responsible for the association between diet and sitting time in emerging adults. Additionally, future studies should further examine the finding that high sedentary reporters also engaged in higher levels of physical activity in this age group. Finally, future studies that objectively measure sedentary time and diet quality are needed in order to provide more conclusive evidence of the association between sedentary behaviour and diet quality in emerging adults.

6.6 Conclusions

Sedentary behaviour is becoming an important public health topic, as its unique physiological effects on cardio-metabolic health are becoming increasingly apparent in the literature. There are few studies that look at the relationship between sedentary behaviour and diet, and fewer still that study these variables in emerging adults. The purpose of this study was to examine the relationship between sedentary time and diet quality in emerging adults.
Primary data collection was conducted using a convenience sample of 100 undergraduate students enrolled in an introductory nutrition course, of which 85 females were included in the study. A non-significant inverse relationship between total sedentary time and diet quality was found, with significant inverse relationships between sedentary time and fruit and vegetable intake and fibre intake. This suggests that diet may be a contributing factor to the negative health consequences that have been observed in people who spend most of their day sedentary. Differences in physical activity levels and screen time were also discovered between “low” vs. “high” sedentary reporters. Participants who reported high level of sedentary behaviour tended to engage in more television watching, which was expected based on results from previous research. Of particular interest, was that high sedentary reporters also engaged in significantly more physical activity compared to low sedentary reporters. This contributes to findings in the literature that shows the protective benefits of exercise can be cancelled out by increases in sedentary behaviour, or the “active couch potato” phenomenon (Owen et al., 2010).

The present study provides important insight for healthcare professionals and health researchers into the relationship between sedentary behaviour and diet quality in emerging adults. The findings suggest there is an inverse relationship between time spent sitting and diet, which can be used to inform population based health messages and interventions. For example, focusing on reducing sedentary time in addition to education around healthy eating and increasing physical activity levels will provide a more comprehensive approach in terms of chronic disease prevention. Additionally, for individuals who are not meeting physical activity recommendations, a focus on reducing
sedentary time as opposed to increasing physical activity may be a more feasible goal and more likely to lead to successful behaviour change.

As well, the findings also show that this particular demographic (emerging adults) spends a considerable amount of time sitting and since health behaviours in adolescence and early adulthood have been shown to strongly track into late adulthood, it is especially important to target emerging adults for health interventions aimed at reducing sedentary time. Diet may play a role in the relationship between sedentary behaviour and chronic disease risk, and should also be a focus of future research studies. This study provides important groundwork upon which future studies exploring sedentary behaviours and diet can build.
7.0 References


*Proceedings of the National Academy of the Sciences, 4*(12), 370-373.


Objectively measured sedentary time may predict insulin resistance independent of moderate- and vigorous-intensity physical activity. *Diabetes, 58*, 1776-1779. doi: 10.2337/db08-1773


*Journal of Science and Medicine in Sport, 15*(6) S295.


Pate, R. R., O'Neill, J. R., & Lobelo, F. (2008). The evolving definition of "sedentary". 

_Exercise Sport Sciences Reviews, 36_(4), 173-178.


_Journal of the American Medical Association, 282_(16), 1561-1567.


8.0 Appendix

8.1 Consent Form

CONSENT TO PARTICIPATE IN A CLASS PROJECT AND RESEARCH

Step Up Study Sessions

You are asked to participate in a class project and research study conducted by Dr. Andrea Buchholz and Dr. Jess Haines of the Dept Family Relations and Applied Nutrition, University of Guelph. Funding is from the Learning Enhancement Fund, University of Guelph.

If you have any concerns about this research, please feel free to contact:
- Dr. Jess Haines, tel 519-824-4120 ext 53870, jhaines@uoguelph.ca
- Dr. Andrea Buchholz, tel 519-824-4120 ext 52347, abuchhol@uoguelph.ca
- Graduate Research Assistant: Anne Szeto, szetoa@uoguelph.ca
- Graduate Research Assistant: Caroline Fraser, cfrase07@uoguelph.ca

PURPOSE

The main purpose of this project is a learning opportunity for students to participate in optional study sessions (Step-Up Study Sessions and assignment for NUTR*2050*1010). It is also a research project because the investigators would like to publish the data collected.

PROCEDURES

There are three components of this project. You can volunteer to participate in none, one, two or all three components.

Component 1: Optional Assignment

This assignment will involve a tour of the University of Guelph Body Composition and Metabolism Lab (room 206 J.T. Powell Building), body composition testing (percent body fat) using the BOD POD, 3-day food records and diet analysis, a general health survey, and a physical activity survey. The optional assignment is described fully on the next page. You will also be asked to complete 1, 5-minute survey, during which you will be asked various questions on your experience with the assignment.
Component 2: Use of Data from the Optional Assignment for Research Purposes
If you choose to do the optional assignment above, we request your permission to use your data to explore the association between sleep, diet quality, and body composition in young adults.

Component 3: Assessment of the Step-Up study sessions for Research Purposes
You will be asked to complete two, 5-minute questionnaires to assess your study habits and approaches to learning; we will ask you to fill out these questionnaires during the first and final Step-Up study sessions of the semester. Also during the last Step-Up study session, you will also be asked to complete 1, 5-minute survey, during which you will be asked various questions on your experience in the study sessions, what you learned, etc. If you are not able to attend the last Step-Up study session, we will email you the surveys to complete and then email back to us.

Full Description of the Optional Assignment
If you volunteer to participate in the optional assignment, you will visit the Body Composition and Metabolism Lab once, for about 45 minutes. Approximately 1 week before your visit to the lab we will email you instructions and forms to complete a 3-day food record (a list of all the foods you ate over 3 days). We will ask you to bring the completed food record with you to your lab visit. At your lab visit, you will undergo a BOD POD test that will measure your body composition, pictured below.

The BOD POD™ measures the body’s per cent fat mass using air displacement. A test takes approx. 15 minutes.

The BOD POD, which will be operated by the Graduate Research Assistant, uses the displacement of air inside an enclosed chamber to determine your body volume. From the body volume measurements, whole-body density is determined and body fat is calculated. The procedure is simple and painless. The whole test takes approximately 15 minutes, but of these 15 minutes, you will sit in the BOD POD™ for only approximately 5 minutes. You will be asked to wear a bathing suit and bathing cap for this test to minimize the trapping of air between clothing, hair and your skin. Please bring your bathing suit with you. We will provide the bathing cap. You will also have your height measured using a wall mounted stadiometer. We will provide you with a copy of your results before you leave the lab.

We will ask to you to complete some questionnaires that will ask about your health behaviours, sleep habits, physical activity habits and your experience in the lab, what you learned, etc. The questionnaires will take approximately 20 to 25 minutes in total to complete.
You will have the opportunity to complete an optional assignment – worth up to 5 extra percent on your grade for midterm 1 - and for which you will interpret your laboratory data. The assignment will be marked by another professor in the Applied Human Nutrition program, who will communicate your assignment mark to a course Graduate Teaching Assistant (GTA). The GTA – and not the instructor teaching the course – will make the necessary adjustment to your midterm grade. You will be eligible to receive up to a 5 percent bonus on midterm 1. E.g., if you scored 53% on midterm 1, the optional assignment could raise your grade to a maximum of 58% (53% + 5%). Your marked assignment will be returned to you.

**POTENTIAL RISKS AND DISCOMFORTS**

**Component 1: Optional Assignment**
There is a small risk of claustrophobia while sitting in the BOD POD™. This risk is minimal, however you will be able to stop the test at any time by pressing a button under your left knee (and which will release the door), or by simply telling the Graduate Research Assistant that you would like the test to stop.

You may feel slightly embarrassed at having to wear a bathing suit, however, this will be minimized by wearing a hospital gown immediately before the test. You will be able to change back into your clothes immediately after the test. There is a film on the window of the lab, preventing passersby in the hall from seeing into the lab. We will also make sure that there will be very few people in the lab during your test.

If you do not feel comfortable completing the BOD POD™ test, you will be given a sample printout from the BOD POD, and so you will still be able to complete the optional assignment.

You may feel slightly embarrassed when filling out the questionnaires. You are free to omit any questions that may cause you some embarrassment.

**Component 2 (Use of Data from the Optional Assignment for Research Purposes) and Component 3 (Assessment of the Step-Up Study Sessions for Research Purposes)**
There is a small risk that someone other than the above mentioned researchers may see your completed survey data. To minimize this risk, your data will be coded immediately and stored in password-protected computer files. Thus, your individual data will not be identifiable with your name. Any results published or presented will be done using group data and/or coded (unidentifiable) results.

**POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY**
There are no direct benefits to you for participating in this class project and research study.

If you participate in the optional assignment, you will receive a data printout from the BOD POD and which will tell you your per cent body fat, and you will receive a personalized dietary analysis. In the community, body composition testing and dietary analysis can be expensive, but we will be providing this information free of charge. Data
will be used for research purposes to advance the knowledge of body composition and dietary habits of young Canadian adults.

**PAYMENT FOR PARTICIPATION**
You will not receive any compensation, monetary or otherwise, for participating in this project.

**CONFIDENTIALITY**
Every effort will be made to ensure confidentiality of any identifying materials obtained during the study. Data will be coded immediately and stored in password-protected computer files. Thus your individual data will not be identified with your name. Any results published or presented will be done using group data and/or coded (unidentifiable) individual results. Data will be stored in the lab for seven years after which time paper records will be shredded and electronic records will be deleted from computers. We will not use any of your data for anything other than what is indicated in this document.

**PARTICIPATION AND WITHDRAWAL**
You can choose whether to be in this class project and research, or not. If you volunteer to be in this class project and research study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don’t want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise that warrant doing so.

If you decide not to participate in this research study, you can still complete the optional assignment.

**RIGHTS OF RESEARCH PARTICIPANTS**
You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethics clearance through the University of Guelph Research Ethics Board. If you have questions regarding your rights as a research participant, contact:

Research Ethics Coordinator
University of Guelph
437 University Centre
Guelph, ON N1G 2W1

Telephone: (519) 824-4120, ext. 56606
E-mail: sauld@uoguelph.ca
Fax: (519) 821-5236

**CONSENT AND SIGNATURE OF RESEARCH PARTICIPANT**
I have read the information provided for the Step-Up Study Sessions and research study. My questions have been answered to my satisfaction, and I agree to participate. I have been given a copy of this form.

I have read this Consent Form. The components of the class project and research study, including the 3-day food record and the BOD POD™, have been explained to my satisfaction. I understand that I am free to stop participating in testing at any time, even after signing this consent form.
I agree to participate in the following components: (please check boxes for components in which you consent to participate):

☐ **Component 1: Optional Assignment.** I agree to visit the Body Composition and Metabolism Lab, undergo BOD POD testing, and complete a 3-day food record and some short questionnaires.

☐ **Component 2: Use of Data from the Optional Assignment for Research Purposes.** I give permission to the investigators to use my data from the optional assignment in a published manuscript and/or presentation at a conference. I understand that in order to do Component 2, I must also do Component 1.

☐ **Component 3: Assessment of the Step-Up Study Sessions for Research Purposes.** I agree to complete two, 5-minute surveys that will ask about my study habits and approaches to learning, and one, 5-minute survey that will ask my opinions about the study sessions. I give permission to the investigators to use my survey data and my [NUTR*2050][NUTR*1010] course marks in a published manuscript and/or presentation at a conference.

**PARTICIPANT**

________________________________________  ____________________________  
(Printed name)  (Signature)  (Date)

______________________________________________________________________
(University address)

______________________________________________________________________
(Permanent address)

______________________________________________________________________
(E-mail address)

**WITNESS**

________________________________________  ____________________________  
(Printed name)  (Signature)  (Date)
Health Behaviour Questionnaire

SECTION I: Demographics

1. Age: ________ years

2. Gender:
   - [ ] male
   - [ ] female

3. How do you define yourself? *(Check all that apply)*
   - [ ] White, Caucasian
   - [ ] Black, African Canadian, African American
   - [ ] Middle Eastern, Arabic
   - [ ] South Asian (i.e., Indian, Pakistan)
   - [ ] East Asian (i.e., China, Japan)
   - [ ] Southeast Asian (i.e., Thailand, Philippines, Malaysia)
   - [ ] Hispanic
   - [ ] Native
   - [ ] Other (specify): __________________________

SECTION II: Health

4. Do you have any of the following health conditions?
   - [ ] Cardiovascular Disease
   - [ ] Diabetes
   - [ ] Hypertension

Date: _____________________
☐ Hypercholesterolemia
☐ Crohn's Disease
☐ Celiac Disease
☐ Other (please specify): ____________________________________________

5. Are you currently taking any prescription medications? If so, please list the medications you are currently taking:

_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

SECTION III: Overall Mood

6. Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

<table>
<thead>
<tr>
<th></th>
<th>During the Past Week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rarely or none of the time (less than 1 day)</td>
</tr>
<tr>
<td>a) I was bothered by the things that usually don't bother me.</td>
<td>☐</td>
</tr>
<tr>
<td>b) I did not feel like eating; my appetite was poor.</td>
<td>☐</td>
</tr>
<tr>
<td>c) I felt that I could not shake off the blues even with help from my family or friends.</td>
<td>☐</td>
</tr>
<tr>
<td>d) I felt I was just as good as other people.</td>
<td>☐</td>
</tr>
<tr>
<td>e) I had trouble keeping my mind on what I was doing.</td>
<td>☐</td>
</tr>
<tr>
<td>f) I felt depressed.</td>
<td>☐</td>
</tr>
<tr>
<td>g) I felt that everything I did was an effort.</td>
<td>☐</td>
</tr>
<tr>
<td>h) I felt hopeful about the future.</td>
<td>☐</td>
</tr>
<tr>
<td>i) I thought my life had been a</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>---</td>
<td>---</td>
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<tr>
<td>failure.</td>
<td></td>
</tr>
<tr>
<td>j) I felt fearful.</td>
<td></td>
</tr>
<tr>
<td>k) My sleep was restless.</td>
<td></td>
</tr>
<tr>
<td>l) I was happy.</td>
<td></td>
</tr>
<tr>
<td>m) I talked less than usual.</td>
<td></td>
</tr>
<tr>
<td>n) I felt lonely.</td>
<td></td>
</tr>
<tr>
<td>o) People were unfriendly.</td>
<td></td>
</tr>
<tr>
<td>p) I enjoyed life.</td>
<td></td>
</tr>
<tr>
<td>q) I had crying spells.</td>
<td></td>
</tr>
<tr>
<td>r) I felt sad.</td>
<td></td>
</tr>
<tr>
<td>s) I felt that people dislike me.</td>
<td></td>
</tr>
<tr>
<td>t) I could not get “going”</td>
<td></td>
</tr>
</tbody>
</table>

**SECTION IV: Lifestyle**

7. Do you consume alcohol-containing drinks?
   - [ ] Yes
   - [ ] No

If yes, on average how many do you consume per week?

*(One drink is equivalent to: 12 oz beer, 12 oz alcoholic cooler, 4 oz wine, 1 oz hard liquor):_________

8. Do you consume caffeine-containing drinks?
   - [ ] Yes
   - [ ] No

If yes, on average how many do you consume per week?

*(One drink is equivalent to: 8 oz coffee, 24 oz tea, 24 oz soft drink):_________

9. Do you smoke cigarettes/cigars?
   - [ ] Yes
   - [ ] No

If yes, how many cigarettes/cigars per day?_____________________

For how long have you smoke?_______________________________
SECTION V: Physical Activity Level

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

10. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week

☐ No vigorous physical activities ✨Skip to question 12

11. How much time did you usually spend doing vigorous physical activities on one of those days?

_____ hours per day

_____ minutes per day

☐ Don't know/Not sure

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.
12. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ days per week

☐ No moderate physical activities  ➔ **Skip to question 14**

13. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ hours per day

_____ minutes per day

☐ Don’t know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

14. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ days per week

☐ No walking  ➔ **Skip to question 16**

15. How much time did you usually spend **walking** on one of those days?

_____ hours per day

_____ minutes per day

☐ Don’t know/Not sure
This question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

16. During the last 7 days, how much time did you spend sitting on a week day?

_____ hours per day

_____ minutes per day

☐ Don’t know/Not sure

SECTION VI: Sleep

The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, what time have you usually gone to bed at night?

   BED TIME __________

2. During the past month, how long (in minutes) has it usually take you to fall asleep each night?

   NUMBER OF MINUTES __________

3. During the past month, what time have you usually gotten up in the morning?

   GETTING UP TIME __________

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)
HOURS OF SLEEP PER NIGHT

For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you ... 

   a) Cannot sleep within 30 minutes 
       Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

   b) Wake up in the middle of the night or early morning 
       Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

   c) Have to get up to use the bathroom 
       Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

   d) Cannot breathe comfortably 
       Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

   e) Cough or snore loudly 
       Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

   f) Feel too cold
Not during the past month ____  Less than once a week ____  Once or twice a week ____  Three or more times a week ____

g) Feel too hot
Not during the past month ____  Less than once a week ____  Once or twice a week ____  Three or more times a week ____

h) Had bad dreams
Not during the past month ____  Less than once a week ____  Once or twice a week ____  Three or more times a week ____

i) Have pain
Not during the past month ____  Less than once a week ____  Once or twice a week ____  Three or more times a week ____

j) Other reason(s), please describe
________________________________________________________________________
________________________________________________________________________

How often during the past month have you had trouble sleeping because of this?
Not during the past month ____  Less than once a week ____  Once or twice a week ____  Three or more times a week ____

6. During the past month, how would you rate your sleep quality overall?

  Very good _____
  Fairly good _____
  Fairly bad _____
Very bad       _____

7. During the past month, how often have you taken medicine to help you sleep (prescribed or “over the counter”)?

   Not during the past month ____  Less than once a week ____  Once or twice a week ____  Three or more times a week ____

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

   Not during the past month ____  Less than once a week ____  Once or twice a week ____  Three or more times a week ____

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

   No problem at all _____
   Only a very slight problem _____
   Somewhat of a problem _____
   A very big problem _____
Instructions:

- These questions are about the usual amount of time over the past 12 months that you spent sitting or lying down.
- The amount of time you spent sitting or lying down may have varied over the past 12 months. Do your best to estimate your usual pattern over the past 12 months.
- If you did not participate in a particular sitting task, please write “0” in the time response field.
- For each of the sitting tasks only count the time where this was your main focus. For example, if you spent one hour sitting on the sofa reading a book while you had a CD on in the background, count this time as one hour reading (do not also ‘double count’ as one hour listening to music).

If you have any questions please contact
Telephone:
Email:
The SIT-Q is organized into seven sections, each asking about sitting or lying down in different settings.

Section 1 – Sleeping and Napping

Section 2 – Meals

Section 3 – Transportation

Section 4 – Work, Study and Volunteering

Section 5 – Childcare and Elder Care

Section 6 – Light Leisure and Relaxing

Section 7 – Final Questions
SECTION 1 – SLEEPING AND NAPPING

Sleeping and napping are an important part of your daily routine.

If you do shift work or you have variable sleeping patterns, please try to estimate the average number of hours in your sleep period, whether this is during the night or day.

SLEEPING

Think about how many hours you usually slept each night over the past 12 months.

Please record how long you usually slept on weekdays and weekends. This may include time you spent lying quietly while waiting to fall asleep, or after awakening.

1. How long did you usually sleep per night? ___hr ___min
   (include time spent lying quietly while waiting to fall asleep, or after awakening) ___hr ___min
   (weekday) ___hr ___min (weekend)

NAPPING

A nap is a brief sleep, often during the day. A nap can be taken in a chair as well as in a bed.

Did you take a nap each day, on either weekdays or weekends, over the past 12 months?

⇒ If no, please write “0” in the response section, below.
2. How long did you usually nap per day? __hr __min __hr __min
   (do not include occasional naps) (weekday) (weekend)
SECTION 2 - MEALS

Eating is a task we don’t often think about, but it can take up quite a bit of time each day.

Please think about the amount of time you usually spent sitting for meals over the past 12 months:

- **do** report times when your main focus was eating, including eating out
- **do** report the amount of time you spent between sitting down and being finished with a meal (leaving the table)
- **do not** include time spent preparing food
- **do not** include times you were eating while doing other things, like snacking while watching TV (you will be asked about this later).

3. How long did you usually spend sitting for meals **per day**? __hr __min __hr __min
   (weekday) (weekend)
SECTION 3 – TRANSPORTATION

This section refers to the time you spent sitting during transportation (travelling in a car, bus, train, etc.) in the past 12 months:

- **do** report time spent as either a driver or a passenger
- **do** report time spent commuting to and from work
- **do not** report time spent sitting during transportation as part of your job (you will be asked about this later)
- **do not** include occasional travel such as holidays
- **do not** include transportation on motorcycles, scooters or bicycles.

4. How long did you usually spend sitting during transport per day? __hr __min __hr __min
   (weekday) (weekend)
SECTION 4 – WORK, STUDY AND VOLUNTEERING

“Work” refers to your occupation or your job - all tasks done to earn money or make a living. You may work full-time or part-time; you may work for a company or be self-employed.

“Study” refers to formal educational activities related to school, technical college or university.

“Volunteering” refers to work that you do for no pay, such as helping at a hospital, church or sports club.

Please complete one response section for each type of work, study or volunteering you did in the past 12 months:

- there is space to record up to four different types of work, study or volunteering you may have done over the past 12 months
- do include the usual amount of time that you spent sitting down as part of your work, study or volunteering
- do not record holiday time here, even if it is paid vacation.

➔ If you did not do any work, study or volunteering in the past 12 months, please skip to Section 5 on page 11.

Choose type of “job”:  □ work □ study □ volunteering

Please name Job #1: __________________________

5a. How many weeks in the past 12 months did you do Job # 1? ___ weeks

6a. How many days per week did you do Job # 1? ___ days

7a. How much time per day did you spend sitting for Job # 1? ___hr ___min
(include driving and travelling while doing this job; do not include time commuting to and from this job)
Think about the total time you spent sitting during Job # 1. We are interested in how often you stood up and moved around to “break up” the time you spent sitting. For example, you might have taken short walks to get a drink of water, to collect a document from the printer or to talk to someone else in the office.

8a. How often did you “break up” the time you spent sitting in Job # 1?

☐ (less than hourly) ☐ (hourly) ☐ (half hourly) ☐ (every 10 mins) ☐ (every 5 mins)

OR ☐ I did not sit for more than 30 minutes in a day

➔ Did you have any other work, study or volunteering “jobs” in the past 12 months? If so, continue on the next page.

➔ If you did not have any other jobs, please skip to Section 5 on page 11.
Choose type of “job”: □ work □ study □ volunteering

Please name Job #2: ______________________

5b. How many weeks in the past 12 months did you do Job #2? __ weeks

6b. How many days per week did you do Job #2? __ days

7b. How much time per day did you spend sitting for Job #2? __hr __min

(include driving and travelling while doing this job; do not include time commuting to and from this job)

Think about the total time you spent sitting during Job #2.

8b. How often did you “break up” the time you spent sitting in Job #2?

□ (less than hourly) □ (hourly) □ (half hourly) □ (every 10 mins) □ (every 5 mins)

OR □ I did not sit for more than 30 minutes in a day

⇒ Did you have any other work, study or volunteering “jobs” in the past 12 months? If so, continue on the next page.

⇒ If you did not have any other jobs, please skip to Section 5 on page 11.
Choose type of “job”: □ work □ study □ volunteering

Please name Job #3 ______________________

5c. How many weeks in the past 12 months did you do Job # 3? ___ weeks

6c. How many days per week did you do Job # 3? ___ days

7c. How much time per day did you spend sitting for Job # 3? ___hr ___min
   (include driving and travelling while doing this job; do not include time commuting to and from this job)

Think about the total time you spent sitting during Job # 3.

8c. How often did you “break up” the time you spent sitting in Job # 3?
   □ □ □ □ □
   (less than hourly) (hourly) (half hourly) (every 10 mins) (every 5 mins)

OR □ I did not sit for more than 30 minutes in a day

➔ Did you have any other work, study or volunteering “jobs” in the past 12 months? If so, continue on the next page.

➔ If you did not have any other jobs, please skip to Section 5 on page 11.
Choose type of “job”: □ work □ study □ volunteering

Please name Job #4 ______________________

5d. How many weeks in the past 12 months did you do Job #4? ___ weeks

6d. How many days per week did you do Job #4? ___ days

7d. How much time per day did you spend sitting for Job #4? ___hr ___min

(include driving and travelling while doing this job; do not include time commuting to and from this job)

Think about the total time you spent sitting during Job #4.

8d. How often did you “break up” the time you spent sitting in Job #4?

□ □ □ □ □
(less than hourly) (hourly) (half hourly) (every 10 mins) (every 5 mins)

OR □ I did not sit for more than 30 minutes in a day
SECTION 5 – CHILDCARE AND ELDER CARE

This section refers to the time you spent sitting while taking care of your children, grandchildren or elderly family members.

Were you involved in childcare or elder care each day, on either weekdays or weekends, over the past 12 months?

→ If no, please write “0” in the response section, below.

Please record the usual amount of time you spent sitting during childcare or elder care over the past 12 months.

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>9. How long did you usually spend sitting or lying down while caring for your child per day?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(weekday)</td>
<td></td>
<td>(weekend)</td>
<td></td>
</tr>
<tr>
<td>(examples: nursing baby, helping child with homework)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. How long did you usually spend sitting down while caring for an elderly family member per day?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(weekday)</td>
<td></td>
<td>(weekend)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(examples: reading aloud, assistance with eating meals)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SECTION 6 – LIGHT LEISURE AND RELAXING

This section refers to things done for enjoyment, during your own time.

Please record the usual amount of time you spent sitting or lying down in these pursuits over the past 12 months.

SCREEN TIME

11. How long did you usually spend watching TV (dvsds/videos) or playing video games per day? ___hr ___min ___hr ___min
   (weekday) (weekend)

12. How long did you use a computer for leisure or for additional work on your own time per day? ___hr ___min ___hr ___min
   (weekday) (weekend)

Think about the total time you spent watching TV or using a computer during your leisure-time. We are interested in how often you stood up and moved around to “break up” the time you spent sitting or lying down. For example, you might have got up to get a cup of coffee during a commercial break.

13. How often did you “break up” the time you spent watching TV or using a computer during your leisure-time?

   □ □ □ □ □
   (less than hourly) (hourly) (half hourly) (every 10 mins) (every 5 mins)
14. How often did you eat snack-foods (e.g. chips, sweets) while watching TV during your leisure-time?

☐ (always)  ☐ (usually)  ☐ (sometimes)  ☐ (rarely)  ☐ (never)

15. How long did you usually spend reading while sitting or lying down per day?___hr ___min___hr ___min

(weekday)  (weekend)

16. How long did you usually spend in other leisure pursuits while sitting down per day?___hr ___min___hr ___min

(weekday)  (weekend)

Some examples:

listening to music  talking to friends  sewing/knitting
doing crosswords/puzzles  doing crafts  attending a sporting event
woodworking  playing cards  praying/meditating
writing letter  sitting outdoors  watching a movie at the cinema
SECTION 7 – FINAL QUESTIONS

Were you involved in other daily pursuits done sitting or lying down that were not covered in this questionnaire, on either weekdays or weekends, over the past 12 months?

➔ If no, please continue to question 17.

Please record the usual amount of time you spent sitting or lying down in other pursuits not covered in this questionnaire.

Other pursuits

........................................................................... __hr __min__hr __min
(weekday) (weekend)

........................................................................... __hr __min__hr __min
(weekday) (weekend)

........................................................................... __hr __min__hr __min
(weekday) (weekend)

17. Please estimate the amount of time it took to complete the SIT-Q __hr __min

18. Date questionnaire completed ___ / ___ / ____
(dd) (mm) (year)

Thank you for your help with this questionnaire.
8.4 SIT-Q ADMINISTRATION AND ANALYTIC GUIDELINES

Administration

The SIT-Q is a measure of habitual sedentary behaviors across occupation, transportation, household and leisure-time domains. It was designed for use in population cohort studies, and is administered as a written questionnaire.

Data entry

Time spent in each sedentary behaviour is converted to minutes (either manually at time of data-entry) or automatically if scanned into Blaise, entered into an Access database or similar.

All missing data should be follow-up by re-contacting participants as soon as possible after return of the questionnaire. Ideally, all response sections should be filled in as “0” if the item does not apply to the participant (as per instructions). In practice, participants tend to leave sections blank if they do not apply (eg third and fourth job sections, childcare and elder care). Ensure that these responses are entered as “0” in the spreadsheet or database, to enable summary statistics to be calculated without creating missing variables.

Section 7 – Final questions – is not included in the following data dictionary or data reduction syntax. Investigators should review activities listed in this section and add to an existing SIT-Q domain as appropriate, or add as an additional component of overall sedentary time.
Data dictionary

The following data labels are suggested for setting up databases to enter questionnaire responses.

<table>
<thead>
<tr>
<th>Data label</th>
<th>Item</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>q1_wday</td>
<td><em>How long did you usually sleep per night - weekdays</em></td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q1_wend</td>
<td><em>How long did you usually sleep per night - weekends</em></td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q2_wday</td>
<td><em>How long did you usually nap per day - weekdays</em></td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q2_wend</td>
<td><em>How long did you usually nap per day - weekends</em></td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q3_wday</td>
<td><em>How long did you usually spend sitting for meals per day - weekdays</em></td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q3_wend</td>
<td><em>How long did you usually spend sitting for meals per day - weekends</em></td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q4_wday</td>
<td><em>How long did you usually spend sitting during transport per day - weekdays</em></td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q4_wend</td>
<td><em>How long did you usually spend sitting during transport per day - weekends</em></td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>job1_type</td>
<td><em>Choose type of “job” - work, study or volunteering</em></td>
<td>Categorical</td>
</tr>
<tr>
<td>q5a</td>
<td><em>How many weeks in the past 12 months did you do Job #1</em></td>
<td>Continuous – weeks/year</td>
</tr>
<tr>
<td>q6a</td>
<td><em>How many days per week did you do Job #1</em></td>
<td>Continuous – days/week</td>
</tr>
<tr>
<td>q7a</td>
<td><em>How much time per day did you spend sitting for Job #1</em></td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q8a</td>
<td><em>How often did you “break up” the time you spent sitting in Job #1</em></td>
<td>Categorical</td>
</tr>
<tr>
<td>job2_type</td>
<td><em>Choose type of “job” - work, study or volunteering</em></td>
<td>Categorical</td>
</tr>
<tr>
<td>q5b</td>
<td><em>How many weeks in the past 12 months did you do Job #2</em></td>
<td>Continuous – weeks/year</td>
</tr>
<tr>
<td></td>
<td>Job #2</td>
<td>weeks/year</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>q6b</td>
<td>How many days per week did you do Job #2</td>
<td>Continuous – days/week</td>
</tr>
<tr>
<td>q7b</td>
<td>How much time per day did you spend sitting for Job #2</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q8b</td>
<td>How often did you “break up” the time you spent sitting in Job #2</td>
<td>Categorical</td>
</tr>
<tr>
<td>job3_type</td>
<td>Choose type of “job” - work, study or volunteering</td>
<td>Categorical</td>
</tr>
<tr>
<td>q5c</td>
<td>How many weeks in the past 12 months did you do Job #3</td>
<td>Continuous – weeks/year</td>
</tr>
<tr>
<td>q6c</td>
<td>How many days per week did you do Job #3</td>
<td>Continuous – days/week</td>
</tr>
<tr>
<td>q7c</td>
<td>How much time per day did you spend sitting for Job #3</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q8c</td>
<td>How often did you “break up” the time you spent sitting in Job #3</td>
<td>Categorical</td>
</tr>
<tr>
<td>job4_type</td>
<td>Choose type of “job” - work, study or volunteering</td>
<td>Categorical</td>
</tr>
<tr>
<td>q5d</td>
<td>How many weeks in the past 12 months did you do Job #4</td>
<td>Continuous – weeks/year</td>
</tr>
<tr>
<td>q6d</td>
<td>How many days per week did you do Job #4</td>
<td>Continuous – days/week</td>
</tr>
<tr>
<td>q7d</td>
<td>How much time per day did you spend sitting for Job #4</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q8d</td>
<td>How often did you “break up” the time you spent sitting in Job #4</td>
<td>Categorical</td>
</tr>
<tr>
<td>Question</td>
<td>Description</td>
<td>Response Options</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td>------------------</td>
</tr>
<tr>
<td>q9_wday</td>
<td>How long did you usually spend sitting or lying down while caring for your child per day - weekday</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q9_wend</td>
<td>How long did you usually spend sitting or lying down while caring for your child per day - weekend</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q10_wday</td>
<td>How long did you usually spend sitting down while caring for an elderly family member per day - weekday</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q10_wend</td>
<td>How long did you usually spend sitting down while caring for an elderly family member per day - weekend</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q11_wday</td>
<td>How long did you usually spend watching TV or playing video games per day - weekday</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q11_wend</td>
<td>How long did you usually spend watching TV or playing video games per day - weekend</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q12_wday</td>
<td>How long did you use a computer for leisure or for additional work on your own time per day - weekday</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q12_wend</td>
<td>How long did you use a computer for leisure or for additional work on your own time per day - weekend</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q13</td>
<td>How often did you “break up” the time you spent watching TV or using a computer during your leisure-time</td>
<td>Categorical 1 = &lt; hourly 2 = hourly 3 = half hourly 4 = every 10 mins 5 = every 5 mins 0 = did not sit for &gt; 30 mins/day</td>
</tr>
<tr>
<td>q14</td>
<td>How often did you eat snack-foods (eg chips, sweets) while watching TV during your leisure-time</td>
<td>Categorical 1 = always 2 = usually 3 = sometimes 4 = rarely 5 = never</td>
</tr>
<tr>
<td>q15_wday</td>
<td>How long did you usually spend reading while sitting or lying down per day - weekday</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q15_wend</td>
<td>How long did you usually spend reading while sitting or lying down per day - weekend</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q16_wday</td>
<td>How long did you usually spend in other leisure pursuits while sitting or lying down per day - weekday</td>
<td>Continuous – min/day</td>
</tr>
<tr>
<td>q16_wend</td>
<td>How long did you usually spend in other leisure pursuits while sitting or lying down per day - weekend</td>
<td>Continuous – min/day</td>
</tr>
</tbody>
</table>
Data reduction syntax

** Section 1 – Sleeping and napping **
generate sleep = (q1_wday*5+ q1_wend*2)/7
label var sleep “Sleep mins/day”
generate nap = (q2_wday*5 + q2_wend*2)/7
label var nap “Nap mins/day”

** Section 2 – Meals **
generate meals = (q3_wday*5 + q3_wend*2)/7
label var meals “Meals mins/day”

** Section 3 – Transport **
generate transport = (q4_wday*5 + q4_wend*2)/7
label var transport “Transport mins/day”

** Section 4 – Work, Study and Volunteering **

** Job 1 **
label var job1_type “Job 1 type”
label values job1_type lab1
label define lab1 1 “Work” 2 “Study” 3 “Volunteering”
generate job1_wk = (q5a* q6a* q7a)/52
label var job1_wk “Job 1 mins/wk”
generate job1_day = (q5a* q6a* q7a)/365
label var job1_day “Job 1 mins/day”
generate work1_wk = job1_wk if job1_type==1
replace work1_wk=0 if work1_wk==.
generate work1_day = job1_day if job1_type==1
replace work1_day=0 if work1_day==.
generate study1_wk = job1_wk if job1_type==2
replace study1_wk=0 if study1_wk==.
generate study1_day = job1_day if job1_type==2
replace study1_day=0 if study1_day==.
generate vol1_wk = job1_wk if job1_type==3
replace vol1_wk=0 if vol1_wk==.
generate vol1_day = job1_day if job1_type==3
replace vol1_day=0 if vol1_day==.

** Job 2 **
label var job2_type “Job 2 type”
label values job2_type lab2
label define lab2 1 “Work” 2 “Study” 3 “Volunteering”
generate job2_wk = (q5b* q6b* q7b)/52
label var job2_wk “Job 2 mins/wk”
generate job2_day = (q5b* q6b* q7b)/365
label var job2_day “Job 2 mins/day”
generate work2_wk = job2_wk if job2_type==1
replace work2_wk=0 if work2_wk==.
generate work2_day = job2_day if job2_type==1
replace work2_day=0 if work2_day==.
generate study2_wk = job2_wk if job2_type==2
replace study2_wk=0 if study2_wk==.
generate study2_day = job2_day if job2_type==2
replace study2_day=0 if study2_day==.
generate vol2_wk = job2_wk if job2_type==3
replace vol2_wk=0 if vol2_wk==.
generate vol2_day = job2_day if job2_type==3
replace vol2_day=0 if vol2_day==.

** Job 3 **
label var job3_type “Job 3 type”
label values job3_type lab3
label define lab3 1 “Work” 2 “Study” 3 “Volunteering”
generate job3_wk = (q5c* q6c* q7c)/52
label var job3_wk “Job 3 mins/wk”
generate job3_day = (q5c* q6c* q7c)/365
label var job3_day “Job 3 mins/day”
generate work3_wk = job3_wk if job3_type==1
replace work3_wk=0 if work3_wk==.
generate work3_day = job3_day if job3_type==1
replace work3_day=0 if work3_day==.
generate study3_wk = job3_wk if job3_type==2
replace study3_wk=0 if study3_wk==.
generate study3_day = job3_day if job3_type==2
replace study3_day=0 if study3_day==.
generate vol3_wk = job3_wk if job3_type==3
replace vol3_wk=0 if vol3_wk==.
generate vol3_day = job3_day if job3_type==3
replace vol3_day=0 if vol3_day==.

** Job 4 **
label var job4_type “Job 4 type”
label values job4_type lab4
label define lab4 1 “Work” 2 “Study” 3 “Volunteering”
generate job4_wk = (q5d* q6d* q7d)/52
label var job4_wk “Job 4 mins/wk”
generate job4_day = (q5d* q6d* q7d)/365
label var job4_day “Job 4 mins/day”
generate work4_wk = job4_wk if job4_type==1
replace work4_wk=0 if work4_wk==.
generate work4_day = job4_day if job4_type==1
replace work4_day=0 if work4_day==.
generate study4_wk = job4_wk if job4_type==2
replace study4_wk=0 if study4_wk==.
generate study4_day = job4_day if job4_type==2
replace study4_day=0 if study4_day==.
generate vol4_wk = job4_wk if job4_type==3
replace vol4_wk=0 if vol4_wk==.
generate vol4_day = job4_day if job4_type==3
replace vol4_day=0 if vol4_day==.
generate work_no = 0
replace work_no = 1 if job1_type ==1 | job2_type == 1 | job3_type == 1 | job4_type == 1
label var work_no “Number of participants who work”
generate work_wk = work1_wk + work2_wk + work3_wk + work4_wk
label var work_wk “Total work mins/wk”
generate work_day = work1_day + work2_day + work3_day + work4_day
label var work_day “Total work mins/day”
generate study_no = 0
replace study_no = 1 if job1_type ==2 | job2_type == 2 | job3_type == 2 | job4_type == 2
label var study_no “Number of participants who study”
generate study_wk = study1_wk + study2_wk + study3_wk + study4_wk
label var study_wk “Total study mins/wk”
generate study_day = study1_day + study2_day + study3_day + study4_day
label var study_day “Total study mins/day”
generate vol_no = 0
replace vol_no = 1 if job1_type ==3 | job2_type == 3 | job3_type == 3 | job4_type == 3
label var vol_no “Number of participants who work”
generate vol_wk = vol1_wk + vol2_wk + vol3_wk + vol4_wk
label var vol_wk “Total volunteering mins/wk”
generate vol_day = vol1_day + vol2_day + vol3_day + vol4_day
label var vol_day “Total volunteering mins/day”
generate total_job_wk = work_wk + study_wk + vol_wk
label var total_job_wk “Total ‘job’ mins/wk”
generate total_job_day = work_day + study_day + vol_day
label var total_job_day “Total ‘job’ mins/day”

** Section 5 – Childcare and elder care **
generate childcare = (q9_wday*5+ q9_wend*2)/7
generate eldercare = (q10_wday*5+ q10_wend*2)/7
generate total_care = childcare + eldercare
label var total_care “Total care mins/day”

** Section 6 – Light leisure and relaxing **
generate TV = (q11_wday*5 + q11_wend*2)/7
generate computer = (q12_wday*5 + q12_wend*2)/7
generate screentime = TV + computer
label var screentime “Total screen time mins/day”
generate reading = (q15_wday*5 + q15_wend*2)/7
generate other = (q16_wday*5 + q16_wend*2)/7
generate total_leisure = screentime + reading + other
label var total_leisure “Total leisure time sitting mins/day”
** Total sedentary time **

\[
generate \ total\_sitting = meals + transport + total\_job\_day + total\_care + total\_leisure
\]

label var total_sitting “Total sedentary time”

** Reporting overview **

Sedentary behaviours are assessed separately for weekdays and weekends within each domain except work, study and volunteering. This response format is designed to facilitate recall. For descriptive purposes, these behaviours are also usually presented separately for weekdays and weekend days. For analytic purposes, average minutes per day are calculated for each type of sedentary behaviour.

Sedentary behaviour during work, study and volunteering is reported based on weeks per year, days per week and hours per day. Given that most individuals do not work on a daily basis, the descriptive statistics for each type of “job” (work, study or volunteering) are summarized as hours or minutes of sedentary behaviour in this domain per week. However, to allow calculation of total sedentary time, reported time in work, study and volunteering is recalculated to minutes of sedentary behaviour per day.

** Presentation of results **

It is suggested that sedentary behaviours from each SIT-Q domain except work, study and volunteering are initially described as hours or minutes per day. These descriptive data should be based only on participants who reported sedentary time in these domains, i.e. the non-zero sample.

** Reported time (minutes per day) for sedentary behaviours assessed by the SIT-Q **

<table>
<thead>
<tr>
<th>Sedentary behaviours</th>
<th>Weekday</th>
<th>Weekend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
For the work, study and volunteering domain, sedentary time should be summarized as hours per week spent in paid work, study and voluntary work. If participants report more than one type of paid job, these should be combined for reporting purposes.

**Reported sedentary time (hours per week) during work, study or volunteering**

<table>
<thead>
<tr>
<th>n</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paid employment</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td></td>
</tr>
<tr>
<td>Volunteer work</td>
<td></td>
</tr>
</tbody>
</table>

The frequency of breaks in sitting time reported for each type of “job” (work, study or volunteering) and when watching television or using a computer during leisure-time can be presented as categorical variables. If participants report more than one type of paid job, the frequency of breaks should be reported for the job that contributes the most sedentary time. The frequency of breaks can also be used as a covariate in analyses (to assess the effect of breaking up sedentary time).
Frequency of breaks in sedentary behaviours

<table>
<thead>
<tr>
<th>Less than hourly</th>
<th>Work (n = )</th>
<th>Study (n = )</th>
<th>Volunteering (n = )</th>
<th>Screen-time (n = )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hourly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Half hourly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Every 10 minutes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Every 5 minutes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None (did not sit for more than 30 minutes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total time spent in sedentary behaviour should exclude sleeping and napping (sleeping and napping should be presented separately).