

# **The Associations Between Physical Activity, Sedentary Behaviour and Anxiety in Post-Secondary Students**

by

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fulfillment of the requirements for the degree of

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## THESIS EXAMINATION INFORMATION

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### **Master of Health Science in Community Health**

Thesis title: The Associations Between Physical Activity, Sedentary Behaviour, and Anxiety in Post-Secondary Students

An oral defense of this thesis took place on November 26<sup>th</sup>, 2020 in front of the following examining committee:

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The above committee determined that the thesis is acceptable in form and content and that a satisfactory knowledge of the field covered by the thesis was demonstrated by the candidate during an oral examination. A signed copy of the Certificate of Approval is available from the School of Graduate and Postdoctoral Studies.

## ABSTRACT

**Introduction:** The prevalence of anxiety is high in post-secondary students and most do not meet recommended physical activity levels. It is hypothesized that low levels of physical activity may be associated with anxiety in post-secondary students.

**Purpose:** To determine whether physical activity and sedentary behaviour are associated with symptoms of anxiety in post-secondary students.

**Methods:** Systematic review of the literature and cross-sectional study of undergraduate students in two Faculties at UOIT.

**Results:** The systematic review provides inconclusive evidence for the association between physical activity, sedentary behaviour and anxiety. The cross-sectional study suggests that muscular strengthening is associated with anxiety in the Faculty of Health Sciences and that aerobic physical activity is associated with anxiety in the Faculty of Education. No association was found between sedentary behaviour and anxiety.

**Conclusion:** Physical activity is associated with anxiety in post-secondary students. More research is required to understand causal relationships of this association.

**Keywords:** anxiety; aerobic physical activity; muscular strength; exercise; post-secondary

## AUTHOR'S DECLARATION

I hereby declare that this thesis consists of original work of which I have authored. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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The research work in this thesis that was performed in compliance with the regulations of Research Ethics Board/Animal Care Committee under **REB Certificate number #14515**.

Michael Short

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YOUR NAME

## **STATEMENT OF CONTRIBUTIONS**

I led the systematic review of the literature presented in Chapter 2. The systematic review was performed in collaboration with researchers from the Centre for Disability Prevention and Rehabilitation. I collaborated with a Health Sciences librarian to construct the search strategy and I searched the designated databases, screened articles, critically appraised the relevant articles, synthesized the evidence, led the interpretation of the results, and wrote the paper.

I contributed to the UOIT Mental Health and Wellness Study in collaboration with researchers from the Centre for Disability Prevention and Rehabilitation. Specifically, I:

1. Assisted with recruitment of participants and administered the study questionnaire;
2. Validated and analyzed the data on the association between physical activity, sedentary behaviour and moderate to extremely severe symptoms of anxiety;
3. Interpreted the results;
4. Wrote the paper.

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## LIST OF ABBREVIATIONS AND SYMBOLS

ASSIST	Alcohol, Smoking and Substance Involvement Screening Test
DASS-21	Depression, Anxiety, and Stress Scales- 21 item
FHSc	Faculty of Health Sciences
FEEd	Faculty of Education
HFSSM	Household Food Security Survey Module
PA	Physical Activity
PASB-Q	Physical Activity and Sedentary Behaviour Questionnaire
PSQI	Pittsburgh Sleep Quality Index
SB	Sedentary Behaviour
UOIT	University of Ontario Institute of Technology

## **Chapter 1. Introduction**

### **1.1 ANXIETY**

#### ***1.1.1 What is anxiety?***

Multiple definitions of anxiety exist.<sup>1,2</sup> Therefore, when studying the epidemiology of anxiety, it is important to use a clear definition and a measurable construct. In my thesis, I define anxiety as “a state of uneasiness, a bodily response to a perceived danger that could be real or imaginary and triggered by an individual’s thoughts, beliefs, and feelings”.<sup>3</sup> This definition relates to the definition of Generalized Anxiety Disorder (GAD), “chronic excessive worry about a number of events or activities for at least six months, and the worry must be experienced as difficult to control.”<sup>1,4,5</sup> GAD is one of the most common forms of the anxiety disorders and as much as 20% of adults experience symptoms of anxiety resembling GAD each year.<sup>6</sup>

Although I rely on the construct of anxiety as expressed in GAD, my thesis does not focus on the diagnosis of GAD.<sup>4</sup> Rather, I am interested in the broader experience of anxiety as expressed through symptoms experienced by post-secondary students.

#### ***1.1.2 The burden of anxiety symptoms in the general population***

According to the 2012 Canadian Community Health Survey, Mental Health (CCHS-MH), the lifetime prevalence of GAD was 8.7% (95%C.I.: 8.2,9.3) while the 12-month prevalence of GAD was 2.6% (95%C.I.: 2.3,2.8) in Canadians over the age of 15 years.<sup>5</sup> It has been estimated that approximately 700,000 Canadians over the age of 15 years were affected by symptoms that were comparable to GAD in 2012.<sup>4</sup> However, these prevalence estimates likely underestimate the burden related to anxiety in the general population because they rely on a diagnosis of GAD.<sup>4</sup>

Therefore, measuring the prevalence of symptoms of anxiety may be useful to capture the full impact of anxiety in the population.

### ***1.1.3 The burden of anxiety symptoms in post-secondary students***

The available evidence suggests that the prevalence of anxiety may be higher in post-secondary students than in the general population.<sup>4,5,7</sup> A 2016 health survey of post-secondary institutions in Canada found that 64.5% of students reported some form of anxiety in the past year.<sup>7</sup> The same survey, repeated in 2019, noticed that the proportion of students reporting overwhelming anxiety increased to 68.9% in 2019.<sup>8</sup> This survey found that 13% of students studying at the University of Ontario Institute of Technology in 2016 reported experiencing overwhelming anxiety in the last 30 days, yet additional school specific data for the University of Ontario Institute of Technology was not provided for 2019.<sup>7</sup>

Similarly, a study at a mid-western Canadian university reported that 39% of nursing students identified experiencing some form of attenuating anxiety over the previous week.<sup>9</sup> Furthermore, it has been reported that the biweekly prevalence of anxiety in students sampled in a post-secondary school in Pakistan was 70%.<sup>10</sup> In a sample of medical students studying in India, it was found that 66.9% of students were experiencing a form of anxiety.<sup>11</sup> Similar findings were also reported in students studying in the United States, Norway, and the United Kingdom.<sup>12,13,14</sup> These statistics suggest that anxiety is endemic in post-secondary students.

### ***1.1.4 Impact of anxiety on post-secondary students***

Students experiencing anxiety levels beyond healthy levels can be negatively affected by it.<sup>16</sup> For example, Bruffaerts et al. found that students who reported problems with anxiety were more likely to experience a decrease in academic performance, observable in their GPA.<sup>16</sup> Students who experience anxiety may also be more likely to engage in academic dishonesty, which may

lead to further academic difficulties and possible expulsion from their academic institution.<sup>17</sup> Furthermore, it was reported that students experiencing mental health disorders, including anxiety, were twice as likely to drop out of university when compared to their peers with adequate mental health.<sup>16</sup> Finally, symptoms of anxiety are associated with substance and alcohol abuse in post-secondary students.<sup>17</sup> This is a significant health concern because substance and alcohol abuse may lead to worsening symptoms of anxiety.<sup>18,19</sup>

#### ***1.1.5 Possible risk factors for anxiety in post-secondary students***

Post-secondary students live in unique environments that may make them susceptible for increased levels of anxiety. The students may no longer be living at home and are put in a new setting in which they are unfamiliar with their new peers and professors. The students must navigate their new environment independently, now responsible for their own self-care. These environments and social settings bring new financial and academic pressures, changes in sleep patterns and poor sleep quality, and the need to create new interpersonal relationships.<sup>15</sup>

Several risk factors for the development of anxiety symptoms in post-secondary students have been proposed. A study of American adults (including post-secondary students) suggests smoking, heavy drinking, frequent sleep inefficiency, younger age, physical inactivity, and recurrent pain may be risk factors for frequent anxiety symptoms.<sup>19</sup>

An association between sleep quality and symptoms of anxiety in post-secondary students has also been reported.<sup>20,21</sup> Specifically, a 2012 study of Ethiopian students found that moderate to extremely severe levels of anxiety were associated with poor sleep quality.<sup>21</sup> Similarly, a study of Estonian medical students reported an association between heightened anxiety and lower sleep quality in female students but not males.<sup>20</sup>

Another potential risk factor for anxiety in this population is substance use. Behaviours such as binge-drinking and cannabis use have become synonymous with the post-secondary social culture.<sup>18,22,23</sup> A study using data from the American College Health Assessment 2016 Survey reported that 69.3% of Canadian post-secondary students used alcohol in the last 30 days, 17.9% of students used cannabis in the last 30 days, and 11% of students were considered to be smokers.<sup>23</sup> In this study, an association was found between alcohol and reported anxiety, but not with tobacco or cannabis use.<sup>23</sup>

Food insecurity and low back pain have also been hypothesized as risk factors that may contribute to the development of symptoms of anxiety in post-secondary students. A longitudinal study of college and university students in the United States found that 29% of students were food insecure in the last year and that this food insecurity was associated with increased anxiety.<sup>24</sup> Finally, one study of 8664 students in China reported that 26.6% of post-secondary students experienced chronic low back pain in the previous three months and that this was associated with anxiety.<sup>25</sup>

Two additional possible risk factors for anxiety in post-secondary students are physical activity and sedentary behaviours.<sup>26</sup> These factors are the focus of my thesis and are discussed in detail below.

## **1.2 PHYSICAL ACTIVITY**

Physical activity is defined as, “any bodily movement produced by skeletal muscles that require energy expenditure.”<sup>27</sup> The Canadian Physical Activity Guidelines provides specific recommendations for moderate-to-vigorous aerobic physical activity (MVPA), and for muscular strengthening. In Canada, it is recommended that adults (aged 18 to 64 years of age) perform at least 150 minutes of MVPA per week and perform muscular strengthening at least two days or

more per week.<sup>28</sup> However, Canadians of all ages have difficulty meeting the recommended physical activity levels.<sup>29,30</sup> A 2013 study reported that 68% of Canadians between the ages of 18 to 39 years of age had insufficient physical activity according to these guidelines.<sup>30</sup> The failure to meet the Canadian Physical Activity Guidelines is also common in post-secondary students. The available evidence suggests that only 50-65% of postsecondary students meet the recommended levels of physical activity.<sup>31,32</sup> In 2016, 66% of students surveyed at the University of Ontario Institute of Technology did not meet the Canadian Physical Activity Guidelines.<sup>7</sup>

It has been hypothesized that physical activity is associated with anxiety,<sup>29,33,34,35,36,37</sup> and that physical activity may be an effective intervention for many mental health problems, including depression and anxiety.<sup>29</sup> In a randomized controlled trial of post-secondary students from Turkey, those randomized to three aerobic exercise classes per week for ten weeks reported less trait anxiety than their peers in a control group who participated in lectures on physical activity.<sup>34</sup> In a cross-sectional study of 22,073 post-secondary female students, a weak negative association was found between low levels of moderate-to-vigorous physical activity and high levels of student anxiety.<sup>33</sup> In the same study, an association was found between low amounts of strength training and higher levels of student anxiety.<sup>33</sup>

Mechanisms have been proposed to explain the association between physical activity and symptoms of anxiety. One theory states that physical activity acts as a psychosocial buffer for experiencing adverse symptoms of anxiety.<sup>29</sup> This theory suggests that physical activity provides social support, elicits a feeling of achievement, and increases confidence and self-esteem.<sup>29</sup> Furthermore, it is hypothesized that physical activity may reduce anxiety through the distraction method.<sup>35</sup> The distraction method states that by participating in physical activity, one is able to distance from stressful stimuli, therefore leading to a reduction in anxiety.<sup>35</sup> Proposed



physiological mechanisms for the protective effects of physical activity towards symptoms of anxiety include elevating body temperature, which in turn provides a therapeutic effect, as well as the release of neurochemicals such as serotonin and brain-derived neurotrophic factor (BDNF), which have been shown to reduce anxiety.<sup>35</sup> Therefore, both physiological and psychological mechanisms may help explain the benefits of physical activity on anxiety.

### **1.3 SEDENTARY BEHAVIOUR**

A sedentary behaviour is defined as any waking behaviour characterized by an energy expenditure less than or equal to 1.5 metabolic equivalents (1 MET = 1kcal/kg/hour)

<sup>a</sup>, while in a sitting, reclining, or lying posture.<sup>28</sup> Examples of sedentary behaviour includes sitting in front of a computer or watching television (screen time).<sup>27,28</sup>

Sedentary behaviour is a growing problem among Canadians. In the 2012 Canadian Community Health Survey (CCHS), over 60% of adults reported more than two hours per day of total screen time, with young adults reporting the highest amount of screen time, with greater than 5 hours of screen time per week.<sup>39</sup> Furthermore, 28% of adults (particularly young adults) reported a total sedentary time of more than five hours per day. Another important concern is that total leisure screen time has been increasing among Canadians.<sup>38</sup> For example, the proportion of Canadian young adults reporting the use of leisure computer time has increased from 5% in 1998 to 24% in 2010.<sup>38</sup> This trend has continued, with 44% of adults reporting greater than 5 hours per week of computer use, with 31% of Canadian adults reporting greater than 2 hours per day of leisure computer use from 2007 to 2012.<sup>39</sup>

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<sup>a</sup> One MET is the energy required to sit quietly<sup>27,28</sup>

Sedentary behaviour in the form of screen time was found to be positively associated with student anxiety. In a cross-sectional study of 4915 college students from China, high screen time increased the likelihood of reporting symptoms of anxiety by 49%.<sup>47</sup> Furthermore, it is plausible that the association between sedentary behaviour and student anxiety can influence the association between physical activity and student anxiety.<sup>47</sup> For example, students with low physical activity and low screen time may be 30% less likely to report symptoms of anxiety than their peers who were also in the low physical activity group but were experiencing high screen times.<sup>47</sup>

Sedentary lifestyles are prevalent among post-secondary students.<sup>42</sup> In their systematic review, Moulin, Truelove, Burke, and Irwin reported that post-secondary students from across the world have an average screen time (11.1 hours/day) similar to that of white-collar workers, and that this puts post-secondary students at risk for chronic diseases such as cardiovascular disease and Type 2 diabetes.<sup>40</sup> Comparatively, the average screen time reported by Canadian students was 11.72 hours/day.<sup>40</sup>

While few studies have investigated the prevalence of sedentary behaviour among post-secondary students, two studies reported high prevalence of daily screen time. One study reported that 72.7% of post-secondary students in China spend more than two hours of screen time per day<sup>36</sup> while the second study reported that 86.2% of post-secondary students in Sichuan, China had more than four hours per day of screen time.<sup>37</sup> However, it is important to remember that sedentary time reported by students may be attributed to time spent in class and studying.<sup>42</sup>

Sedentary behaviour has been hypothesized to be associated with poor mental health, including anxiety.<sup>29,40,43</sup> Specifically, the social isolation experienced during sedentary time may be the mechanism that leads to increased anxiety.<sup>44</sup> Another mechanism proposed to explain the association between sedentary behaviour and anxiety is the lack of brain stimulation during screen

watching activities (i.e. television watching and social media consumption), which leads to reduced neuroplasticity in the primary motor cortex and a reduction in cerebral blood flow.<sup>43</sup> This subsequently leads to reduced cognitive performance and poorer mental health.<sup>43</sup>

Other proposed mechanisms point to increased stimulation of the central nervous system, leading to increased arousal and anxiety.<sup>45</sup> For example, physiological responses to video game playing have shown similar physiological responses to exercise, such as increased heart rate and blood pressure without increases in metabolic variables of exercise, such as VO<sub>2</sub>max.<sup>46</sup> This suggests that while the CNS is aroused in a similar fight-or-flight response as seen in exercise, the benefits do not increase with video game playing and may in fact increase arousal, and potentially anxiety.<sup>46</sup>

Finally, a relevant mechanism which may apply to students is the displacement theory.<sup>43,45</sup> According to the displacement theory, sedentary activities such as media consumption, displace the engagement from protective activities such as adequate physical activity and proper sleep to sedentary behaviour and inadequate sleep duration or poor sleep quality which leads to an increased risk of anxiety.<sup>43,45</sup> This theory proposes that the post-secondary student has less time available for healthy behaviours (e.g., physical activity or adequate sleep) because of time being spent engaged in sedentary behaviours (e.g., social media, playing video games, leisure computer time, or T.V. watching).<sup>43,45</sup>

#### **1.4 THE NEED FOR FURTHER RESEARCH ON THE ASSOCIATIONS BETWEEN PHYSICAL ACTIVITY, SEDENTARY BEHAVIOUR AND SYMPTOMS OF ANXIETY**

It is important to determine whether physical activity and sedentary behaviour are associated with anxiety to formulate evidence-based etiological hypotheses of the role of these modifiable risk factors on mental health. While the current literature has investigated the possible

role of overall levels of physical activity, it is also necessary to investigate the possible role of more specific measures of physical activity such as moderate-to-vigorous aerobic activity, strength training and sedentary behaviour because they may have different associations with symptoms of anxiety. To my knowledge, no study has investigated the associations between different types of physical activity and symptoms of anxiety in post-secondary students. Moreover, the literature currently lacks a systematic review investigating the association between physical activity, sedentary behaviour and symptoms of anxiety in post-secondary students. Furthermore, there is a dearth of studies investigating the association between physical activity, sedentary behaviour, and symptoms of anxiety in post-secondary students in Canada.

My thesis addresses these gaps by including measures of different forms of physical activity and sedentary behaviour and investigates their associations with symptoms of anxiety in a sample of post-secondary students at the University of Ontario Institute of Technology (UOIT).

## **1.5 OBJECTIVES**

My thesis aimed to:

1. Conduct a systematic review of the literature investigating the associations between physical activity, sedentary behaviour and symptoms of anxiety in post-secondary students; and
2. Investigate the associations between physical activity, sedentary behaviour and symptoms of anxiety in post-secondary students enrolled in the Faculty of Health Sciences and Faculty of Education at the University of Ontario Institute of Technology in the Fall 2017 semester.

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## Chapter 2. Systematic Review of the Literature

***Title: Physical Activity, Sedentary Behaviour, and Symptoms of Anxiety in Post-Secondary Students: A Systematic Review***

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## 2.1 ABSTRACT

**Introduction:** Symptoms of anxiety are endemic in the post-secondary student population. While it is normal for students to experience anxiety, high levels of anxiety can be detrimental to their health. Yet, little is known about the etiology of high levels of anxiety in this population. It is hypothesized that physical activity and sedentary behaviour may be associated with anxiety in post-secondary students. Therefore, I conducted a systematic review of the literature to synthesize the evidence of factors of physical activity and sedentary behaviour associated with anxiety in post-secondary students.

**Methods:** I systematically searched Medline, CINAHL, and PsychInfo from January 2000 to September 2018. Cross-sectional studies, cohort studies, and randomized controlled trials were eligible for inclusion. All relevant papers were critically appraised by independent reviewers for their internal validity. I synthesized the evidence from low and moderate risk of bias studies using the best evidence synthesis principles.

**Results:** I retrieved 826 articles. After excluding 354 duplicates, I screened the eligibility of 472 articles. Of those, 13 were critically appraised and seven articles were of low (n=3) and moderate (n=4) risk of bias. Two cross-sectional studies found associations between physical activity, sedentary behaviour and symptoms of anxiety, while one cross-sectional study did not find any association between physical activity and symptoms of anxiety. Two cross-sectional studies found weak negative correlations between physical activity and anxiety scores, while one cross-sectional study found a weak positive correlation between physical activity and symptoms of anxiety. One randomized controlled study found no statistical difference between a session of yoga versus a quiet rest session and their associations with anxiety. Overall, the evidence is inconclusive as to

whether there is an association between physical activity, sedentary behaviour, and symptoms of anxiety in post-secondary students.

**Conclusion:** It is unclear if there is an association between physical activity, sedentary behaviour and symptoms of anxiety in post-secondary students. Preliminary research suggests that a combination of physical activity and sedentary behaviour may also be associated with symptoms of anxiety in this population. However, with only weak correlations found in the majority of the research, unsubstantial evidence exists whether this association exists among post-secondary students. Physical activity and sedentary behaviour are two modifiable risk factors that may help prevent or mitigate the symptoms of anxiety, therefore, more research is required to understand the association between physical activity, sedentary behaviour, and symptoms of anxiety in post-secondary students.

**Keywords:** *Physical activity, sedentary behaviour, post-secondary students, undergraduate students, anxiety*

## 2.2 BACKGROUND

High levels of anxiety are a growing problem among post-secondary students in Canada. In fact, most Canadian undergraduate students experience overwhelming anxiety during the academic year.<sup>1,2</sup> It has been shown in a cross-sectional study analyzing data from 21 different countries, that anxiety disorders were the most prevalent mental health disorders among college and university students.<sup>3</sup> Furthermore, little is understood about modifiable risk factors and symptoms of anxiety in post-secondary students.<sup>4</sup> With the knowledge that mental health issues may be associated with decreased future professional success, it is paramount that the post-secondary student population be studied in order to understand protective measures for anxiety.<sup>5</sup> Previous cross-sectional studies suggest that physical activity, sedentary behaviour and anxiety symptoms may be associated in post-secondary students.<sup>6,7</sup> Specifically, Thome and Espelage reported that students who coped with anxiety through exercise were less anxious than their peers.<sup>7</sup> However, this study did not report an association between general exercise and anxiety. A study by Hawker reported that physical activity and mental well-being (which included anxiety) are positively associated among nursing students.<sup>6</sup> Together, these studies indicate that it is possible that a lack of physical activity and an increase in sedentary behaviour is associated with the increase in anxiety.

Several physiological and psychological mechanisms that may explain an association between physical activity, sedentary behaviour, and symptoms of anxiety have been proposed. First, the thermogenic model hypothesizes that a potential therapeutic effect may be felt when body temperature is elevated through activities such as physical activity.<sup>8</sup> The authors of this model concede that it is not understood why the elevation of body temperature induces therapeutic effects and suggest more research be undertaken to grant a better understanding of this model.<sup>8</sup> Second,

the visceral-afferent feedback model states that physical activity may increase stimulation of the ascending reticular activating system. With enough excitation through physical activity or exercise, an inhibitory effect may be triggered, which can lead to a reduction in anxiety.<sup>8</sup> Other physiological mechanisms include an increase of serotonin sensitivity and the release of endogenous opioids which are associated with physical activity participation and an increase in brain-derived neurotrophic factor (BDNF). An increase in BDNF may explain why increased physical activity can lead to a reduction in anxiety.<sup>9</sup>

Psychological models can also help unpack the association between physical activity and anxiety. Specifically, the distraction method, which states that by participating in physical activity, you may be distracting yourself from stressful stimuli leading to less stress and anxiety.<sup>8</sup> The facilitation of social interaction in some physical activities may also explain the negative association between physical activity and symptoms of anxiety.<sup>9</sup> The inverse can be said of sedentary behaviour, which facilitates social isolation.<sup>9</sup>

Similarly, there are suggested mechanisms used to hypothesize an association between sedentary behaviour and symptoms of anxiety. One such mechanism is that screen-based sedentary behaviour may increase the arousal of the central nervous system (CNS).<sup>7</sup> A second mechanism states that screen-based sedentary behaviour may also disrupt otherwise healthy sleep patterns. In turn, these altered sleep patterns may lead to an increased level of anxiety.<sup>7</sup> Similar findings have been found when investigating other mental health conditions, therefore, this association may be seen between physical activity, sedentary behaviour, and anxiety.<sup>6,8,10</sup>

Data on student lifestyles are helpful in hypothesizing an association between physical activity, sedentary behaviour and moderate to extremely severe symptoms of anxiety. Most post-secondary students do not meet the recommended guidelines for physical activity of at least 150



minutes of moderate-to-vigorous aerobic physical activity per week and at least two events of muscular strengthening per week.<sup>11,12,13</sup> In transitioning to post-secondary studies, students may experience unique lifestyle changes that can negatively affect their mental health state, such as reduced sleep quality, increased independence with reduced family support, and increased sedentary behaviour. Reasons for these lifestyle changes may be attributable to an increase in perceived pressure for post-secondary students to perform academically and create new social circles, therefore reducing the amount of time they may choose to invest in physical activity and proper sleep.<sup>14</sup>

To my knowledge, no systematic review has synthesized the evidence on the association between physical activity, sedentary behaviour, and anxiety in post-secondary students. Previous systematic reviews in adults reported a negative association of physical activity and anxiety symptoms and a positive association between sedentary behaviour and anxiety.<sup>13,15</sup> However, these findings may not be generalizable to the post-secondary student population due to differences in environment, working hours, and unique lifestyle adaptations present in the post-secondary setting.<sup>13</sup>

Therefore, the purpose of my systematic review was to synthesize the literature on the association between physical activity, sedentary behaviour, and anxiety in post-secondary students.

## **2.3 METHODS**

I conducted a systematic review of the literature. I followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology to report my systematic review.

**Definitions:**

Physical activity: any bodily movement requiring energy expenditure that is produced by skeletal muscles.<sup>16</sup>

Sedentary behaviour: activities requiring minimal amounts of movement which result in a low level of energy expenditure that is similar to a resting level energy expenditure (1.0-1.5 metabolic equivalents [METs]).<sup>7</sup>

Anxiety: a state of excessive and persistent uneasiness to a perceived danger that could be real or imaginary that may inhibit an individual's ability to perform activities of daily living.<sup>7,17</sup>

**Eligibility Criteria:**

Eligible articles met the following inclusion criteria: 1) published in English in peer-reviewed journals; 2) study sample was a post-secondary student population; 3) randomized control trials, cohort studies, case-control studies, or cross-sectional studies; 4) studies published between January 2000 to October 2018.

Studies were ineligible if they were letters, editorials, conference abstracts, pilot studies, or book chapters. Studies investigating Social Physique Anxiety were also excluded due to their specific relationship with exercise.

**Search of the Literature**

I searched MEDLINE, CINAHL, and PsychINFO. The search strategy was created in collaboration with a health science librarian. This search strategy was implemented in MEDLINE and was then adapted for use in CINAHL and PsychINFO. The following terms were used in the development of the search strategy: undergraduate students, postsecondary students, anxiety,

physical activity, exercise, sedentary behaviour, college students, sport participation, sedentary behaviour, sitting time, and screen time. EndNote was used to record the number of duplicates and exclude these articles. The search strategy is documented in Appendix A.

### **Study Selection**

Studies were screened in a two-phase process by two independent reviewers. In the first phase, titles and abstracts were screened by two reviewers and classified as relevant, possibly relevant, or irrelevant. In the second phase of screening, the full text of the possibly relevant articles was reviewed to ensure that a paper met the inclusion criteria. If disagreement for inclusion occurred, a third reviewer reviewed the paper and ruled on the eligibility of the paper.

### **Methodology Quality Assessment**

Eligible studies were critically appraised using the Hoy tool.<sup>18</sup> The appropriate SIGN tool was used to critically appraise randomized controlled trials. Critical appraisal was performed to assess each study to evaluate the internal validity of studies by focusing on selection bias, measurement bias and confounding. An overall risk of bias was then determined based on the assessment of internal validity and classified as low-, moderate- or high-risk of bias. This was performed independently by pairs of trained reviewers.

### **Data Collection and Synthesis**

The following data were extracted from the low and moderate risk of bias studies: age of participants, the year of study of the students, the program of study, geographical location of the study, the time of year when the study took place and the measures of associations between physical activity, sedentary behaviour, and anxiety. These statistics include the mean and standard

deviation, correlation coefficients, odds ratios, prevalence ratios, relative risk, confidence intervals (CI) and p-values when statistical tests were conducted.

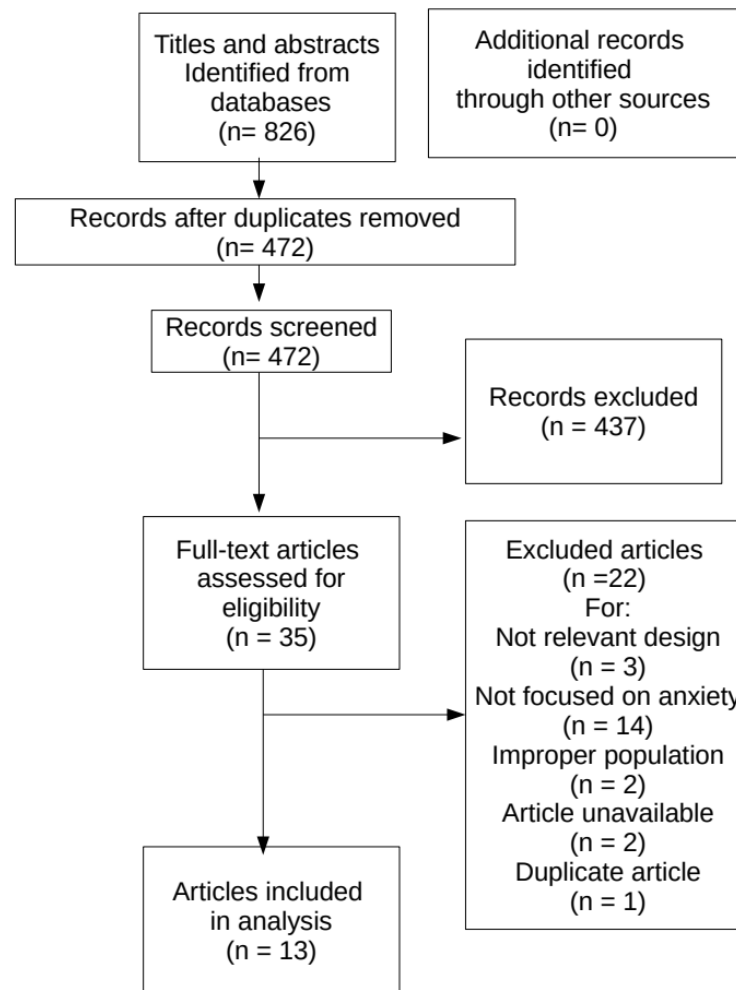
Meta-analysis was not performed as the samples in each of the studies included were different in regard to geographical location, the academic faculty from which the sample was drawn, and in some studies, gender.

## **2.4 RESULTS**

### **Search Results**

I retrieved 826 articles from the MEDLINE, CINAHL, and PsychINFO databases. Of the 826 articles screened, 354 duplicate articles were removed. The remaining 472 articles were screened for eligibility. Of those, 35 articles were selected for full text screening. After full text screening, the number of articles selected for critical appraisal was reduced to 13. The primary reasons for exclusion of an article included the use of: 1.) a general measure of student mental health rather than a measure of anxiety (n=14); 2.) an improper or absent measure of physical activity and/or sedentary behaviour (such as measuring biometrics versus time spent performing physical activity) (n=3); or 3.) an ineligible population (i.e. middle-school students) (n=2).

**Figure 2.1:** Database Search and Stage 1 and 2 Screening Results



### Characteristics of Included Studies
















Thirteen articles were critically appraised. Of those, three had low risk of bias<sup>1,19,20</sup> and four articles were found to have moderate risk of bias.<sup>6,10,21,22</sup> Six articles were deemed to have a high risk of bias.<sup>14,23,24,25,26,27</sup> Of the articles with low risk of bias, one was a randomized controlled trial<sup>1</sup> while two articles were cross-sectional studies.<sup>19,20</sup> All three studies provided clear and concise research questions. All low risk of bias studies used valid and reliable tools to collect data

and used appropriate sampling methods. The four moderate risk of bias articles were cross-sectional studies.<sup>6,10,21,22</sup> (Table 2.1)

The six high risk of bias articles had low response rates,<sup>14,24</sup> did not report using a valid and reliable instrument to measure physical activity,<sup>23,24,25</sup> failed to provide an adequate sample or description of the sample studies,<sup>23,27</sup> and failed to include physical activity in the analysis.<sup>26</sup> Furthermore, one study also failed to provide acceptable case definitions for physical activity and sedentary behaviour.<sup>24</sup>

My synthesis included six cross-sectional studies<sup>6,10,19,20,21,22</sup> and one randomized control trial.<sup>1</sup> These studies were conducted in China, Canada, the United Kingdom, and the United States. Only one study focused exclusively on female post-secondary students,<sup>1</sup> with the remainder including both males and females. Sample sizes of these studies ranged from 56 to 4747 participants.

**Table 2.1:** Consensus Results for Risk of Bias of Included Articles

Authors, Year	Sampling Population	Random Selection	Non-response bias minimal	Case Definition/ Clear Research	Valid and reliable instruments	Data Collection	Length of Prevalence Period	Equation used for parameter of interest	Overall
Wu, Tao, Zhang, Zhang, and Tao, 2014									Low
Dore, O'Loughlin, Beauchamp, Martineau and Fournier 2016								N/A	Low

Albracht-Schulte and McComb, 2018	■	■	■	■	■	■	■	N/A	Low
Feng, Zhang, Du, and He, 2014	■	■	■	■	■	■	■	■	Moderate
Thome and Espelage, 2004	■	■	■	■	■	■	■	■	Moderate
Hawker, 2012	■	■	■	■	■	■	■	■	Moderate due to convenience sampling
Zeng, Wang, Xie, Hu, and Reinhardt, 2019	■	■	■	■	■	■	■	■	Moderate

■ = low, ■ = moderate, ■ = high

## 2.5 SUMMARY OF EVIDENCE

### 2.5.1 Cross-sectional Studies

#### 2.5.1.1 Low Risk of Bias Studies

One cross-sectional study investigated 4747 college students (97.7% participation from Anhui Medical University in central China) (Table 2.2). The mean age of the participants was  $19.2 \pm 1.4$  years of age, with 58.4% of the sample being female. Physical activity was measured with the Physical Activity Rank Scale from the Youth Risk Behaviour Survey. Screen time was assessed using a single question which measured whether students had more than two hours of screen time per day. Symptoms of anxiety were measured using the Self-rating Anxiety Scale.<sup>20</sup> The one-week prevalence of low physical activity was 92.3%, while daily prevalence of high screen time (greater than 2 hours/day) was 20.8%. The one-week prevalence of anxiety was 16.3%

in this sample. The authors found that screen time in excess of 2 hours was associated with symptoms of anxiety (OR= 1.49, 95%CI: 1.24;1.79). The authors found no association between physical activity and symptoms of anxiety (OR: 0.86, 95%CI: 0.63;1.16). However, when comparing students with low screen time and low physical activity to students with high screen time and low physical activity, it was found that, students with the low screen times and low physical activity were less likely to report symptoms of anxiety (OR=0.66,95%CI: 0.55;0.79). When the same comparison was made between students with high screen time and low physical activity to students with high screen time and high physical activity, the authors found no association (OR: 0.66, 95%CI: 0.31;1.37). Lastly, compared to their peers with low physical activity and high screen time, students who had low screen time and high levels of physical activity were less likely to report symptoms of anxiety (OR:0.61, 95%CI: 0.43;0.88).<sup>20</sup>

Another cross-sectional study investigated the association between physical activity and symptoms of anxiety in 1527 post-secondary students (87.5% participation rate) studying in Quebec, Canada. (Table 2.2). The mean age of participants was 18.4±2.4 years of age and 58% of the sample was female (Table 2.2). The Physical Activity Godin-Shephard Leisure-Time Physical Activity Questionnaire was used to measure physical activity, while the Hospital Anxiety and Depression Scale (HADS) gauged symptoms of anxiety. 95% of the sample reported to be physically active. The authors found no correlation between total physical activity and HADS scoring for anxiety ( $\beta$  coefficient = - 0.005, 95%CI: -0.014;0.003).<sup>19</sup> A weak correlation was found between moderate-to-vigorous physical activity and HADS scoring for anxiety ( $\beta$  coefficient = - 0.011, 95% CI:-0.020; -0.001).<sup>19</sup>

#### 2.5.1.2. Moderate Risk of Bias



The third cross-sectional study sampled 1106 Chinese post-secondary students. The mean age of participants was  $18.9 \pm 0.9$  years of age, with 42.6% of the sample being female. Physical activity and screen time were both measured using single questions (Table 2.3). The findings illustrated 81.6% of the students sampled were physically inactive in a week and 72.7% of students reported high levels of daily screen time (above 2 hours per day) (Table 2.2). Anxiety was measured using the Self-rating Anxiety Scale (Table 2.3) and 7.6% of the sample reported weekly anxiety (Table 2.2). The authors found no association between physical activity and symptoms of anxiety (OR: 0.61, 95%CI: 0.31;1.20).<sup>10</sup> The authors also compared varying levels of physical activity and sedentary behaviour in combination to investigate the synergistic association with symptoms of anxieties and reported no association between levels of physical activity and sedentary behaviour and anxiety.<sup>10</sup>

The study by Thome and Espelage<sup>21</sup> included 324 participants with a mean age of  $19.9 \pm 2.7$  years of age. Physical activity, measured by the Godin Leisure-Time Exercise Question, was weakly correlated with anxiety as measured by the State-Trait Anxiety Inventory ( $r = -0.08$ ,  $p = 0.05$ ). (Table 2.3) The authors also found that the correlation between physical activity and state anxiety was stronger in males ( $r = -0.27$ ,  $p < 0.05$ ) than for females ( $r = -0.01$ ,  $p = 0.05$ ). (Table 2.3)

The fifth cross-sectional study included 215 first and third year nursing students enrolled in the School of Nursing and Midwifery studies at Cardiff University in the United Kingdom.<sup>6</sup> The sample primarily included females (93.4%) with a mean age of  $27.3 \pm 8.8$  years of age. The International Physical Activity Questionnaire (IPAQ) was used to measure physical activity and the HADS to measure anxiety. 23.8% of the sample was found to be meeting physical activity recommendations (Table 2.2). Weak correlations were found between physical activity and anxiety with the strongest correlation found between total METS (metabolic equivalents; a measure of

energy expenditure of a physical activity) and anxiety ( $r = 0.07$ ,  $p = 0.390$ ).<sup>6</sup> Other weak correlations were reported between moderate METS and anxiety ( $r = -0.03$ ,  $p = 0.984$ ) and walking METS and anxiety ( $r = 0.06$ ,  $p = 0.415$ ). No correlation was found between vigorous METS and anxiety ( $r = 0.00$ ,  $p = 0.984$ ).<sup>6</sup>

In the final cross-sectional study, 544 Chinese post-secondary students were sampled. The mean age of participants was  $20.2 \pm 1.2$  years of age, with 97.4% of the sample female. Students were asked to report daily screen time equal to or in excess of 4 hours and regular physical activity. Physical activity was categorized as active or inactive (Table 2.3). 71.7% of participants reported that they were physically inactive and 86.2% of participants reported having more than 4 hours of screen time a day. (Table 2.2) The DASS-21 was used to measure anxiety in the sample (Table 2.3). 41.7% of students reported anxiety (Table 2.2).<sup>22</sup> Crude analysis showed that students with screen time greater than or equal to 4 hours were more likely to report symptoms of anxiety than their peers who had less than 4 hours of screen time (OR: 1.74, 95%CI: 1.03;2.94).<sup>22</sup> Similarly, crude analysis showed that students who did not exercise regularly were more likely to report symptoms of anxiety than their active peers (OR: 1.60, 95%CI: 1.04;2.46). After adjusting for confounders, the study found a statistically significant association between physical inactivity and symptoms of anxiety (OR: 5.38, 95%CI: 3.33;8.70).<sup>22</sup>

#### 2.5.1.3 Summary of Evidence from Cross-Sectional Studies:

Two cross-sectional studies reported associations between physical activity, sedentary behaviour and symptoms of anxiety.<sup>20,22</sup> Of the two studies, one study reported an association between the lack of physical activity and symptoms of anxiety (OR:5.38, 95%CI: 3.33;8.70).<sup>22</sup> The other study reported an association between a combination of high physical activity and low screen time and symptoms of anxiety (OR:0.61, 95%CI: 0.43;0.88).<sup>20</sup> Both studies reported

associations between screen time and symptoms of anxiety, with screen time greater than two hours a day being associated with an increased likelihood of reporting symptoms of anxiety.<sup>20,22</sup> One cross-sectional study found no associations between physical activity, sedentary behaviour and symptoms of anxiety.<sup>10</sup>

The three other cross-sectional studies reported weak correlations between physical activity and anxiety scores.<sup>6,19,21</sup> No correlations regarding sedentary behaviour and anxiety were reported. Two studies reported weak inverse correlations between physical activity and anxiety scores,<sup>19,21</sup> while one study reported weak positive correlations between physical activity and anxiety scores.<sup>6</sup>

### **2.5.2 Randomized Controlled Trials**

One randomized controlled trial investigated the effect of a yoga session on state anxiety of 40 female students at an American college. (Table 2.2) This study was a cross-over randomized control in which two randomized groups engaged in a 30-minute yoga session followed by a 30-minute quiet rest on two different days. One group participated in the yoga session first while the other group performed quiet rest. The groups then switched activities for the next session. The Spielberger's Trait Anxiety Inventory was used to assess participant state anxiety. A statistically significant decrease in mean state anxiety was observed ( $p=0.001$ , 95%CI: 2.71,7.09) for the yoga and rest sessions between baseline ( $33.5\pm1.1$ ) and post-condition ( $28.6\pm0.84$ ). That is, yoga and quiet rest were observed to reduce scores of mean state anxiety. However, no difference in state anxiety was found between the participation in yoga or participation in quiet rest.<sup>1</sup>

## 2.6 DISCUSSION

Seven articles were included in my systematic review. Of the seven articles, six articles were cross-sectional studies. Two cross-sectional studies reported associations between physical activity, sedentary behaviour, and anxiety,<sup>20,22</sup> while three cross-sectional studies reported weak correlations between physical activity and anxiety scores.<sup>6,19,21</sup> One cross sectional study found no association between physical activity, sedentary behaviour and symptoms of anxiety.<sup>10</sup> The randomized controlled trial found that both yoga and quiet rest reduced anxiety scores, however, there was no significant difference between the two interventions on anxiety scores.<sup>1</sup>

Furthermore, three studies reported correlations between physical activity and anxiety scores.<sup>6,19,21</sup> Of the three studies, two studies reported a weak negative correlation between physical activity and anxiety scores, while one study reported a weak positive correlation between physical activity scores. Therefore, while it is apparent that there may be some association between physical activity and anxiety, it cannot be distinguished whether this association is one of statistical or clinical significance. Furthermore, with the differing methodologies and conflicting results of the cross-sectional studies it is difficult to conclude whether an association between physical activity and symptoms of anxiety truly exists.

**Table 2.2:** Sample characteristics of included studies

<b>Author</b>	<b>Sample Size</b>	<b>Mean Age</b>	<b>Gender</b>	<b>Physical Activity</b>	<b>Sedentary Behaviour</b>	<b>Anxiety</b>
Wu, X., Tao, S., Zhang, Y., Zhang, S., and Tao, F. China, 2014	4747 participants (97.7% participation rate)	19.2 ±1.4 years	58.4% female	92.3% reported low physical activity	79.2% reported low screen time	16.3% reported anxiety
Dore, I., O'Loughlin, J., Beauchamp, G., Martineau, M., and Fournier, L. Canada, 2016	1527 participants (87.4% participation rate)	18.4±2.4 years	58.0% female	95% reported being physically active at least once/week	N/A	N/A
Albracht-Schulte, K., and Robert-McComb, J. United States, 2018	56 participants 16 participants dropped out (28%)	20.1±1.9 years	100% female	N/A	N/A	N/A
Feng, Q., Zhang, Q., Du, Y., Ye, Y., and He, Q. China, 2014	1106 participants (92.2% participation rate)	18.9±0.9 years	42.6% female	81.6% reported low physical activity	72.7% reported high screen time	7.6% reported anxiety
Thome, J., and Espelage, D. United States, 2004	324 participants (No response rate reported)	19.9±2.7 years	72.5% female	Not reported	Not reported	Not reported
Hawker, C. United Kingdom, 2012	215 participants (79% participation rate)	27.3±8.8 years	93.4% female	23.8% reportedly meeting DoH guidelines	N/A	Average score on question 8.4±3.1
Zeng, Y., Wang, G., Xie, C., Hu, X., and Reinhardt, J. China, 2019	544 participants (89.9% participation rate)	20.2±1.2 years	97.4% female	71.7% reportedly inactive	86.2% reported high screen time	41.7% reported anxiety

**Table 2.3:** Summary of included articles for the association between physical activity, sedentary behaviour and anxiety in post secondary students

Author, Year, Country	Independent Variables	Dependent Variable	Results
Wu, X., Tao, S., Zhang, Y., Zhang, S., and Tao, F. China, 2014	<i>Physical Activity:</i> Youth Risk Behaviour Survey, Physical Activity Rank Scale <i>Screen time:</i> Single question. Answers categorized as: $\leq 2$ hrs/day and $>2$ hrs/day)	<i>Anxiety:</i> Self-rating Anxiety Scale	<b>Adjusted Odd's Ratios:</b> High ST positively associated with anxiety (OR:1.49, 95%CI: 1.24; 1.79) High PA negatively associated with anxiety (OR:0.86, 95%CI: 0.63; 1.16) High ST/Low PA vs. High ST/ High PA (OR:0.66, 95%CI: 0.31; 1.37) High ST/Low PA vs Low ST/Low PA (OR:0.66, 95%CI: 0.55; 0.79) High ST/Low PA vs Low ST/High PA (OR: 0.61, 95%CI: 0.43; 0.88)
Dore, I., O'Loughlin, J., Beauchamp, G., Martineau, M., and Fournier, L. Canada, 2016	Godin-Shephard Leisure-Time Physical Activity Questionnaire (GSLTPAQ)	Hospital Anxiety and Depression Scale (HADS)	Adjusted Total PA: ( $\beta$ coefficient = -0.005, 95%CI: -0.014; 0.003) Adjusted MVPA: ( $\beta$ coefficient = - 0.011, 95%CI: -0.020; - 0.001)
Albracht-Schulte, K., and Robert-McComb, J. United States, 2018	Heart rate  Participants underwent one 30 minute session of structured Yoga and one 30 minute session of quiet rest in random order	Spielberger's Trait Anxiety Inventory	Bonferonni post-hoc comparisons indicate scores significantly decreased ( $p=0.001$ , 95%CI[2.71,7.09] from baseline ( $33.50\pm1.11$ ) and post-condition ( $28.60\pm0.84$ ). No significant difference between yoga and rest Yoga: Baseline= $33.48\pm9.41$ Post-Condition= $27.43\pm7.05$ Rest: Baseline= $33.53\pm10.63$ Post-Condition= $29.78\pm7.82$

Feng, Q., Zhang, Q., Du, Y., Ye, Y., and He, Q. China, 2014	<p><i>Physical Activity:</i> Single question with answers of daily, 5-6 d/week, 3-4 d/week, 1-2 d/week, less than once per week</p> <p><i>Screen Time:</i> Single question with answers <math>\leq 2</math> hrs/day and <math>&gt;2</math> hrs/day</p>	<p><i>Anxiety:</i></p> <p>Self-rating Anxiety Scale</p>	<p>Physical Activity (PA) Odd's Ratio</p> <p>Low PA: Reference</p> <p>High PA: OR 0.61, 95% CI: 0.31;1.20</p> <p>Screen Time (ST) Odd's Ratio</p> <p><math>&gt;2</math>hrs/day: Reference</p> <p><math>\leq 2</math>hrs/day: OR 1.52, 95% CI: 0.87;2.64</p> <p>Low ST/Low PA: OR 1.51, 95% CI: 0.81; 2.77</p> <p>Low ST/High PA: OR 0.92, 95% CI: 0.36; 2.33</p>
Thome, J., and Espelage, D. United States, 2004	Godin Leisure Time – Exercise Questionnaire	State-Trait Anxiety Inventory (STAI)	<p>STAI state anxiety and Godin total score</p> <p><math>r = -0.08</math></p> <p>STAI trait anxiety and Godin total score</p> <p><math>r = -0.05</math></p>
Hawker, C. United Kingdom, 2012	International Physical Activity Questionnaire (IPAQ)	Hospital Anxiety and Depression Scale (HADS)	<p>Total METS and Anxiety <math>r = 0.07</math> (<math>p = 0.390</math>)</p> <p>VMETS and Anxiety <math>r = 0.00</math> (<math>p = 0.984</math>)</p> <p>MMETS and Anxiety <math>r = -0.03</math> (<math>p = 0.697</math>)</p> <p>WMETS and Anxiety <math>r = 0.06</math> (<math>p = 0.415</math>)</p>
Zeng, Y., Wang, G., Xie, C., Hu, X., and Reinhardt, J. China, 2019	Questions regarding daily screen time greater than or equal to 4 hrs, regular physical activity, regular exercise, and leisure activity	DASS-21 Chinese version	<p>Adjusted Physical Inactivity:</p> <p>OR= 5.38 (95% CI: 3.33;8.70)</p> <p>Crude Screen <math>\geq 4</math> hrs/day</p> <p>OR= 1.74 (95% CI: 1.03;2.94)</p>

Three studies investigated the association of screen time and anxiety.<sup>10,20,22</sup> Two studies found statistically significant associations that showed that students with higher screen time were more likely to report symptoms of anxiety than students with less screen time.<sup>20,22</sup> Conversely, the last study did not find an association between screen time and anxiety.<sup>10</sup> Preliminary evidence suggests that screen time may be associated with an increase in symptoms of anxiety. It is important to note that these studies failed to investigate non-screen time based sedentary behaviours. Both of the studies that found associations between high screen time and symptoms of anxiety were performed at Chinese universities. It would be of interest to investigate if this association also occurred outside of these institutions, in a different cultural setting.

Two of the cross-sectional studies also investigated different combinations of physical activity and sedentary behaviour, in an attempt to observe any synergistic effects in association with symptoms of anxiety.<sup>20,22</sup> Low physical activity levels and high screen time were used as reference categories for both studies. One study reported that the different combinations of physical activity and sedentary behaviour did not alter the association significantly (low ST/low PA; High ST/High PA; Low ST/High PA).<sup>20</sup> The second study reported that low screen time and low physical activity levels were associated with higher reporting of symptoms of anxiety compared to low physical activity and high screen time, while low screen time and high physical activity levels were associated with less reporting of symptoms of anxiety.<sup>22</sup> Therefore, future research may wish to further investigate the effect of combining physical activity and differing levels of sedentary behaviour, or vice versa, on the resulting association with symptoms of anxiety.

The objective of this systematic review was to synthesize the current literature investigating the association between physical activity, sedentary behaviour, and symptoms of anxiety in post-



secondary students. While the associations between physical activity, sedentary behaviour and other forms of mental health conditions have been investigated,<sup>6,8,21</sup> it had yet to be determined what the literature says specifically for anxiety in a post-secondary student population. This systematic review has highlighted that a possible association exists between screen time and symptoms of anxiety, with higher levels of screen time linked to higher self-report of anxiety in a Chinese university setting. Furthermore, early evidence exists for an association between levels of physical activity and symptoms of anxiety. That is, the studies included in the analysis of this systematic review report that lower levels of physical activity participation seem to be associated with a greater likelihood of reporting symptoms of anxiety. Yet, as a number of other studies found no association between physical activity and symptoms of anxiety, it is necessary to conduct future research across a variety of cultures and populations to truly understand if an association exists.

There were limitations with this systematic review. One limitation of the study was the number of articles included in the synthesis of the literature. 826 articles were identified through the initial search of three databases, with the final synthesis including only seven articles. This may be representative of a lack of substantial interest in the topic, yet it still does not allow for a clear consensus as to the associations as investigated in the literature. Also, I was unable to perform a meta-analysis due to the nature of the results of the studies. This does leave the interpretation open to researcher bias. Another limitation of the study is that the studies use different tools to assess the independent and dependent variables. This may account for variances in results across the post-secondary population and makes it difficult to compare results. Furthermore, the cross-sectional studies all used self-reported questionnaires to measure independent and dependent variables. While the tools used were valid and reliable, it may present an over-reporting of physical activity and under-reporting of both sedentary behaviour and anxiety, which would skew results.

Social desirability regarding physical activity and sedentary behaviour may cause students to overreport physical activity levels while underreporting sedentary behaviour levels. The scarcity of randomized controlled trials in the literature limits the analysis to only look at possible associations between physical activity, sedentary behaviour, and symptoms of anxiety. Any conclusions regarding causal relationships is not possible using only a single study. Lastly, the search for this systematic review was conducted two years ago. Therefore, newer research may have been omitted from the results. It would be beneficial for an updated systematic review to be conducted.

This review points to the need for future research. While some results yielded statistically significant associations, many of the results offered only preliminary insight into a possible association, whether that be due to crude analyses that did not take in to account confounding variables or results that yielded statistical insignificance. More research is needed in order to provide clarity as to whether a true statistically significant association exists between physical activity, sedentary behaviour and symptoms of anxiety. Of interest also is the combination of synergistic effects between varying amounts of physical activity and sedentary behaviour and its association with symptoms of anxiety. While the studies included in this analysis may provide a framework, more research should be conducted in a variety of samples to observe the synergistic relationship between physical activity and sedentary behaviour. Another interesting area of research would include delineating gender differences among the associations between physical activity, sedentary behaviour and symptoms of anxiety. It was noted in one study that when they stratified for gender, the association between physical activity and anxiety was observed in males, but not females.<sup>7</sup> Research should be focused on this topic as this may have more specific implications when attempting to influence policy.

## **2.7 CONCLUSION**

Anxiety has been found to be endemic among post-secondary students.<sup>1,6,8,21</sup> However, its association to physical activity and sedentary behaviour needs further investigation due to the inconsistencies that exist in the current literature. Good quality epidemiological studies are needed to explore these associations and to determine whether exercise and physical activity should be considered possible interventions to limit the burden of anxiety in post-secondary students. This is important because physical activity and sedentary behaviour are two modifiable risk factors that may help prevent or mitigate the symptoms of anxiety.

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### **Chapter 3. Mental Health and Wellness Study**

***Title: The Association Between Physical Activity, Sedentary Behaviour and Symptoms of Anxiety in Post-Secondary Students***

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### 3.1 ABSTRACT

**Background:** Post-secondary students frequently experience symptoms of anxiety during the academic year. It is hypothesized that low levels of physical activity, and high levels of sedentary behaviour may be associated with symptoms of anxiety.

**Objective:** To investigate the association between physical activity, sedentary behaviour and moderate to extremely severe symptoms of anxiety in post-secondary students enrolled in Faculty of Health Sciences and Faculty of Education at the University of Ontario Institute of Technology (Ontario Tech) in the fall of 2017.

**Methods:** We conducted a cross-sectional study using an online questionnaire. Students were invited to participate in three consecutive recruitment waves. We used the Physical Activity and Sedentary Behaviour Questionnaire (PASB-Q) to measure physical activity and sedentary behaviour. Physical activity was measured as total aerobic activity (minutes per week) and muscular strengthening (number of sessions/events per week). Sedentary behaviour was measured in number of hours per day of activities such as watching television, sitting on the computer, and commuting to work. We used the DASS-21 to measure symptoms of anxiety. The association between physical activity, sedentary behaviour and moderate to extremely severe symptoms of anxiety was quantified using multivariable logistic regression, controlling for sociodemographic variables, comorbidities, substance abuse, food insecurity, and sleep quality. The analysis was stratified by Faculty.

**Results:** 882 of 2,199 (40.1%) eligible participants completed the questionnaire. Participation was 35% (685/1,931 eligible students) in the Faculty of Health Sciences and 77% (207/268 eligible students) in the Faculty of Education. 48.6% of participants reported moderate to severe symptoms

of anxiety in the Faculty of Health Sciences and 43.0% of participants reported moderate to severe symptoms of anxiety in the Faculty of Education. Poor aerobic physical activity (i.e., below Canadian Physical Activity Guidelines) was associated with moderate to extremely severe anxiety in the Faculty of Education (OR: 2.33, 95%CI: 1.25, 4.36) but no association was found in the Faculty of Health Sciences (OR:1.18 ,95%CI: 0.82,1.69 ). However, poor muscular strength was associated with moderate to extremely severe anxiety in the Faculty of Health Sciences (OR: 1.54, 95%CI: 1.11, 2.15) but not associated in the Faculty of Education (OR: 1.45, 95%CI: 0.74, 2.83). We found no association between sedentary behaviour and moderate to extremely severe anxiety in either Faculty.

**Conclusion:** Aerobic activity and muscular strengthening were associated with moderate to extremely severe symptoms of anxiety in our sample but the associations varied across Faculties. However, we found no association between sedentary behaviour and moderate to extremely severe symptoms of anxiety in either Faculty. More research is necessary to investigate the relationship between anxiety and the many forms of physical activity that are available for students.

**Keywords:** *aerobic physical activity, muscular strength, sedentary behaviour, anxiety, post-secondary students*

### 3.2 BACKGROUND

Anxiety is “a state of uneasiness, a bodily response to a perceived danger that could be real or imaginary and triggered by an individual’s thoughts, beliefs, and feelings”.<sup>1</sup> Symptoms of anxiety are endemic among Canadian university students.<sup>2</sup> In a recent survey of Canadian university students, 61.5% reported having experienced overwhelming anxiety at least once in the past year.<sup>2</sup> Similar levels of anxiety have been reported by post-secondary students in other countries including Pakistan, the United States, Norway, and the United Kingdom.<sup>1,3,4,5</sup>

The impact of anxiety in post-secondary students is significant. Studies have reported that students suffering from a mental health disorder, such as anxiety, experienced a decrease in their Grade Point Average (GPA).<sup>6,7,8,9</sup> A decrease in GPA leads to poorer educational outcomes, which may cause further mental health problems, such as increased anxiety to perform better.<sup>9</sup> The decrease in GPA can also be exacerbated by learning difficulties, which themselves have been shown to be associated with anxiety.<sup>6</sup> Furthermore, it has been reported that students suffering from mental health disorders, such as anxiety, were twice as likely to drop out of university when compared to their peers who were not struggling with mental health disorders.<sup>7,8</sup> Other adverse effects of anxiety among post-secondary students also include poorer relationships formed between themselves and other students and faculty members, as well as lower participation and engagement in clubs and activities on campus.<sup>8</sup> This may contribute to a downward spiral where decreased engagement in extracurricular activities may lead to sedentary behaviour and social isolation, which in turn may lead to an increase in anxiety.<sup>8,10</sup> Finally, elevated levels of anxiety may lead to the development of depression after completion of post-secondary studies.<sup>6</sup>

Little is known about the etiology of anxiety in post-secondary students. Possible risk factors include poor sleep, physical inactivity, obesity, sedentary behaviour, academic and

financial pressures, social and sexual issues, substance use, and diet.<sup>3,6,11,12</sup> Of those, physical activity and sedentary behaviours are of particular interest in post-secondary students because they are modifiable risk factors that require intervention. Specifically, approximately 35-50% of post-secondary students do not meet the recommended weekly levels of moderate to vigorous levels of physical activity.<sup>13,14</sup> A survey of students enrolled at Ontario Tech University suggest that its student population is even less active, and that 66% of students do not meet the weekly minimum aerobic and muscular physical activity levels outlined by the Canadian Physical Activity Guidelines.<sup>2</sup> The Canadian Physical Activity Guidelines suggest that adults 18 to 64 years of age accumulate at least 150 minutes of moderate (~50% maximum intensity) to vigorous (~70 to 80% maximum intensity) aerobic physical activity, as well as sessions of muscular strengthening at least two days per week.<sup>15,16</sup>

Previous studies that investigated the association between physical activity and mental health report conflicting results.<sup>3,12,17,18,19,20</sup> A study of nursing students from the United Kingdom, found no correlation ( $r=0.007$ ,  $p=0.390$ ) between physical activity and anxiety.<sup>3</sup> Similarly, a study among American post-secondary students did not find an association ( $r=-0.08$ ) between exercise and anxiety at a mid-Western American university.<sup>12</sup> However, a study of students from China reported that those who were physically inactive were more likely to report symptoms of anxiety than their active peers (OR:5.38, 95%CI: 3.33, 8.70).<sup>20</sup> These findings suggest that the association between physical activity and anxiety may vary across student populations.

Overall, previous studies suggest that sedentary behaviour is associated with symptoms of anxiety in post-secondary students. In one study, students who spent more than two hours engaging in screen-based activities were more likely to report symptoms of anxiety than their peers who spent less than two hours engaging in screen-based activity (OR: 1.49, 95% CI: 1.24, 1.79).<sup>21</sup>

Similarly, when comparing students with similar levels of physical activity, students who reported less than two hours of screen time per day were less likely to report symptoms of anxiety (OR:0.79 96% CI: 0.59, 0.85).<sup>21</sup> Moreover, a study of post-secondary students from China found that those who spent four or more hours engaging in screen-based activities were more likely to report symptoms of anxiety than their peers who spent less time on similar devices (OR:1.74, 95% CI: 1.03, 2.94).<sup>20</sup> While these studies suggest that an association exists between sedentary behaviour and anxiety, the validity of the results must be interpreted with caution because of possible methodological limitations. Specifically, these studies did not control for a broad range of covariates that may explain associations. Moreover, the measurement of sedentary behaviours was limited to screen time and therefore, did not consider other sedentary behaviours such as commuting via public transit, or time spent sitting in lectures.

Many possible modifiable risk factors may influence the symptoms of anxiety felt by post-secondary students. Modifiable risk factors such as substance use, poor sleep quality, food security and diet, experiencing frequent pain, and younger age have been shown to be associated with symptoms of anxiety experienced by post-secondary students.<sup>2,3,6,8,11,12,22,23,24,25</sup> Furthermore, additional factors such as academic and financial pressures and the formation of new social circles and relationships may influence symptoms of anxiety.<sup>3,6,11,12,22</sup> These risk factors must also be taken into consideration when undertaking the study of symptoms of anxiety in post-secondary students

Therefore, the purpose of the current study was to investigate the association between physical activity, sedentary behaviour and moderate to extremely severe symptoms of anxiety in post-secondary students enrolled in the Faculty of Health Sciences and the Faculty of Education at Ontario Tech in the Fall 2017 semester, after adjusting for other modifiable risk factors.

### **3.3 METHODS**

#### **3.3.1 *Study design and source population***

We conducted a cross-sectional study in the Fall 2017 semester at Ontario Tech. Protocols and procedures were approved by the UOIT Research Ethics Board (UOIT REB#14515).

#### **3.3.2 *Study sample***

The study sampled included undergraduate students enrolled in the Faculty of Health Sciences or the Faculty of Education who were 18 years of age or over and willing to consent to the study prior to participation.

#### **3.3.3 *Recruitment***

We implemented a three-wave recruitment strategy. In first wave, students in 27 classes from the two Faculties were invited to participate. Core and mandatory classes were selected within each Faculty. Therefore, every student enrolled in the two Faculties had the opportunity to enroll in the study and complete the questionnaire during class. The recruitment methodology was standardized across classes. We first asked the professor/lecturer to read a script introducing the research team. The professor/lecturer then left the classroom for approximately 20 minutes to allow for the research team to interact with the students. This interaction began with a five-minute PowerPoint presentation by the research team members who outlined the purpose of the study, introduced the consent form, and provided contact information for both community and school-based mental health services (if students needed to discuss mental health issues). Following the presentation, students were encouraged to ask questions about the study. The students were then given 15 minutes to complete the questionnaire in class.

The second wave of recruitment involved an email reminder from the professor of the course which included a hyperlink to the online questionnaire. The third wave of recruitment was

an email reminder sent by each Dean of each respective Faculty, which included a hyperlink to the online questionnaire.

We also advertised the study through social media postings on Twitter and Facebook and by posting advertisements in areas of high traffic to further inform students of the ongoing study.

### **3.3.4 Data Collection**

#### *Measured Variable*

We developed a study questionnaire with content experts. This questionnaire included several tools to measure the presence and severity of mental health symptoms and related covariates including physical activity, sedentary behaviour, comorbidities, substance use, food security, sleep quality, sociodemographic factors, and neck/low-back pain.

Data were collected via an online questionnaire and stored securely via Google Forms and Google Drive. The questionnaire included 114 questions divided into nine sections. Students were required to use their UOIT Banner ID to access the questionnaire. Once completed, the participant's UOIT Banner ID was removed from the raw data and they were assigned a participant number. Once a student had submitted the questionnaire, they were unable to access it again. This ensured that we did not collect duplicate data.

#### *Independent Variables: Physical activity and Sedentary Behaviour*

The Physical Activity and Sedentary Behaviour Questionnaire (PASB-Q) was used to measure physical activity and sedentary behaviour.<sup>15</sup> The PASB-Q is a seven-item tool that is used to assess total aerobic physical activity (such as running or cycling) and total muscle strengthening activities in a typical week. According to the PASB-Q total aerobic physical activity is defined as moderate-to-vigorous activity, such as brisk walking or running. Aerobic physical activity is

measured by two questions including the average time spent daily performing moderate to vigorous physical activity and the number of days per week aerobic physical activity is performed. Total aerobic physical activity is calculated by multiplying the two answers.<sup>15</sup> Muscular strengthening activities are defined as activities ranging from resistance training to heavy gardening. Muscular strengthening is measured using a single question, which assesses the frequency of muscular strengthening events in a single week.<sup>15</sup> The PASB-Q also measures the total sedentary behaviour in a typical day. Sedentary behaviour is calculated by three questions in the PASB-Q, which are then added to yield total sedentary behaviour per day.<sup>15</sup> Sedentary behaviour, as defined by the PASB-Q, is any continuous sitting, such as that experienced while commuting, watching television and working on the computer. The PASB-Q has shown to be a valid and reliable instrument for measuring physical activity and sedentary behaviour in post-secondary students and older adults.<sup>26, 27</sup>

The PASB-Q was scored and then categorized into five categories: poor, fair, good, very good, and excellent according to the developers' recommendations from the PASB-Q (Table 3.1).<sup>15</sup> Total aerobic physical activity was calculated by multiplying the number of minutes reported on a typical day by the number of days that the participants engage in aerobic activity on average.<sup>15</sup> Total sedentary behaviour is calculated by summing seating time and screen time values.<sup>15</sup> We categorized total aerobic physical activity, muscular strengthening, and total sedentary behaviour into dichotomous variables for analysis.<sup>26</sup>



**Table 3.1:** Scoring for the Physical Activity and Sedentary Behaviour Questionnaire (PASB-Q)

<b>Health Benefit Rating</b>	<b>Excellent</b>	<b>Very Good</b>	<b>Good</b>	<b>Fair</b>	<b>Poor</b>
Aerobic Activity (minutes/week)	300+	225-299	150-224	75-149	0-74
Strength Activity (times/week)	4	3	2	1	0
Sedentary Behaviour (hours/day)	<2	2-4	4-6	6-8	>8

*Dependent Variable: Anxiety*

The Depression, Anxiety, and Stress Scales 21-item (DASS-21) questionnaire was used to measure student symptoms of anxiety.<sup>28</sup> The DASS-21 is a short form version of the DASS-42 tool which was created to assess the severity of symptoms of anxiety, depression, stress, and psychological distress. The DASS-21 is composed of three subscales (anxiety, stress, and depression). The anxiety subscale includes seven questions that measure symptoms of anxiety in the previous 30 days. Questions are scored from “0” (Does not apply to me/never) to “3” (Applied to me very much, or most of the time/almost always). An anxiety sub-score can be calculated by adding together the numerical value (0-3) of each question. The total score ranges from 0-42.<sup>28</sup> The numerical sub-score can then be categorized using the given score chart to give the categories of normal (0-6), mild (7-9), moderate (10-14), severe (15-19), or extremely severe (20-42).<sup>28</sup> The DASS-21 has been shown to be valid and reliable in our population.<sup>29</sup>

*Covariates*

The potential covariates included sleep quality, substance use, food insecurity, and socio-demographic variables.

*Sleep Quality:* The Pittsburgh Sleep Quality Index (PSQI) was used to assess overall sleep quality of the sample. The PSQI is composed of 19 items which provide seven scores for sleep quality. These seven scores include subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction.<sup>30</sup> The PSQI has been shown to be valid and reliable for measuring sleep quality.<sup>31</sup>

*Food Insecurity:* The Household Food Security Survey Model (HFSSM) was used to assess food insecurity among post-secondary students. The HFSSM tool was designed to identify and assess the severity of food insecurity experienced per household. Severity, as identified through the tool, is measured on a scale of 0 to 10, with 10 indicate severe food insecurity <sup>32</sup> This tool has been found to be a valid and reliable tool for assessing the severity of food insecurity in a post-secondary population.<sup>33,34</sup>

*Substance use:* The Alcohol, Smoking and Substance Involvement Screening Tool (ASSIST) was included within our questionnaire to measure substance use in the post-secondary student sample.<sup>35</sup> The ASSIST tool measures the lifetime and three month use of alcohol, cigarette and substance use (marijuana, cocaine, amphetamines, sedatives, hallucinogens, inhalants, opioids and other drugs).<sup>35</sup> The ASSIST tool is also used to assess risk of current and/or future harm as well as substance dependence.<sup>35</sup> The ASSIST was created for health care workers and professionals working with high risk groups, yet it has been shown to be valid and reliable among post-secondary students.<sup>36,37</sup>

*Neck and low back pain intensity:* Neck and low back pain were assessed using the Musculoskeletal Pain Intensity – Numeric Rating Scale (NRS). This tool was composed of two one-item scales that measured the severity of neck pain and low back pain.<sup>38</sup> The scales ranged from 0, representing no pain, to 10, representing the worst pain possible.<sup>38</sup> The Musculoskeletal

Pain Intensity – Numeric Rating Scale has been shown to be clinically appropriate and valid and reliable for use in this population.<sup>38</sup>

*Sociodemographic characteristics:* Sociodemographic variables were analyzed using questions from Statistics Canada. Information including Faculty, area of study, age, gender, marital status, number of dependents, number of comorbidities, academic average, year of study, social support, personal income, household income, number of hours working for pay, living arrangement, commute time to the university, international/domestic student status, parental marital status, employment status of parents/guardians coping, and ethnicity was collected in this section of the questionnaire.

### **3.3.5 Pilot study**

A pilot study was conducted in March 2017 at Ontario Tech to test the feasibility of the questionnaire developed for use in the cross-sectional study. We selected three classes in the Faculty of Health Sciences to be included. Students were eligible to participate if they were 18 years of age or older, registered in the Faculty of Health Sciences, and in attendance in class on the day the questionnaire was administered. Valid and reliable tools were combined in a single questionnaire in order to investigate symptoms of anxiety, stress, and depression, and modifiable risk factors such as physical activity, sleep quality, food insecurity, comorbidities, and neck/low back pain. These tools included the DASS-21, Pittsburgh Sleep Quality Index, the ASSIST, the HFSSM, sociodemographic questions from Statistics Canada, the Musculoskeletal Pain Intensity – Numeric Rating Scale, and the International Physical Activity Questionnaire (IPAQ).<sup>28,30,32,35,38</sup>

Upon administration of the survey, we achieved a participation rate of 79.6% (n=137/172), with active involvement in the nursing, community health, and kinesiology classes being 82%, 85%, and 72%, respectively. Students took an average time of 15 minutes and 35 seconds

(SD=4:27) to complete the questionnaire. Average scores for questions rating the length of the questionnaire (scored on a scale of 0-10; 0 indicating too short and 10 indicating too long) and clarity of the questions (scored on a scale of 0-10; 0 indicating the questions were unclear and 10 indicating the questions were clear) were 6.5/10 (SD=1.9) and 8.4/10 (SD=2.20), respectively, showing that the questionnaire was of proper length and was understandable to the post-secondary students sampled. We found that students were satisfied with the length of the questionnaire and found its questions clear and concise. However, upon investigation of the responses, we found that students had difficulty properly answering the questions regarding physical activity from the IPAQ. We replaced the International Physical Activity Questionnaire with the Physical Activity and Sedentary Behaviour Questionnaire (PASB-Q) upon suggestion by an expert for the cross-sectional study.

### **3.3.6 Data analysis**

The analysis included six steps:

#### ***I. Data transfer and validation***

Data were retrieved from Google Forms via an Excel document and converted from Excel format into SPSS. Team members performed validation checks to ensure that the data were transferred successfully without errors. Scores were calculated for each tool used in the questionnaire independently by the research team and cross-checked for validity of the scores. This check ensured that each score was calculated correctly before moving on to statistical analysis.

It was observed during this process that aerobic physical activity and muscular strength data included illogical entries. Specifically, the data included negative values, such as negative time spent performing physical activity. Moreover, some students' muscular strength data also

included negative values, as well as values far above what would be expected to be possible. For example, it was deemed illogical for a student to participate in 0.5 of a session of muscular strengthening and the student should have answered with 1 rather than 0.5. Illogical data were also defined by upper bounds on inputted data. Upper bounds were put in place to exclude highly unlikely, and therefore assumed erroneous, amounts of physical activity. For example, it would be highly unlikely for a student to perform 1200 minutes (20 hours) of exercise a day. For muscular strengthening activities, this upper limit was 14 events of muscular strengthening per week. This accounted for individuals participating in muscular strengthening activities up to two times per day for seven days a week. Aerobic physical activity was limited to 420 minutes of aerobic physical activity per day (2940 minutes per week). This upper limit allowed for both student athletes and students with physically demanding jobs to be included for analysis. As it could not be assumed what the true value of physical activity the student was attempting to input, students who had inputted illogical data were excluded from analysis. Both upper limits for muscular strengthening and aerobic physical activity were approved by an expert in the field of Kinesiology.

## ***II. Categorization of aerobic physical activity, muscular strengthening and sedentary behaviour***

Aerobic physical activity and muscular strengthening were dichotomized based on the Canadian Physical Activity Guidelines.<sup>15</sup> Students who participated in 150 minutes or more of moderate to vigorous aerobic physical activity per week were classified as physically active (Good, Very Good, Excellent categories of the PASB-Q), while those who were under 150 minutes were deemed physically inactive (Poor, Fair categories of the PASB-Q, Table 3.1).<sup>15</sup> For muscular strength, students engaging in two or more events of strengthening were categorized as being physically active while those engaging in one or no muscular strengthening events were physically inactive. Sedentary behaviour was dichotomized as Poor (greater than eight hours of sedentary

behaviour) and Fair-to-Excellent (less than eight hours of sedentary behaviour, Table 3.1).<sup>15</sup> Few students were classified in the Good, Very Good, or Excellent categories. Therefore, after consulting a kinesiology expert, it was decided to dichotomize sedentary behaviour in this way. To ensure that the dichotomization did not alter the result, Z-score tests were performed comparing this dichotomization (Poor vs Fair/Good/Very Good/Excellent) with the dichotomization Poor/Fair vs Good/Very Good/Excellent. Z-tests scores showed no significant changes between the two different ways of dichotomization, therefore, Poor vs Fair/Good/Very Good/Excellent was used to increase statistical power in regard to analysis.

### ***III. Categorization of symptoms of anxiety***

The anxiety scores from the DASS-21 anxiety subscale were dichotomized into two categories: 1) normal or mild symptoms of anxiety versus 2) moderate to extremely severe symptoms of anxiety. This classification was informed by an expert in the field (KM). It is understood that post-secondary students are expected to feel some level of anxiety in their daily lives and that this anxiety may be necessary for optimal academic performance. Therefore, both “normal” and “mild” categories on the DASS-21 were considered normal for this population. We deemed that once a student enters the “moderate” classification of anxiety, that this anxiety would more than likely have negative implications on academic performance, social life, and overall well-being.<sup>28</sup>

### ***III. Descriptive statistics, participation, and selection bias***

Z-score tests were used to determine whether statistically significant differences were present for the baseline characteristics (including physical activity, sedentary behaviour, and

anxiety scores) of students between Faculties. A Z-score of 3.0 or more indicated that statistically significant differences existed between samples.

Participation bias was assessed by comparing the study samples to the student population in each of the Faculties. Ontario Tech University provided aggregate characteristics of the student populations for both Faculties and these were compared to the characteristics of the samples of each Faculty using Z-score test.

#### ***IV. Prevalence of physical activity, sedentary behaviour and moderate to extremely severe anxiety symptoms***

The one-week prevalence and 95% confidence intervals (CI) of aerobic physical activity, muscular strengthening, sedentary behaviour, and symptoms of anxiety was calculated. For aerobic physical activity, if a participant met or exceeded the amount of aerobic physical activity per week as recommended by the Canadian Physical Activity Guidelines, they were classified as physically active and included in the numerator. The denominator included all participants who reported levels of aerobic physical activity inside the acceptable data range. The same methodology was used to calculate the prevalence of students who met the Canadian Physical Activity Guidelines for muscular strengthening.

The daily prevalence of sedentary behaviour was calculated using students who scored “poor” on the PASB-Q in the sedentary behaviour subscale as the numerator, and all participants who provided a valid response for sedentary behaviour as the denominator.

The one-month prevalence of moderate to extremely severe symptoms of anxiety was computed. Students who reported moderate to extremely severe scores of anxiety symptoms of the DASS-21 questionnaire were included in the numerator, while total number of students who

answered the anxiety questions of the DASS-21 were included in the denominator. The prevalence estimates were stratified by Faculty.

The confidence intervals (CI) for prevalence estimates were calculated using the following equation:

$$\rho \pm \sqrt{\rho(1-\rho)/n}$$

where  $\rho$  is the prevalence and  $n$  is the total number in the sub-sample.

#### ***V. Crude association between physical activity, sedentary behaviour and symptoms of anxiety: univariate logistic regression models***

Univariate logistic regression models were used to compute the crude association between aerobic physical activity, muscular strengthening, sedentary behaviour, covariates, and moderate to extremely severe symptoms of anxiety in each Faculty. Therefore, six separate models were built to investigate aerobic physical activity, muscular strengthening, and sedentary behaviour independently with symptoms of anxiety. The reference categories for aerobic physical activity and muscular strength followed the recommendations of the Canadian Physical Activity Guidelines, using the Good to Excellent category as reference. This category included students who were meeting the recommendations for aerobic physical activity and muscular strengthening. For sedentary behaviour, the reference category was Fair to Excellent which denoted students who reported eight or less hours of sedentary behaviour. The associations were measured as odds ratios (OR) and 95% CI.

#### ***VI. Multivariable Logistic Regression Models***



The impact of covariates on the associations of interest was assessed by building multivariable logistic regression models. Covariates were added separately to each univariate logistic regression models. The inclusion of covariates that resulted in a change of  $\pm 10\%$  in the crude regression coefficient ( $\beta$ ) were added to a multivariable model that included all covariates that met these criteria. The final multivariable model was built by sequentially removing covariates from the least significant to most significant. If removing a covariate resulted in a change of  $\pm 10\%$  in the adjusted  $\beta$  value for the independent variable then the covariate was added back to the model. The final model included all  $\beta$  values that led to a  $\pm 10\%$  change in the  $\beta$  for the independent variable then the covariate.

### **3.4 RESULTS**

#### **3.4.1 *Participation Bias***

The Faculty of Health Sciences sample was representative of the general population in respect to gender ( $Z = 1.4705$ ,  $p < 0.05$ ), age ( $Z\text{-score} = 0.2$ ,  $p < 0.05$ ), and domestic status ( $Z = 2.4593$ ,  $p < 0.01$ ). The Faculty of Education was representative of the general population in respect to gender ( $Z = 0.671$ ,  $p < 0.05$ ), age ( $Z = 0.307$ ,  $p < 0.05$ ), and domestic status ( $Z = 0.403$ ,  $p < 0.05$ ).

#### **3.4.2 *Sample characteristics***

A total of 2199 students were eligible for participation and 882 (40.1%) completed the questionnaires. Of those, 685 (35% participation rate) were from the Faculty of Health Sciences and 207 (77% participation rate) were from the Faculty of Education. Students from the Faculty of Health Sciences were predominantly female (79.9%) with an average age of 22.13 ( $\pm 5.49$ ) years of age. 89% of the students were single and 35.7% were not working for pay. (Table 3.2) In the Faculty of Education, the average age of the participants was 25.62 ( $\pm 4.77$ ) years of age. The population was predominantly female (68.1%), single (83.1%) and 37.2% did not work for pay.

Approximately 98% of the Faculty of Health Sciences students were domestic students while 99.5% of students from the Faculty of Education were domestic students.

**Table 3.2:** Sample characteristics in the FHSc and the FEd

	<b>Faculty of Health Science</b>	<b>Faculty of Education</b>
<b>Number of Students Enrolled</b>	1931	268
<b>Number of Participants (response rate)</b>	685 (35%)	207 (77%)
<b>Age</b>	22.1 ( $\pm 5.5$ )	25.6 ( $\pm 4.8$ )
<b>Gender</b>		
Female	539 (79.9%)	141 (68.1%)
Male	128 (19.0%)	65 (31.4%)
Transgender Female to Male	2 (0.3%)	0 (0.0%)
Genderqueer	2 (0.3%)	1 (0.5%)
Not Disclosed	2 (0.3%)	0 (0.0%)
Other	2 (0.3%)	0 (0.0%)
<b>Domestic/International Student</b>		
Domestic	664 (98.4%)	206 (99.5%)
International	11 (1.6%)	1 (0.5%)
<b>Marital status</b>		
Single, never married	601 (89.0%)	172 (83.1%)
Separated/Divorced	13 (1.9%)	3 (1.4%)
Married/Common Law	59 (8.8%)	32 (15.5%)
Widowed	2 (0.3%)	0 (0.0%)
<b>Neck pain in the last 7 days</b>		
Yes	430 (63.7%)	113 (54.6%)
No	245 (36.3%)	94 (45.4%)

<b>Low back pain in last 7 days</b>		
Yes	455 (67.4%)	126 (60.9%)
No	220 (32.6%)	81 (39.1%)
<b>Hours of work for pay</b>		
0	241 (35.7%)	77 (37.2%)
1-9 hours	123 (18.2%)	41 (19.8%)
10-19 hours	171 (25.3%)	58 (28.0%)
20-29 hours	84 (12.4%)	26 (12.6%)
30-39 hours	42 (6.2%)	4 (2.0%)
More than 40 hours	14 (2.1%)	1 (0.5%)
<b>Food security total score</b>		
No food insecurity	484 (71.7%)	160 (77.3%)
Marginal food insecurity	82 (12.2%)	22 (10.6%)
Moderate food insecurity	75 (11.1%)	13 (6.3%)
Severe food insecurity	31 (4.6%)	12 (5.8%)
<b>Lifetime substance use</b>		
Tobacco	226 (35.5%)	87 (42.0%)
Alcohol	528 (72.8%)	178 (86.0%)
Cannabis	298 (44.1%)	106 (51.2%)
Cocaine	35 (5.2%)	16 (7.7%)
Amphetamine-type stimulant	62 (9.2%)	20 (9.7%)
Inhalants	6 (0.9%)	6 (2.9%)
Sedatives/sleeping pills	50 (7.4%)	19 (9.2%)

### **3.4.3 One-month prevalence of anxiety**

The one-month prevalence of moderate to extremely severe symptoms of anxiety was 48.6% (95% CI: 44.8%, 52.4%) in the Faculty of Health Science and 43.0% (95% CI: 36.3%, 49.7%) in the Faculty of Education. Students experiencing extremely severe symptoms were

present in 15.3% (95% CI: 12.6%, 18.0%) of the Faculty of Health Sciences and 12.1% (95% CI: 7.6%, 16.5%) in the Faculty of Education sample.

**Table 3.3:** Prevalence of Poor/Fair Physical Activity and Poor Sedentary Behaviour

	<b>Faculty of Health Sciences</b>	<b>Faculty of Education</b>
<b>Meeting Aerobic Physical Activity Guidelines</b>	40.1% (95% CI: 36.3%, 43.9%)	34.3% (95% CI: 27.8%, 40.8)
<b>Meeting Muscular Strengthening Guidelines</b>	50.9% (95% CI: 47.0%, 54.8%)	38.1% (95% CI: 31.3%, 45.0%)
<b>Sedentary Behaviour &gt;8 hours/day</b>	58.7% (95% CI: 55.0%, 62.4%)	72.9% (95% CI: 66.9%, 79.0%)

#### ***3.4.4 Prevalence of physical activity and sedentary behaviours***

A high proportion of students did not meet the recommended levels of aerobic physical activity and muscular strengthening in both Faculties (Table 3.3). More students in the Faculty of Health Sciences than students in the Faculty of Education met the recommendations of the Canadian Physical Activity Guidelines. Furthermore, a higher proportion of students in both Faculties were meeting the recommendations for muscular strengthening exercises or activities when compared to the students meeting recommendations for aerobic physical activity.

Overall, most students reported being sedentary for greater than eight hours a day (Table 3.3). The prevalence of sedentary behaviour was much higher in the Faculty of Education. It is important to note that no students in either Faculty scored “Excellent” for sedentary behaviour (i.e., less than 2 hours per day).

#### ***3.4.5 Crude associations between physical activity, sedentary behaviours, and moderate to extremely severe symptoms of anxiety***

Faculty of Health Sciences:

We did not find that aerobic physical activity was associated with moderate-to-severe symptoms of anxiety (OR: 1.25: 95%CI: 0.91,1.72) in the Faculty of Health Sciences. However, low levels of muscular strengthening activity were associated with moderate to extremely severe symptoms of anxiety (OR:1.55: 95% C.I. = 1.13, 2.12) in the Faculty of Education. Finally, high sedentary behaviour was not associated with moderate to extremely severe symptoms of anxiety (OR:1.30: 95% C.I. = 0.95, 1.76).

#### Faculty of Education:

We found a crude association between low aerobic physical activity and moderate-to-severe symptoms of anxiety (OR: 2.06: 95% C.I. = 1.12, 3.77). However, muscular strengthening was not associated with moderate to extremely severe symptoms of anxiety (OR: 1.40: 95% C.I. = 0.77, 2.54). Similarly, we did not find an association between sedentary behaviours and moderate to extremely severe symptoms of anxiety (OR: 1.52, 95% C.I. = 0.80, 2.85).

#### ***3.4.6 Adjusted associations between physical activity, sedentary behaviours, and moderate to extremely severe symptoms of anxiety***

##### Faculty of Health Sciences:

Aerobic physical activity was not associated with moderate to extremely severe symptoms of anxiety after adjusting for covariates (OR: 1.18: CI 95%: 0.82,1.69). However, low levels of muscular strengthening was associated with moderate to extremely severe symptoms of anxiety after adjusting for neck pain and gender (OR:1.54: CI 95%: 1.11,2.15). No association was found between sedentary behaviour and moderate to extremely severe symptoms of anxiety despite adjusting for covariates such as age, number of comorbidities, sleep quality, problems coping, and food insecurity (OR: 1.12: CI 95%: 0.78, 1.59). (Table 3.4)

Faculty of Education:

After adjustment of covariates, low levels of aerobic physical activity remained associated with and moderate-to-severe symptoms of anxiety (OR:2.33: CI 95%: 1.25-4.36). No association was found between low levels of muscular strengthening and moderate to extremely severe symptoms of anxiety after adjusting for number of dependents, sleep quality, monthly use of alcohol and/or tobacco, neck pain, problems coping, hours worked for pay, and commute time to school (OR: 1.45: 95% CI: 0.74, 2.83). No association was found even after adjusting for number of dependents, sleep quality, neck pain, and problems coping (OR: 0.95: 95% CI: 0.45, 2.02). (Table 3.4)

**Table 3.4:** Odds Ratio for Adjusted Models.

<b>Independent Variables</b>	<b>Faculty of Health Sciences</b>	<b>Faculty of Education</b>
<b>Aerobic Activity *</b>		
Good to Excellent	1.00	1.00
Poor/Fair	1.18 (0.82, 1.69)	2.33 (1.25, 4.36)
<b>Muscular Strengthening **</b>		
Good to Excellent	1.00	1.00
Poor/Fair	1.54 (1.11, 2.15)	1.45 (0.74, 2.83)
<b>Sedentary Behaviour ***</b>		
Fair to Excellent	1.00	1.00
Poor	1.12 (0.78, 1.59)	0.95 (0.45, 2.02)

\* For Faculty of Health Sciences: 29 cases were excluded due to values exceeding aerobic activity ranges; covariates included age, sleep quality, monthly cannabis use, neck pain, back pain and problems coping. For Faculty of Education: 3 cases were excluded due to values exceeding aerobic activity ranges; covariate included was number of dependents

\*\* For Faculty of Health Sciences: 50 cases were excluded, 8 due to gender inputted values being excluded and 42 due to values outside the range for muscular strengthening values; covariates included neck pain and gender. For Faculty of Education: 14 cases were excluded due to values outside the range for muscular strengthening values; covariates included number of dependents, sleep quality, monthly alcohol use, monthly tobacco use, neck pain, problems coping, hours worked for pay, and commute time to school-based

\*\*\* For Faculty of Health Sciences: 3 cases were excluded; covariates included age, number of comorbidities, sleep quality, problems coping, and food insecurity. For Faculty of Education: covariates include number of dependents, sleep quality, neck pain, and problems coping.

### **3.5 DISCUSSION**

The results for this cross-sectional study suggest that in the Faculty of Health Sciences, an independent association exists between low levels of muscular strengthening activity and moderate to extremely severe symptoms of anxiety. Specifically, students who were less active in muscular strengthening activities were more likely to report moderate-to-extremely severe symptoms of anxiety than their more active peers. However, we found no association between low levels of aerobic physical activity and moderate to extremely severe symptoms of anxiety. Similarly, our analysis suggest that sedentary behaviour is not associated with moderate to extremely severe symptoms of anxiety in the Faculty of Health Sciences.

In the Faculty of Education, we found an independent association between low levels of aerobic physical activity and moderate-to-extremely severe symptoms of anxiety. However, we did not find an association between low levels of muscular strengthening activity and moderate-to-extremely severe symptoms of anxiety, which is in contrast with what was found in the Faculty of Health Sciences. Similarly, there was no significant association between high levels of sedentary behaviour and moderate to extremely severe symptoms of anxiety in students enrolled in the Faculty of Education.

Our research adds to the previous research on the association between physical activity and symptoms of anxiety. Overall, we found that an association exists between aerobic physical activity and symptoms of anxiety in the Faculty of Health Sciences. This is in agreement with research by Zeng, et al. (2019), who found that students who are physically inactive were more likely to report symptoms of anxiety.<sup>20</sup>

Our research also agrees with previous studies that suggested that weak associations exist between physical activity and symptoms of anxiety.<sup>19,21</sup> Interestingly, by investigating two separate constructs of physical activity, we found its association with anxiety may vary by type of physical activity and study population. This finding may help explain the inconsistencies and lack of consensus reported in the current literature.

The differences in associations between both Faculties deserve exploration. Students in the Faculty of Health Sciences may be more interested in physical activity or sport than their peers in the Faculty of Education. This preference may be due to the interests that a person may have that draws them to apply for enrollment in the Faculty of Health Sciences. With programs such as Kinesiology, many students may have pre-existing physical activity habits. Therefore, the percentage of students who may be enjoying their participation in physical activity may be higher



in the Faculty of Health Sciences. It is also important to note that students in the Faculty of Education are enrolled in a professional degree program. Therefore, they are older, more likely to be married/common law and likely have different demands on their time and different obligations outside of school

The differences in symptoms of anxiety observed between students in the two Faculties may be explained by the fact that students in the Faculty of Health Sciences may be experiencing the post-secondary environment for the first time. On the other hand, students in the Faculty of Education, who must already have an undergraduate degree, have already experienced university life and understand performance expectations faced as post-secondary students. Furthermore, students in the Faculty of Education were typically older, once again emphasizing that the sources for the symptoms of anxiety may differ.

When comparing results for the association between sedentary behaviour and symptoms of anxiety, our research does not agree with the current literature. It has been reported in several studies that sedentary behaviour is associated with symptoms of anxiety.<sup>20,21</sup> However, it must be taken into account that Ontario Tech focuses on the use of technology for the delivery of course content. Courses at this post-secondary institution are often hybrid in nature, with a portion of the course content being taught in-class, and a similar amount of content being taught via online lectures and assignments. By providing more content via an on-line format, students are exposed to more sedentary behaviour in the form of screen time and are less likely to commute to school. This may serve to take time away from physical activity engagement, with students being required to spend more time sitting at a computer.

### *Strengths and Limitations*

Our study had strengths and limitations. First, we recruited students in-class. This allowed for the clarification of concerns students may have had, thus maximizing the participation of the students by alleviating any anxieties of participating in such sensitive subject matter. Second, our sample was representative of the students enrolled in each Faculty in regards to gender, age, and domestic status of studies. Third, the participation rate was high in the Faculty of Education. Fourth, we used reliable and valid tools to measure our dependent and independent variables and were able to separate physical activity into two separate components. Fifth, we pilot tested our questionnaire in a representative sample of students from the Faculty of Health Sciences who rated the questionnaire as being of appropriate length and adequate clarity. Finally, we controlled for several covariates in the analysis.

However, our study also had limitations. First, the participation rate was low in the Faculty of Health Sciences. Most participants were recruited in class, and the online/email waves of recruitment yielded low participation. Second, we also used a self-reported questionnaire which may have led to an overestimation of physical activity participation and an underestimation of sedentary behaviour due to social desirability.<sup>26</sup> Similarly, we used self-report measures to assess anxiety. Therefore, the associations should be interpreted cautiously. Finally, we did not assess the interaction between the types of physical activity and sedentary behaviour. It is possible that a combination of aerobic and muscular activity is best when dealing with anxiety, however, this was beyond the scope of the study.

### *Practical Considerations*

Our results suggest that it may be important to incorporate physical activity into the curriculum.<sup>39,40</sup> With almost half of the students in both the Faculty of Health Sciences and the Faculty of Education reporting feeling moderate to extremely severe symptoms of anxiety every month, it is necessary to develop campus-wide efforts to address this problem. While the university does provide students with access to recreational facilities and mental health services, many students may be intimidated by these environments. Their lack of experience with exercising may also deter them from participating in physical activity. By including physical activity into the curriculum, it may provide students with experience and guidance that they currently do not have.<sup>41,42</sup> This would also allow students to feel less isolated in learning proper methods of physical activity as it is unlikely that they would be the only student new to physical activity in their cohort.<sup>42</sup>

It is also important to consider developing and implementing effective education programs for the student population to understand the benefits of physical activity. Courses that focus on the role of physical activity in improving overall health would be beneficial for students.<sup>39,40</sup> This could be achieved through a peer mentoring program in the form of a practicum course for kinesiology students.<sup>41,43</sup> Kinesiology students could act as peer mentors for students who do not have adequate knowledge of exercise, or who may require peer support to participate in physical activities. A peer mentoring program such as this could optimize the social benefits associated with physical activity participation.<sup>41</sup>

Finally, a shift in student culture is necessary. Being stressed and anxious may be perceived by students as a normal aspect of student life at the university. Furthermore, students may believe that engaging in physical activity may not be worthwhile because it will inevitably reduce time to

study.<sup>42</sup> Therefore, a culture where mental health is prioritized through the promotion of physical activity is necessary.<sup>40</sup>

### *Future Research*

Cohort studies are needed to determine whether physical activity and sedentary behaviours are risk factors for symptoms of anxiety in the post-secondary student population. Furthermore, future research should further investigate the impact of different aspects of physical activity (including but not limited to sport participation, single vs. group activities, competitive vs. recreational activities, aerobic activity, muscular strengthening, and low-intensity activities such as yoga or tai chi), and different components of sedentary behaviour (such as screen time, social setting sedentary behaviour and commuting/lecture time) on mental health. Finally, future studies should evaluate the possible synergistic effects between physical activity and sedentary behaviour in regards to their association with symptoms of anxiety.

## **3.6 CONCLUSION**

Our results indicate that there is an association between physical activity and moderate to extremely severe symptoms of anxiety, with different constructs of physical activity being important in the two Faculties. However, we did not find an association between sedentary behaviour and moderate to extremely severe symptoms of anxiety. Students would benefit from the addition of physical activity into the university curriculum, regardless of Faculty, as well as the implementation of a peer mentoring/support program in order to encourage higher participation in physical activity. While our research agrees with the current literature, more work is required to adequately understand how physical activity and sedentary behaviour interact to form associations with symptoms of anxiety.

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## **Chapter 4. Discussion and Conclusion**

### **4.1 THESIS SUMMARY**

My thesis investigated the association between physical activity, sedentary behaviour and symptoms of anxiety in post-secondary students. My research included: 1) a systematic review of the literature on the association between physical activity, sedentary behaviour and symptoms of anxiety in post-secondary students; and 2) a cross-sectional study investigating this association in post-secondary students enrolled in the Faculty of Health Sciences and Faculty of Education at Ontario Tech University (formerly the University of Ontario Institute of Technology [UOIT]).

### **4.2 SYSTEMATIC REVIEW OF THE LITERATURE**

*Objective 1: To conduct a systematic review of the literature investigating the associations between physical activity, sedentary behaviour, and symptoms of anxiety in post-secondary students*

The first objective of my thesis was to synthesize the literature on the associations between physical activity, sedentary behaviour, and symptoms of anxiety in post-secondary students. My literature search resulted in 826 articles retrieved from three databases and my review included seven articles that had low to moderate risk of bias. Of the seven included studies, two cross-sectional studies reported that physical activity and sedentary behaviour were associated with symptoms of anxiety and three cross-sectional studies found that physical activity may be associated with anxiety. Moreover, one cross-sectional study found no association between physical activity, sedentary behaviour and symptoms of anxiety, and one randomized controlled trial reported that yoga was not more effective than rest in reducing anxiety. Overall, the current literature is unclear as to whether physical activity and sedentary behaviour are associated with symptoms of anxiety.

### **4.3 LIMITATIONS OF CURRENT LITERATURE**

The current literature provides conflicting preliminary insight into the association between physical activity, sedentary behaviour and symptoms of anxiety. Critically appraising the available literature allowed me to identify several methodological limitations with the existing literature. First, studies included in the review used different tools to define and measure physical activity, sedentary behaviour, and symptoms of anxiety. This is problematic because it may lead to misclassification bias, and varying levels of association between studies. Furthermore, it may make it difficult to compare results across studies. For example, a tool classifies a student as sedentary if they report more than two hours of sedentary time a day may lead to different conclusions about the presence and magnitude of associations than another that study classifies a student as sedentary if they report four hours a day. Moreover, the tools used in many studies that investigated physical activity did not distinguish between the different facets of physical activity, such as aerobic fitness or muscular strengthening.

All cross-sectional studies in the systematic review used self-report questionnaires. Although the tools used were deemed valid and reliable, the use of self-report questionnaires opens the possibility of social desirability bias where participants overestimate their physical activity levels while underestimating their sedentary time.

Another limitation identified in the literature is a lack of covariates included in their analysis. Therefore, it cannot be ruled out that the reported associations are related to other factors. For example, it is known that students exhibiting one unhealthy modifiable risk factor, such as physical inactivity, are more likely to be exhibiting other unhealthy modifiable risk factors, such as poor sleep quality or substance use.<sup>1</sup> These other risk factors which have been hypothesized to

be associated with anxiety should be controlled for in the analysis.<sup>1</sup> Lastly, because most studies were cross-sectional in design, the etiological role of physical activity and sedentary behaviours in the development of anxiety remains unknown in this population. Future research should focus on improving the methodological quality of this literature by controlling for known covariates, such as substance use or poor sleep quality, as well as focus on using tools that distinguish between the different facets of physical activity and types of sedentary behaviour.

#### **4.4 UOIT MENTAL HEALTH AND WELLNESS STUDY**

*Objective 2: To investigate the associations between physical activity, sedentary behaviour, and symptoms of anxiety in post-secondary students enrolled in the Faculty of Health Sciences and Faculty of Education at the University of Ontario Institute of Technology in the Fall 2017 semester.*

The second objective of my thesis was to investigate the associations between physical activity, sedentary behaviour, and symptoms of anxiety in post-secondary students at UOIT. This objective aimed to address some of the gaps identified in my literature review. Specifically, I used valid and reliable tools to capture data on physical activity, sedentary behaviour, and anxiety symptomatology. Using valid and reliable tools aimed to minimize issues related to measurement and misclassification bias was identified in my systematic review. The tool that I used, the Physical Activity and Sedentary Behaviour Questionnaire (PASB-Q) achieves this goal first by distinguishing between two different types of physical activity.<sup>2</sup> This allowed to conduct stratified analyses of the association between aerobic activity, muscular strengthening exercises and moderate to extremely severe symptoms of anxiety. Second, the PASB-Q asks participants about their physical activity such that participants do not have to recall their physical activity over periods of time. Rather, it is up to the researcher to calculate the weekly physical activity values for the participants based on their answers. I also used the Canadian Physical Activity Guidelines

to guide the dichotomization of aerobic physical activity and muscular strengthening. Furthermore, my cross-sectional study adds to the literature on the association between physical activity and sedentary behaviour on the symptoms of anxiety experienced by post-secondary students by adding results that have been adjusted for covariates. Therefore, I was able to investigate the association between physical activity, sedentary behaviour, and symptoms of anxiety by minimizing the impact of spurious effects from the other risk factors.

My analysis suggests that the association between physical activity and symptoms of anxiety differed between the Faculty of Health Sciences and the Faculty of Education. In the Faculty of Health Sciences, students who did not meet the Canadian Physical Activity Guidelines for muscular strengthening were more likely to report moderate to extremely severe symptoms of anxiety (OR: 1.54; 95% CI = 1.11,2.15). However, in the Faculty of Education, students who did not meet the aerobic physical activity guidelines were more likely to report moderate to extremely severe symptoms of anxiety (OR:2.33; 95%CI = 1.25,4.36). The difference observed in associations may be due to the differences in the type of preferred physical activity between the students of the two Faculties. Furthermore, the time constraints experienced by the students of each Faculty may have influenced their choice of physical activity. Students in the Faculty of Education were, on average, older and had more responsibilities outside of school. Therefore, due to responsibilities and time constraints, the students in this Faculty may have simply found it easy to perform aerobic physical activity rather than muscular strengthening. It may be more time efficient for these students to run outside rather than go to the gym to lift weights.

I found no association between sedentary behaviour and symptoms of anxiety in either faculty. Although surprising, this finding could be due to large amounts of students classified as sedentary at UOIT. Traditionally, With UOIT placed an emphasis on technology-based learning

platforms, there are many opportunities for students to remain sedentary. With a large number of students considered sedentary rather than not physically active, it may have been difficult to measure an association between sedentary behaviour and symptoms of anxiety.

#### **4.5 GAPS ADDRESSED BY THE UOIT MENTAL HEALTH STUDY**

The current literature provides little valid information on the associations between physical activity, sedentary behaviour, and symptoms of anxiety. Therefore, my research adds to the current literature by addressing methodological limitations identified in the existing literature. By using valid and reliable tools to measure two forms of physical activity (aerobic physical activity and muscular strengthening), sedentary behaviour, and anxiety, I was able to add credible findings to the literature. Also, by controlling for several other modifiable risk factors, I was able to better understand the true impact physical activity and sedentary behaviour have on symptoms of anxiety experienced by post-secondary students.

My findings suggest that the association between physical activity and moderate to extremely severe symptoms of anxiety vary according to the type of physical activity and the target population. I found that the association between physical activity and moderate to extremely severe symptoms of anxiety varied between the two Faculties in terms of the type of physical activity. This suggests that a preferred type of physical activity may be important in coping with symptoms of anxiety. This finding agrees with a previous study of Czech and Polish adolescents which suggests that participants who engaged in their preferred type of physical activity were more likely to meet physical activity guidelines than participants who were performing physical activity that they did not prefer.<sup>3</sup> Therefore, the similar nature and preferences of the student population in each Faculty may determine which form of physical activity will yield the best benefit on meeting physical activity guidelines and subsequently assisting in coping with symptoms of anxiety.<sup>3</sup>

Preference of physical activity type may play a role in the association between physical activity and symptoms of anxiety.<sup>3</sup>

My findings add to the current literature by confirming and strengthening previous reports of the lack of association between sedentary behaviour and symptoms of anxiety.<sup>3</sup> Specifically, I used a valid and reliable tool to measure sedentary behaviour which is important because previous studies used a single question to measure this construct without documenting the validity or reliability.<sup>4,5,6</sup> Therefore, by using a valid and reliable tool to measure sedentary behaviour, I was able to confirm the finding that sedentary behaviour is not associated with symptoms of anxiety in post-secondary students.

Finally, my research addressed an important limitation of the current literature, namely the need to control for covariates when computing the association between physical activity, sedentary behaviours and symptoms of anxiety in post-secondary students. I collected a broad range of data using a comprehensive set of questions and questionnaires that have been documented to be valid and reliable (to measure sleep quality, food insecurity, substance abuse, comorbidities, chronic neck and/or low back pain, and several sociodemographic variables). This allowed me to build adjusted models of the association between physical activity, sedentary behaviours and symptoms of anxiety, and therefore to comment on the independence of these cross-sectional associations in post-secondary students.

#### **4.6 GENERAL STRENGTHS OF THE THESIS**

My thesis had several strengths. First, the systematic review search strategy was generated with the assistance of a Health Sciences librarian to ensure its rigor. This ensured that all pertinent articles were captured in the search. Second, the critical appraisal of the systematic review was performed by a multi-disciplinary team to ensure that reviewer bias was effectively minimized.



Furthermore, my cross-sectional study was performed using valid and reliable tools that measured not only the independent and dependent variables of interest, but also a broad range of covariates. My study used a three-wave recruitment strategy to minimize selection bias.

#### **4.7 GENERAL LIMITATIONS OF THE THESIS**

My thesis had limitations. First, the systematic review was performed two years ago and would benefit from updating. Second, the cross-sectional study was performed in only two Faculties, the Faculty of Health Science and the Faculty of Education. Therefore, these findings may not be generalizable to students in other Faculties at Ontario Tech. Third, the cross-sectional study uses a self-report questionnaire. Participants have been shown to over report their physically active time and under report their sedentary time on self-report questionnaires when compared to data gathered via accelerometers.<sup>7</sup> This speaks to the social desirability of being more physically active and less sedentary. The social desirability for being physically active may influence students to overreport their physical activity levels. Furthermore, due to stigma that may still exist on campus, students may have been underreported symptoms of anxiety. Therefore, the prevalence of students meeting the weekly physical activity recommendations may be over inflated.

My study was also vulnerable to selection bias. With the main method of recruitment occurring in-class, students who did not attend class were less likely to participate in the study. Therefore, it is possible that students who participated in the study were healthier and may be more likely to engage in health promoting activities. Studies have shown that students who participate in health risking behaviours are likely participating in several health risking behaviours.<sup>1</sup> Therefore, my sample may include a higher proportion of students participating in physical activity than what is truly present in the student population. Finally, due to the nature of cross-sectional studies, no causal inferences can be made regarding the associations between physical activity and

moderate to extremely severe symptoms of anxiety. Therefore, further studies are required to establish a causal relationship between physical activity and anxiety.

#### **4.8 IMPLICATIONS OF MY RESEARCH**

Anxiety is an important psychological burden for post-secondary students and the healthcare system.<sup>8,9</sup> Among post-secondary students, feelings of anxiety are associated with reduced academic performance, increased the likelihood of dropping out, increased substance use, and may lead to increased prevalence academic dishonesty.<sup>10,11,12,13,14</sup> Therefore, it is necessary to understand the etiology of anxiety in post-secondary students in order to act to put in place protective buffers and barriers so that students may effectively cope with possible anxiety. My research suggests that participation in physical activity may be one such buffer that can be implemented on campus to help post-secondary students with their experience of symptoms of anxiety.

While further research is required to identify a causal relationship between physical activity, sedentary behaviour and symptoms of anxiety, programs or courses can be implemented campus-wide to increase physical activity participation among post-secondary students. Despite the school currently providing access for students to recreational facilities and intramural sports, it may be beneficial to include fitness programs within program curricula to teach students the importance of exercise and how to exercise properly. This strategy could be implemented either by promoting enrollment in fitness courses or through a peer mentoring program, in which kinesiology students are paired with students from other Faculties to assist them in developing a fitness plan. Regarding campus intramurals, it may be beneficial to offer a wide variety of sports and competition levels such that students lacking experience in a particular sport would feel less intimidated by joining a rookie or amateur level league.

Finally, a culture shift in the post-secondary environment is necessary. The current cohort of post-secondary students may feel pressured to prioritize their academics and development of social circles before their physical and mental health.<sup>7</sup> Students must feel that it is acceptable, and in fact healthy, for them to take time to be physically active and get adequate sleep. The culture must shift from one that normalizes poor sleep, poor nutrition, inadequate physical activity and a surplus of sedentary behaviour to one that places the student's health as a higher priority.<sup>1,10,15,16</sup> Previous research has shown that a student may perform poorly academically if they experience psychological distress, and therefore, students must be healthy both physically and mentally in order for them to operate at top efficiency in the academic arena.<sup>1</sup>

#### **4.9 FUTURE RESEARCH**

Further research is needed to determine whether physical activity and sedentary behaviour are independent risk factors for the development and progression of symptoms of anxiety. This can be determined using large cohort studies to better understand the causal relationship between physical activity, sedentary behaviour and symptoms of anxiety. These large cohort studies should also control for the confounders known to be associated with symptoms of anxiety, which include sleep quality, neck and low back pain, substance use, food security, and socioeconomic factors. Moreover, qualitative studies are needed to better understand the barriers and facilitators of physical activity and its relationship to symptoms of anxiety in university students. It should be noted that students who engage in physical activity with low skill in whichever activity they are engaging in may be at increased risk for anxiety.<sup>17</sup> Thus, it is imperative that opportunities for participation in physical activity are provided in a welcoming and non-judgmental way. The student experience of participating in physical activity on campus deserves methodologically sound study to qualitatively investigate their experiences, such as going to the campus gym or

playing intramural sports. This type of research would help influence the creation of programs that would be successful as it could help facilitate participation from students who would otherwise remain inactive. These types of studies are important to better identify the barriers keeping students from engaging in physical activity. Once identified, the barriers can be addressed.

Finally, while my study investigated associations within the Faculty of Health Sciences and the Faculty of Education, the findings of my study are not generalizable to the entire post-secondary population. Understanding the associations between physical activity, sedentary behaviour and symptoms of anxiety in other Faculties and universities is necessary to produce a strategy that could be effective campus wide. Moreover, my study was cross-sectional in design.

#### **4.10 CONCLUSIONS**

I hypothesized that post-secondary students who exhibit behaviours such as physical inactivity and sedentary behaviour may be more likely to report moderate to extremely severe symptoms of anxiety. My research suggests that physical activity may be associated with moderate to extremely severe symptoms of anxiety in post-secondary students, but that the associations may vary across different samples of students. However, I did not find associations between sedentary behaviour and moderate to extremely severe symptoms of anxiety. This suggest that physical activity and sedentary behaviours may not be at opposite ends of a continuum. Post-secondary institutions should be mindful to include education regarding the importance of student engagement in physical activity throughout the school year as well as to work towards the creation of an inclusive physical activity curriculum.

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## APPENDICES

### Appendix A. SEARCH STRATEGY

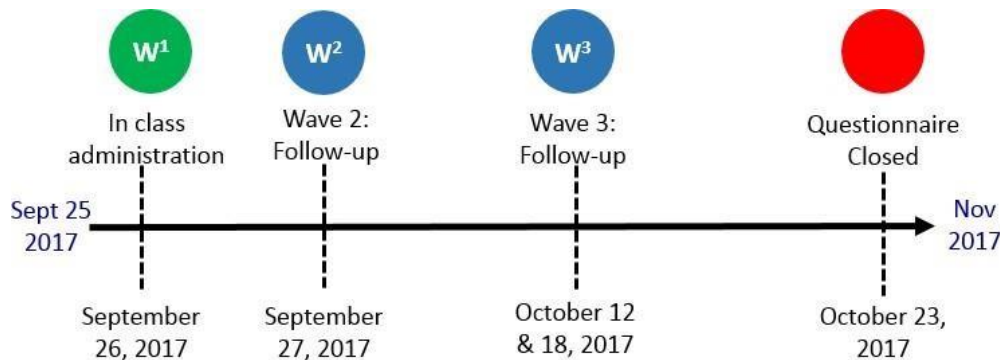
1. Universities/
2. Students/
3. exp Students/
4. exp Schools/
5. exp Education, Professional/
6. (student\* adj4 (colleg\* or universit\*)) .ab,ti.
7. (student\* adj4 (undergraduate\* or professional\*)) .ab, ti.
8. (student\* adj4 (freshman or freshmen or sophomore or senior\*)) .ab, ti.
9. (student\* adj4 (postsecondary or post-secondary or post secondary)) .ab, ti.
10. Or/ 1-9 [\*\*post-secondary students]
11. Case-Control Studies/
12. Cohort Studies/
13. Cross-Sectional Studies/
14. Epidemiologic Studies/
15. Epidemiology/
16. Randomized Control Trials/
17. Follow-Up Studies/
18. Longitudinal Studies/
19. Prospective Studies/
20. Retrospective Studies/
21. (case control or case-control) .ab, ti.
22. Cohort.ab, ti.
23. (cross sectional or cross-sectional).ab, ti.
24. "Epidemiolog\*" .ab, ti.
25. "longitudinal\*" .ab, ti.
26. "prospective" .ab, ti.
27. "retrospective" .ab, ti.
28. Or/11-27 [\*\*study designs]
29. Mental Health/
30. Mental Disorders/
31. Anxiety Disorders/
32. Exp Anxiety/
33. Student Dropouts/
34. Anxiety.ab, ti.
35. (dropout\* and (student\* or rate or prevalence)).ab,ti.
36. Emotional well-being.ab,ti.
37. (mental and (condition\* or disability\* or disorder\* or disease\* or health or illness\* or problem\* or symptom\*)).ab,ti.



38. (psychiatr\* and (condition\* or disability\* or disorder\* or disease\* or health or illness\* or problem\* or symptom\*)).ab,ti.
39. (psychological and (condition\* or disability\* or disorder\* or disease\* or health or illness\* or problem\* or symptom\*)).ab,ti.
40. Social well-being.ab,ti.
41. Or/29-40 [\*\* anxiety]
42. Physical Fitness/
43. Physical Activity/
44. exp Physical Activity/
45. exp Exercise/
46. exp Sport
47. Strength Training/
48. Resistance Training/
49. Aerobic Training/
50. Motor Activity/
51. Martial Arts/
52. Weightlifting/
53. (stretch\* and (active or ballistic or dynamic or static or isometric)).ab,ti.
54. "exercise\*".ti.
55. Muscle strength.ab,ti.
56. (training and (fitness or endurance or strength\* or resistance or plyometric or aerobic)).ab,ti.
57. Running.ab,ti.
58. Walking.ab,ti.
59. Sports.ab,ti.
60. Yoga.ab,ti.
61. Or/ 42-60 [\*\*physical activity]
62. Sedentary lifestyle/
63. Sitting.ab,ti.
64. Sedentary.ab, ti.
65. (screen and (activit\* or behavi\* or time)).ab,ti.
66. (television and (activit\* or behavi\* or time)).ab,ti.
67. Or/62-66 [\*\*sedentary]
68. 61 or 67
69. 10 and 28 and 41 and 68
70. Limit 120 to (English language and yr="2000-Current")

## Appendix B. RECRUITMENT STRATEGY

Three waves of recruitment and data collection were conducted to maximize participation. It was our understanding that all three administrations, together, would increase the quality and size of our sample.



### Wave 1

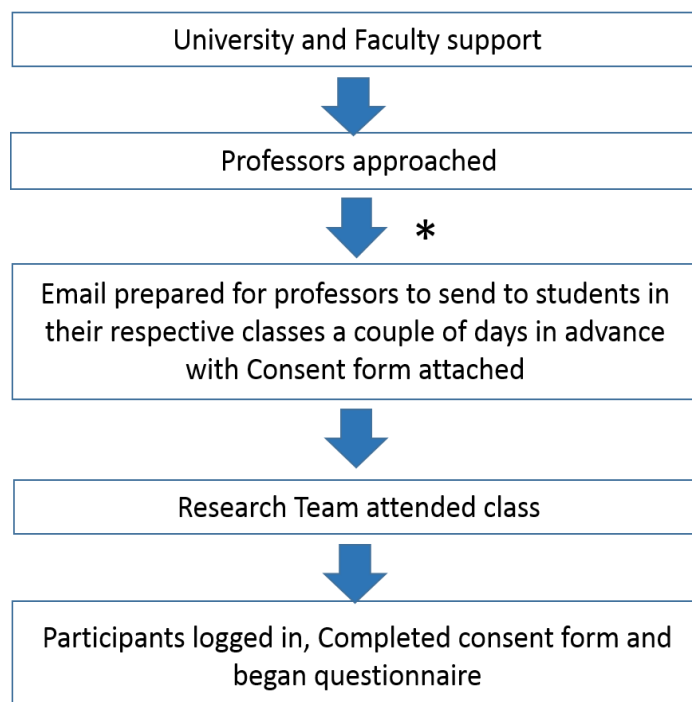
The first wave of data collection was conducted in-class.

### *Course selection*

The classes were selected by gaining access to the list of courses being offered by the FHS in the Fall of 2017, and cross-referencing all offered classes with online program maps for each stream within the FHS. Program maps outline all the courses that students are required to enroll in for each year of the program; maps are designed according to each stream offered in the FHS. Required courses that overlapped across streams in the FHS were selected for the in-class wave of administration. When we encountered no overlapping course across streams within a specific year of study, the largest class in that stream was selected. The objective with this strategy was to decrease and/or minimize the possibility of asking students to complete the questionnaire more than once. We selected courses within which the most number of students, across the most number of streams offered within the FHS, are enrolled. We selected a total of 8 courses (covering approximately 1440 enrolled students). This required 12 in-class administrations during our first wave of the study. Due to the small size and structure of the programs in the FEd, we administered the questionnaire in one required course.

However, there were 3 unique administrations within this course to account for different sections. We anticipated reaching all students enrolled in the FEd Bachelor of Education (concurrent program), through administering the questionnaire in this course.

Figure 1. Wave one recruitment strategy diagram



Step 1: University and Faculty support – This support enabled us to send out and post information via different mediums to promote the University Mental Health and Wellness study.

Step 2: Professors Approached – FHS and FEd faculty were updated and informed of full procedures that would take place throughout the study and questionnaire administration process.

Step 3: Email was prepared for professors to send to students in their respective classes a couple of days in advance with consent form attached. A week prior to the study, an email was sent out to the students to invite them to take part in the study. Consent form were attached to the email, to allow all potential participant the opportunity to review prior to questionnaire administration. They were also informed that the study is voluntary, that it would take place during class time, and that a laptop or mobile-device would be needed in order to participate in the study.

Step 4: Research Team attended class – On the day of the study, the research coordinator (KS) and the graduate students involved in the project (NH, AR, MS, NFS) attended attend the class. To minimize the potential for coercion, we clearly stated that the study is voluntary and that non-participation will not affect their grades in any way. We also asked the course instructor to leave the classroom before the researchers addressed the students. The professor were invited to return to the classroom once all

participating students completed the survey. The autonomy of the participants was respected by administering informed consent and clearly explaining that the study is voluntary and participants are free to withdraw.

Step 5: Participants were asked to log in, complete the consent form and begin the questionnaire - Students who were interested in participating were provided with the URL for the study (this URL is unique for the study). The URL was posted on the screen in the classroom. Students were requested to read and provide informed consent by ticking a box. Students were also asked if they agree for the data to be used for secondary analyses. The study coordinator was present to answer any questions regarding the informed consent. We requested that students who do not to participate remain in their seat to protect the identities of participants. We remained in the classroom for 15 minutes, post survey start (20 minutes in total).

## **Wave 2**

Our second wave of administration was conducted through Blackboard message. Blackboard is an online external server used by post-secondary institutions to facilitate communication between students and instructors. All students have personalized accounts; students are added to Blackboard groups according to the courses within which they are enrolled.

These groups are known as “classrooms”.

Within each classroom, students have access to announcement boards and messages. We prompted the instructors in all courses from initial administration to send a Blackboard message to all enrolled students. This message included standardized information to all students regarding the objectives of the study, and include a link directing them to the questionnaire. We also included information regarding informed consent within this message. Students who were in-class and completed the questionnaire during the first wave of administration were unable to access it again. Our rationale for administering through Blackboard message was to offer students who were absent in-class and/or did not participate during the initial administration, an opportunity to participate if they chose. Our second wave of administration was only accessible to students enrolled in the courses that we completed an in-class administration (13 in-class administrations, 9 courses in FHS; 3 in-class administrations, 1 course in FEd).

## **Wave 3**

Our third wave of administration was conducted through an email sent from the Dean of FHS and FEd to all enrolled students in their respective faculties. The email included a short description of the study and our objectives, and a link directing students to an

external Google drive where they could access the questionnaire if they chose to participate. The email also outlined information regarding informed consent. Students who completed the questionnaire during the first or second wave (either through in-class administration or via Blackboard message), were unable to access the questionnaire. Our rationale for our third and final wave of administration was to extend our reach to all enrolled students enrolled in a program in the two faculties, and offer an opportunity for them to participate in our study.

The data collected through the questionnaire was anonymized; therefore, information was irrevocably stripped of direct identifiers, no codes were kept to allow future re-linkages, and risk of re-identification of individuals from remaining indirect identifiers is low or very low.

## Appendix C: **IN-CLASS PRESENTATION SCRIPT**

Good Morning/Afternoon. My name is \_\_\_\_\_. I am a Graduate student in the Faculty of Health Sciences. My thesis supervisor is Dr. Pierre Côté and I am studying mental health and wellness in undergraduate students. Therefore, we are conducting an online survey to better understand mental health and wellness in undergraduate university students.

In order to conduct the study at the university, we need to understand if it is adequate and acceptable to you. We have spoken with your professors about testing the questionnaire in your class and they have agreed. The study is also supported by the Dean, of your Faculty.

Your participation in this study is completely voluntary. You will be asked to read an informed form that explains the study and what is required from you. The consent form also outlines the risks and benefits of participating in the study. If you agree to participate, we will ask you to complete the questionnaire today in class. Students who start to complete the questionnaire can drop out at any time if they wish to however, once the questionnaire has been submitted, the information will be maintained for data analysis. If you do not wish to participate in this study, you may quietly remain in the classroom.

You will be required to use your UOIT.net login to access the questionnaire. Your UOIT.net user name and/or student ID number will be deleted from the data set prior to Dr. Côté receiving the data. This will ensure that that your confidentiality and anonymity are maintained. All of the data will be stored on a secure network, which IT has assisted in creating to guarantee that no one else will have access to this data.

Appendix D: **REB APPROVAL/REQUEST CHANGE**

*Date: September 4, 2017 (November 18, 2017)*

*To: Pierre Côté*

*From: Janice Moseley, Research Ethics Officer for Shirley Van Nuland, REB Chair*

*File # & Title: 14515 - UOIT-CMCC Mental Health and Wellness Study*

**Status: APPROVED**

*(CHANGE REQUEST APPROVED [received at the REB on November 9, 2017]) Current*

*Expiry: September 01, 2018 Current Expiry: September 01, 2018*

Notwithstanding this approval, you are required to obtain/submit, to UOIT's Research Ethics Board, any relevant approvals/permissions required, prior to commencement of this project.

The University of Ontario, Institute of Technology Research Ethics Board (REB) has reviewed and approved the change request related to the research proposal cited above. This request has been reviewed to ensure compliance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2 (2014)) and the UOIT Research Ethics Policy and Procedures. You are required to adhere to the protocol as last reviewed and approved by the REB.

**Continuing Review Requirements** (all forms are accessible from the [IRIS research portal](#)):

- **Renewal Request Form:** All approved projects are subject to an annual renewal process. Projects must be renewed or closed by the expiry date indicated above ("Current Expiry"). Projects not renewed 30 days post expiry date will be automatically suspended by the REB; projects not renewed 60 days post expiry date will be automatically closed by the REB. Once your file has been formally closed, a new submission will be required to open a new file.
- **Change Request Form:** Any changes or modifications (e.g. adding a Co-PI or a change in methodology) must be approved by the REB through the completion of a change request form before implemented.
- **Adverse or Unexpected Events Form:** Events must be reported to the REB within 72 hours after the event occurred with an indication of how these events affect (in the view of the Principal Investigator) the safety of the participants and the continuation of the protocol (i.e. un-

anticipated or unmitigated physical, social or psychological harm to a participant).

- **Research Project Completion Form:** This form must be completed when the research study is concluded.

Always quote your REB file number (**14515**) on future correspondence. We wish you success with your study.

Dr. Shirley Van Nuland REB  
Chair  
[shirley.vannuland@uoit.ca](mailto:shirley.vannuland@uoit.ca)

Janice Moseley Research  
Ethics Officer  
[researchethics@uoit.ca](mailto:researchethics@uoit.ca)

*NOTE: If you are a student researcher, your supervisor has been copied on this message.*



## UOIT Mental Health and Wellness Study

Thank you very much for your willingness to participate in this survey. Your answers to the questionnaire will remain confidential. Once completed and submitted, the researchers will not be able to trace your answers back to you. If you agree to participate please check the box which is located at the bottom of the informed consent form.

The purpose of this study is to assess the test feasibility of a conducting a large study to describe the burden and lifestyle factors associated with mental health and wellness in undergraduate university students.

This questionnaire inquires about mental health and wellness and factors that may be related to it. These factors include sleep quality, physical activity, food access, neck and back pain, substance use and socio-demographic variables.

You must be 18 years or older to participate in this study.

We would like to remind you that if you are concerned about your well-being, or feel that, you may benefit from support and assistance, please contact Student Mental Health Services to set up an appointment. You can contact student services in one of three ways:

- email [studentlifeline@uoit.ca](mailto:studentlifeline@uoit.ca)
- call 905.721.3392
- drop by Student Life suite (U5 Building at North Campus or 2nd floor of 61 Charles St for the downtown campus) for a chat.

There are also community resources available 24/7, they are: Distress Centre Durham at 905-430-2522 and Durham Crisis Line at 905-666-0483

Thank you very much for considering participating in this important study which will help us better understand mental health and wellness in university students.

\* Required

Title of Research Study:  
UOIT-CMCC Mental Health and Wellness study

Researcher(s):  
Dr. Pierre Côté, Dr. Victoria Smye, Dr. Robert Weaver, Dr. Efrosini Papaconstantinou, Dr. Jennifer Laffier, Dr. Ellen Vogel, Dr. Tyler Frederick, and Dr. Cindy Malachowski, Kathy Smith, MHSc, Nayantara Hattangadi, Andrew Reynolds, Michael Short and Nancy Flynn  
Faculty of Health Sciences,  
University of Ontario Institute of Technology  
Contact number: (905) 721-8668 Ext 3674  
Email: [Kathy.smith@uoit.ca](mailto:Kathy.smith@uoit.ca)

You are invited to participate in a research study at the University of Ontario Institute of Technology in the Faculty of Health Sciences and Faculty of Education. This study (REB File # 17-xxxx) has been reviewed by the University of Ontario Institute of Technology Research Ethics Board and has been approved as of Month day 2017. Please read this form carefully, and feel free to ask any questions you might have. If you have any questions about your rights as a participant in this study, please contact the Ethics and Compliance Officer at 905 721 8668 ext 3693 or [compliance@uoit.ca](mailto:compliance@uoit.ca).

Before agreeing to participate in this study, it is important that you read and understand the following explanation of the proposed study procedures. The following information describes the purpose, procedures, benefits, and risks associated with this study. It also describes your right to refuse to participate or withdraw from the study at any time. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is known as the informed consent process.

Please read through this document carefully, and ask Kathy Smith or Dr. Pierre Côté to explain anything that you don't understand before consenting to this study. Make sure all your questions have been answered to your satisfaction before signing this document.

**Purpose and Procedure:**  
The purpose of this study is to enhance our understanding of lifestyle factors that may be associated with mental health issues and help identify students who may be at risk of developing mental health problems. This information is necessary to mitigate the disabling effects of mental health problems.

**Informed** The mental health and well being in university students is a public health concern in Canada. However, we know very little about the prevalence of depressive symptoms,

**Consent** anxiety and stress among undergraduate university students. Therefore, we need to investigate these issues to better prevent and manage mental health problems in university students.

We would appreciate if you could work with us in gaining knowledge about mental health and wellness in undergraduate students by consenting to participate in this study and completing an online questionnaire. You will complete this questionnaire once during the class time. The questionnaire will take approximately 15 minutes to complete, and all information provided is confidential.

**Time commitment:**

The questionnaire is a one-time, only, administration and will take approximately 15 minutes to complete. The one-time administration will be in-class first. However if you are not able to participate in class there will be two follow emails sent that will provide a link to the questionnaire to enable you to complete the questionnaire.

**Potential Benefits:**

There are no direct benefits for participating in the study. However, participating will provide indirect benefits to the student community by reducing stigma and improving awareness of mental health and wellness.

**Potential Risk or Discomforts:**

There are no known risks associated with participating in the study. However, participants may experience psychological or emotional discomfort. We remind you that UOIT students who need support or help should feel free to contact UOIT Student Mental Health services at the Student life suite.

We're here to support you! UOIT offers a range of services for students to support their positive mental health, strengthen their resilience, and help them manage the multiple demands of university life. If you are concerned about your well-being, or feel that, you may benefit from support and assistance, please contact Student Mental Health Services to set up an appointment. You can email ([studentlifeline@uoit.ca](mailto:studentlifeline@uoit.ca)), call 905.721.3392 or drop by Student Life suite (U5 Building at North Campus or 2nd floor of 61 Charles St for the downtown campus).

For more information, and to learn about the services offered please visit the Student Mental Health website: <http://studentlife.uoit.ca/mentalhealth/index.php>

#### Storage of Data:

All data and consent forms will be kept on a secure UOIT network, which the UOIT IT Department has assisted with. The IT department at UOIT will have access to the raw data and will remove and destroy all identifiers (Banner ID, UOIT.net login and date of birth). This data will be stored on a secure Google Drive account. Dr. Pierre Côté, Dr. Efrosini Papaconstantinou, Ms. Kathy Smith, Ms. Nayantara Hattangadi, Mr. Andrew Reynolds, Mr. Michael Short and Ms Nancy Flynn will have access to the de-identified amalgamated data but not to the raw data.

#### Confidentiality:

You will be using your UOIT.net account to login and answer the questionnaire. Once the data is collected, the UOIT net administration will take the data from the first administration of the questionnaire and assign a Study ID. The Study ID will bear no resemblance to any of your personal identifiers. The Study ID will maintain your anonymity. The UOIT net administration will then send a study data file without identifiers to Dr. Pierre Côté; the IT department will also destroy any original data files with identifiers once the study data file has been sent to Dr. Pierre Côté. Data files will be stored within UOITs Google Drive Suite for Education instance, which is hosted by Google.

#### Anonymity:

The raw data will be de-identified of any Banner ID or UOIT.net login information and replaced with a Study ID. The de-identified files will be sent to the research team to ensure your anonymity is maintained. Neither Dr. Côté, nor any of the researchers, will have information relating to personal identifiers so the release of these findings will be completely anonymous.

#### Right to Withdraw:

Your participation in this study is completely voluntary and will not affect your standing **Informed** within this course. You are free to withdraw at any point in time. If you do not wish to

**Consent** take part in the study, you do not need to complete the consent form and may remain

seated in the class. If you wish to withdraw after giving informed consent but before

**(Continued)** submitting the questionnaire, you may do so by leaving the webpage where the questionnaire is available. This data will not be recorded.

You can also withdraw at anytime before November 15, 2017 by contacting Neil Hopkins or Bevin Moolenschot from the UOIT IT Department by emailing [Ask@uoit.net](mailto:Ask@uoit.net). They will delete your data and you information will be used in the analysis.

#### Compensation for Participation:

There will be no compensation to participants for involvement with this study.

#### Debriefing and Dissemination of Results:

The results of this study will be completed by December 2017. If you desire to receive information regarding the results of this study, please contact the researchers at (905) 721-8668 Ext 5922 or by email at [kathy.smith@uoit.ca](mailto:kathy.smith@uoit.ca) or [pierre.cote@uoit.ca](mailto:pierre.cote@uoit.ca). You will also be invited to a debriefing session were the results of the study will be presented to participants.

#### Participant Concerns and Reporting:

This research project has been approved by the University of Ontario Institute of Technology Research Ethics Board (REB File # 17-xxxxx) as of Month day 2017.

If you have any questions concerning the research study, or experience any discomfort related to the study please contact the researcher(s) at (905) 721-8668 Ext 5922 or by email at [kathy.smith@uoit.ca](mailto:kathy.smith@uoit.ca) or [pierre.cote@uoit.ca](mailto:pierre.cote@uoit.ca).

Any questions regarding your rights as a participant, complaints or adverse events may be addressed to Research Ethics Coordinator at [researchethics@uoit.ca](mailto:researchethics@uoit.ca) or (905) 721 8668 ext 3693.

## 1. Informed Consent \*

*Check all that apply.*

☐ I consent to voluntarily take part in the study with the understanding I may withdraw at any time. I have had an opportunity to ask questions and my questions have been answered. I am aware of all the risks and benefits associated with my participation and have read the entire consent form. I am free to ask questions about the study in the future.

## 2. Secondary Use of Data

The information collected for this study may be used for secondary research in the future. This could include secondary data analysis, future research studies etc.

*Check all that apply.*

☐ I agree to allow the data collected in the study to be used for future secondary research

completed Ready and submitted, the researchers will not be able to trace your answers back to you. The to questionnaire includes questions regarding lifestyle behaviours (sleep habits, physical activity, alcohol and drug use, food access, socio-demographic variables, neck and back pain) on begin mental health.

About yourself

3. How old are you? \* *Mark only one oval.*

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4. What gender do you identify with? \*

*Mark only one  
oval.*

☐ Female

☐ Male

☐ Transgender Male/Trans Man/Female-to-Male (FTM)

☐ Transgender Female/Trans Woman/Male-to-Female (MTF)

☐ Genderqueer, neither exclusively male nor female (or Gender Fluid, or Non-Binary Gender)

☐ Choose not to disclose

☐ Other:

---

5. What is your program of study? \* *Mark only one oval.*

- ☐ Nursing
  - ☐ Kinesiology
  - ☐ Public Health
  - ☐ Human Health
  - ☐ Medical Laboratory Science
  - ☐ Allied Health Science
  - ☐ Health Science Comprehensive
  - ☐ Fitness and Health Promotion Bridge
  - ☐ Nursing (Registered Practical Nurse
  - ☐ Bridge) Other:
- 

6. What is your year of study? \* *Mark only one oval.*

- ☐ 1st year
- ☐ 2nd year
- ☐ 3rd year
- ☐ 4th year
- ☐ 5+ year

7. Have you been diagnosed with any of the following medical conditions by a healthcare provider?

Please check all that may apply



Check all that apply.

- ☐ Allergies (including hay fever or nasal allergy)
- ☐ Arthritis, for example osteoarthritis, rheumatoid arthritis, gout or any other type, excluding fibromyalgia
- ☐ Asthma
- ☐ Attention disorder or learning disability (e.g., attention deficit disorder, attention deficit hyperactivity disorder, learning disability)
- ☐ Bowel disorder such as Crohn's Disease, ulcerative colitis, Irritable Bowel Syndrome or bowel incontinence
- ☐ Chronic fatigue syndrome
- ☐ Eating disorder (e.g., anorexia nervosa, bulimia nervosa)
- ☐ High blood pressure
- ☐ Intestinal or stomach ulcers
- ☐ Migraine headaches
- ☐ Mood disorder such as depression, bipolar disorder, mania or dysthymia
- ☐ Scoliosis
- ☐ Sexually transmitted infection(s)

Other: ☐ \_\_\_\_\_

**About your  
physical  
activity in  
the past 7  
days**

Please answer the following questions based on what you do in a typical week. To increase accuracy, you may wish to think about your physical activity and sedentary behaviour for one week prior to answering the questions.

**Aerobic Physical Activity**

8. In a typical week, how many days do you do moderate-intensity (like brisk walking) to vigorous-intensity (like running) aerobic physical activity ? \* *Mark only one oval.*

- ☐ 1 day
- ☐ 2 days
- ☐ 3 days
- ☐ 4 days
- ☐ 5 days
- ☐ 6 days
- ☐ 7 days

9. On average for days that you do at least moderate-intensity aerobic physical activity (as specified above), how many minutes do you do?
- 

Please answer the following questions based on what you do in a typical week. To increase accuracy, you may wish to think about your physical activity and sedentary behaviour for one week prior to answering the questions.

Muscle Strengthening Physical Activity

10. In a typical week, how many times do you do muscle strengthening activities (such as resistance training or very heavy gardening)?
- 

Please answer the following questions based on what you do in a typical week. To increase accuracy, you may wish to think about your physical activity and sedentary behaviour for one week prior to answering the questions.

Perceived Aerobic Fitness

11. In general, would you say that your aerobic fitness (ability to walk/run distances) is: \*

*Mark only one oval.*

- ☐ Excellent
- ☐ Very Good
- ☐ Good
- ☐ Fair
- ☐ Poor

Please answer the following questions based on what you do in a typical week. To increase accuracy, you may wish to think about your physical activity and sedentary behaviour for one week prior to answering the questions.

#### Sedentary Behaviour

12. On a typical day, how many hours do you spend in continuous sitting: at work, in meetings, volunteer commitments and commuting (i.e., by motorized transport)? \* *Mark only one oval.*

- None
- less than 1 hour
- 1 to less than 2 hours
- 2 to less than 3 hours
- 3 to less than 4 hours
- 4 to less than 5 hours 5 to less than 6 hours more than 6 hours

13. On a typical day, how many hours do you watch television, use a computer, read, and spend sitting quietly during your leisure time? \* *Mark only one oval.*

- None
- less than 1 hour
- 1 to less than 2 hours
- 2 to less than 3 hours
- 3 to less than 4 hours

- 4 to less than 5 hours
- 5 to less than 6 hours
- more than 6 hours

14. When sitting for prolonged periods (one hour or more), at what interval would you typically take a break to stand and move around for two minutes? \*

*Mark only one oval.*

- ☐ less than 10 minutes
- ☐ 10 to less than 20 minutes
- ☐ 20 to less than 30 minutes
- ☐ 30 to less than 45 minutes
- ☐ 45 to less than 1 hour
- ☐ 1 to less than 1.5 hours
- ☐ 1.5 to less than 2 hours
- ☐ more than 2 hours

### About your Mental Health

Please read each statement and place a check beside the option which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

- Never: Did not apply to me at all
- Sometime: Applied to me to some degree, or some of the time
- Often: Applied to me to a considerable degree, or a good part of time
- Almost Always: Applied to me very much, or most of the time

15. Your Mental Health \*

Check the one best response (below) regarding your mental health in the past week.

Mark only one oval per row.

	Never	Sometimes	Often	Almost Always
I found it hard to wind down	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was aware of dryness of my mouth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I couldn't seem to experience any positive feeling at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it difficult to work up the initiative to do things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I tended to over-react to situations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experienced trembling (e.g. in the hands)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt that I was using a lot of nervous energy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was worried about situations in which I might panic and make a fool of myself	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt that I had nothing to look forward to	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found myself getting agitated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it difficult to relax	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt down-hearted and blue	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was intolerant of anything that kept me from getting on with what I was doing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt I was close to panic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was unable to become enthusiastic about anything	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I felt I wasn't worth much as a person	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt that I was rather touchy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt scared without any good reason	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt that life was meaningless	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16. Please think about the last 30 days, taking both good and bad days into account. For each question, please tell me how much of a problem it is for you on a scale from 1 to 5. 1 means no problem and 5 means extreme problem. \*

Mark only one oval per row.

	1	2	3	4	5	Don't Know
How much of a problem do you have with feeling sad, low or depressed?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How much of a problem do you have with feeling worried, nervous or anxious?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How much of a problem is handling stress, such as controlling the important things in your life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How much of a problem is coping with all the things you have to do?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

About  
your  
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.

17. During the past month when have you USUALLY gone to bed at night? \*

Please indicate the hour (Hrs) and minute (Mins) and ensure you have chosen AM or PM.

Example: 8:30 AM

18. During the past month, how long has it USUALLY taken you to fall asleep each night? \*

Mark only one  
oval.

15 minutes or less

16 - 30 minutes

31 - 60 minutes

more than 60 minutes

19. During the past month, when have you USUALLY gotten up in the morning? \*

Please indicate the hour (Hrs) and minute (Mins) and ensure you have chosen AM or PM.

---

*Example: 8:30 AM*

20. During the past month, how many HOURS of actual sleep did you get a night?  
(This may be different than the number of hours you spend in bed.) \*

Please indicate the number of hours (Hrs) and minutes (Mins).

*Mark only one  
oval.*

more than 7 hours sleep/night

6 to 7 hours

sleep/night

5 to 6 hours

sleep/night

less than 5 hours

sleep/night

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

\*

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



Mark only one oval per row.

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
Cannot get to sleep within 30 minutes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wake up in the middle of the night or early morning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have to get up to use the bathroom	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cannot breathe comfortably	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cough or snore loudly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feel too cold	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feel too hot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have bad dreams	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have pain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other reason(s), please describe, including how often you have had trouble sleeping of this reason(s):	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

22. If you have checked Other reason(s) above, please describe:

23. During the past month... \*

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

Mark only one oval per row.

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

24. During the past month, how would you rate your sleep quality overall? \*

Mark only one  
oval.

- ☐ Very good  
☐ Fairly good  
☐ Fairly bad  
☐ Very bad

About  
your  
access to  
Food

These next questions (statements) are about the food eaten in your household in the last 12 months, since March of last year and whether you were able to afford the food you need.

Select the appropriate option from the choices listed below each statement depending on the number of persons in the household.

25. "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." \*

Was that often, sometimes, or never true for (you/your household) in the last 12 months?

*Mark only one oval.*

- ☐ Often true
- ☐ Sometimes true
- ☐ Never true
- ☐ Don't know/refuse to answer

26. "(I/we) couldn't afford to eat balanced meals." \*

Was that often, sometimes, or never true for (you/your household) in the last 12 months?

*Mark only one oval.*

- ☐ Often true
- ☐ Sometimes true
- ☐ Never true
- ☐ Don't Know/refuse to answer

27. In the last 12 months, since last March, did you and/or other persons in your household ever cut the size of your meals or skip meals because there wasn't enough money for food? \* *Mark only one oval.*

- ☐ Yes      *Skip to question 28*
- ☐ No      *Skip to question 29*
- ☐ Don't know      *Skip to question 29*

28. How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

*Mark only one oval.*

- ☐ Yes, almost every month
- ☐ Yes, some months but not every month
- ☐ Yes, only 1 or 2 months
- ☐ No

29. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food? \* *Mark only one oval.*

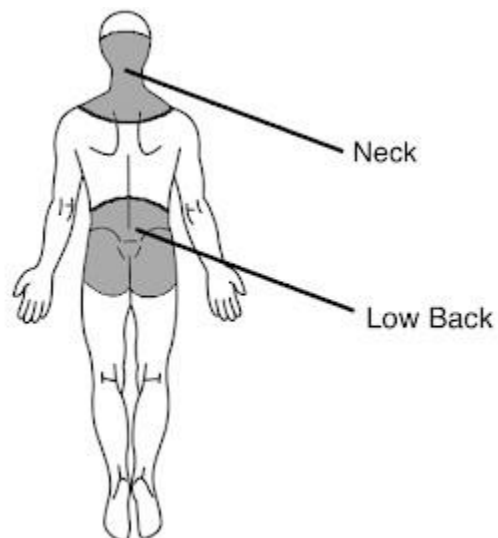
- ☐ Yes
- ☐ No
- ☐ Don't Know

30. In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?

*Mark only one oval.*

- ☐ Yes
- ☐ No
- ☐ Don't Know

## About your Neck and Back Pain



31. In the past 7 days, have you experienced any pain in your NECK? \*

*Mark only one oval.*

☐ Yes

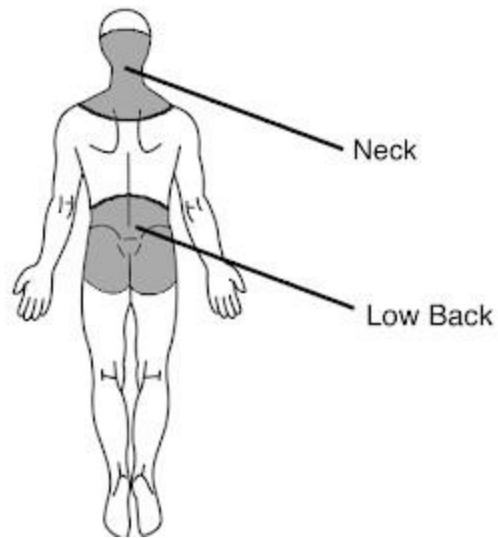
☐ No      *Skip to question 33*

32. If yes, please indicate the intensity of your average NECK pain over the past 7 days on a scale of 0 (no pain) to 10 (worst pain imaginable).

*Mark only one oval.*

0	1	2	3	4	5	6	7	8	9	10
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## About your Low Back Pain



33. In the past 7 days, have you experienced any pain in your LOW BACK? \*

*Mark only one oval.*

☐ Yes

☐ No      *Skip to section 20 (About your Alcohol and Drug use)*

34. If yes, please indicate the intensity of your average LOW BACK pain over the past 7 days on a scale of 0 (no pain) to 10 (worst pain imaginable).

*Mark only one oval.*

0	1	2	3	4	5	6	7	8	9	10
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

This is a brief survey about alcohol, tobacco products and other drugs. Some questions will be asked about your experience of using these substances across your lifetime and in the past three months. These substances can be smoked, swallowed, snorted, inhaled, injected or taken in the form of pills.

Some of the substances listed may be prescribed by a doctor (like amphetamines, sedatives, pain medications). Please do not report MEDICATIONS AS PRESCRIBED by your doctor unless used outside the prescription (e.g. increased frequency or higher doses). While we are also interested in knowing about your use of various illicit drugs, please be assured that information on such use will be treated as strictly confidential.

cigarettes, chewing tobacco, cigars, etc.

## Tobacco use

A  
b  
o  
u  
t  
y  
o  
u  
r  
A  
l  
c  
o  
h  
o  
l  
a  
n  
d  
D  
r  
u

35. In your life, have you ever used tobacco products (cigarettes, chewing tobacco, cigars, etc.)? (NON-MEDICAL USE ONLY) \* *Mark only one oval.*

- ☐ No *Skip to question 41*
- ☐ Yes

cigarettes, chewing tobacco, cigars, etc.

Tobacco use

36. In the past 3 months, how often have you used tobacco products (cigarettes, chewing tobacco, cigars, etc.)? \* *Mark only one oval.*

- ☐ Never *Skip to question 39*
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

cigarettes, chewing tobacco, cigars, etc.

Tobacco use



37. During the past three months, how often have you had a strong desire or urge to use tobacco products (cigarettes, chewing tobacco, cigars, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

38. During the past three months, how often has your use of tobacco products (cigarettes, chewing tobacco, cigars, etc.) led to health, social, legal or financial problems?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

cigarettes, chewing tobacco, cigars, etc.

Tobacco use

39. Has a friend or relative or anyone else ever expressed concern about your use of tobacco products (cigarettes, chewing tobacco, cigars, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

40. Have you ever tried and failed to control, cut down or stop using tobacco products (cigarettes, chewing tobacco, cigars, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

beer, wine, spirits, etc.

Alcohol use

41. In your life, have you ever used alcoholic beverages (beer, wine, spirits, etc.)?  
(NON-MEDICAL USE ONLY)

*\* Mark only one oval.*

- ☐ No      *Skip to question 48*
- ☐ Yes

beer, wine, spirits, etc.

Alcohol use

42. In the past three months, how often have you used alcoholic beverages (beer,

wine, spirits,

etc.)? \* *Mark*

*only one oval.*

- ☐ Never      *Skip to question 46*
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

beer, wine, spirits, etc.

#### Alcohol use

43. During the past three months, how often have you had a strong desire or urge to use alcoholic beverages (beer, wine, spirits, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

44. During the past three months, how often has your use of alcoholic beverages (beer, wine, spirits, etc.) led to health, social, legal or financial problems?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

45. During the past three months, how often have you failed to do what was normally expected of you because of your use of alcoholic beverages (beer, wine, spirits, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

beer, wine, spirits, etc.

#### Alcohol use

46. Has a friend or relative or anyone else ever expressed concern about your use of alcoholic beverages (beer, wine, spirits, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

47. Have you ever tried and failed to control, cut down or stop using alcoholic beverages (beer, wine, spirits, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

marijuana, pot, grass, hash, etc.

Cannabis use

48. In your life, have you ever used Cannabis (marijuana, pot, grass, hash, etc.)?  
(NONMEDICAL USE ONLY) \* *Mark only one oval.*

- ☐ No      *Skip to question 55*
- ☐ Yes

marijuana, pot, grass, hash, etc.

Cannabis use

49. In the past three months, how often have you used Cannabis (marijuana, pot, grass, hash, etc.)? \* *Mark only one oval.*

- ☐ Never      *Skip to question 53*
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

marijuana, pot, grass, hash, etc.

## Cannabis use

50. During the past three months, how often have you had a strong desire or urge to use Cannabis (marijuana, pot, grass, hash, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

51. During the past three months, how often has your use of Cannabis (marijuana, pot, grass, hash, etc.) led to health, social, legal or financial problems?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

52. During the past three months, how often have you failed to do what was normally expected of you because of your use of Cannabis (marijuana, pot, grass, hash, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

marijuana, pot, grass, hash, etc.

#### Cannabis use

53. Has a friend or relative or anyone else ever expressed concern about your use of Cannabis (marijuana, pot, grass, hash, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

54. Have you ever tried and failed to control, cut down or stop using Cannabis (marijuana, pot, grass, hash, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

coke, crack, etc.

Cocaine use

55. In your life, have you ever used Cocaine (coke, crack, etc.)? (NON-MEDICAL USE ONLY) \*

*Mark only one oval.*

- ☐ No *Skip to question 62*
- ☐ Yes

coke, crack, etc.

Cocaine use

56. In the past three months, how often have you used Cocaine (coke, crack, etc.)? \*

*Mark only one oval.*

- ☐ Never *Skip to question 60*
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

coke, crack, etc.

Cocaine use



57. During the past three months, how often have you had a strong desire or urge to use Cocaine (coke, crack, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

58. During the past three months, how often has your use of Cocaine (coke, crack, etc.) led to health, social, legal or financial problems?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

59. During the past three months, how often have you failed to do what was normally expected of you because of your use of Cocaine (coke, crack, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

coke, crack, etc.

#### Cocaine use

60. Has a friend or relative or anyone else ever expressed concern about your use of Cocaine (coke, crack, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

61. Have you ever tried and failed to control, cut down or stop using Cocaine (coke, crack, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

Amphetamine type stimulant use

speed, diet pills, ecstasy, Adderall, Dexedrine, bennies, uppers, amps, etc.

62. In your life, have you ever used Amphetamine type stimulants (speed, diet pills, ecstasy, Adderall, Dexedrine, bennies, uppers, amps, etc.)? (NON-MEDICAL USE ONLY) \*

Mark only one oval.

- ☐ No Skip to question 69
- ☐ Yes

Amphetamine type stimulant use

speed, diet pills, ecstasy, Adderall, Dexedrine, bennies, uppers, amps, etc.

63. In the past three months, how often have you used Amphetamine type stimulants (speed, diet pills, ecstasy, Adderall, Dexedrine, bennies, uppers, amps, etc.)? \*

Mark only one oval.

- ☐ Never Skip to question 67
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

Amphetamine type stimulant use

speed, diet pills, ecstasy, Adderall, Dexedrine, bennies, uppers, amps, etc.

64. During the past three months, how often have you had a strong desire or urge to use Amphetamine type stimulants (speed, diet pills, ecstasy, Adderall, Dexedrine, bennies, uppers, amps, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

65. During the past three months, how often has your use of Amphetamine type stimulants (speed, diet pills, ecstasy, Adderall, Dexedrine, bennies, uppers, amps, etc.) led to health, social, legal or financial problems?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

66. During the past three months, how often have you failed to do what was normally expected of you because of your use of Amphetamine type stimulants (speed, diet pills, ecstasy, Adderall, Dexedrine, bennies, uppers, amps, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

### Amphetamine type stimulant use

speed, diet pills, ecstasy, Adderall, Dexedrine, bennies, uppers, amps, etc.

67. Has a friend or relative or anyone else ever expressed concern about your use of Amphetamine type stimulants (speed, diet pills, ecstasy, Adderall, Dexedrine, bennies, uppers, amps, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

68. Have you ever tried and failed to control, cut down or stop using Amphetamine type stimulants (speed, diet pills, ecstasy, Adderall, Dexedrine, bennies, uppers, amps, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

nitrous, glue, gas, paint thinner, etc.

### Inhalant use

69. In your life, have you ever used Inhalants (nitrous, glue, gas, paint thinner, etc.)?  
(NON-MEDICAL USE ONLY)

*\* Mark only one oval.*

- ☐ No      *Skip to question 76*
- ☐ Yes

nitrous, glue, gas, paint thinner, etc.

Inhalant use

70. In the past three months, how often have you used Inhalants (nitrous, glue, gas, paint thinner, etc.)? \* *Mark only one oval.*

- ☐ Never      *Skip to question 74*
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

nitrous, glue, gas, paint thinner, etc.

Inhalant use

71. During the past three months, how often have you had a strong desire or urge to use Inhalants (nitrous, glue, gas, paint thinner, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

72. During the past three months, how often has your use of Inhalants (nitrous, glue, gas, paint thinner, etc.) led to health, social, legal or financial problems?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

73. During the past three months, how often have you failed to do what was normally expected of you because of your use of Inhalants (nitrous, glue, gas, paint thinner, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

nitrous, glue, gas, paint thinner, etc.

Inhalant use

74. Has a friend or relative or anyone else ever expressed concern about your use of Inhalants (nitrous, glue, gas, paint thinner, etc.)?

Mark only one oval.

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

75. Have you ever tried and failed to control, cut down or stop using Inhalants (nitrous, glue, gas, paint thinner, etc.)?

Mark only one oval.

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

Sedative or Sleeping  
Pill use

Valium, Rohypnol, Ativan, Xanax, Clonazepam, downers, tranks, blue heaven, yellow jackets, etc.

76. In your life, have you ever used Sedatives or Sleeping Pills (Valium, Rohypnol, Ativan, Xanax, Clonazepam, etc.)? (NON-MEDICAL USE ONLY) \* Mark only one oval.

- ☐ No Skip to question 83
- ☐ Yes

Sedative or Sleeping  
Pill use

Valium, Rohypnol, Ativan, Xanax, Clonazepam, downers, tranks, blue heaven, yellow jackets, etc.



77. In the past three months, how often have you used Sedatives or Sleeping Pills (Valium, Rohypnol, Ativan, Xanax, Clonazepam, downers, tranks, blue heaven, yellow jackets, etc.)? \* *Mark only one oval.*

- ☐ Never      *Skip to question 81*
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

**Sedative or Sleeping  
Pill use**

Valium, Rohypnol, Ativan, Xanax, Clonazepam, downers, tranks, blue heaven, yellow jackets, etc.

78. During the past three months, how often have you had a strong desire or urge to use Sedatives or Sleeping Pills (Valium, Rohypnol, Ativan, Xanax, Clonazepam, downers, tranks, blue heaven, yellow jackets, etc.)?

*Mark only one  
oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

79. During the past three months, how often has your use of Sedatives or Sleeping Pills (Valium, Rohypnol, Ativan, Xanax, Clonazepam, downers, tranks, blue heaven, yellow jackets, etc.) led to health, social, legal or financial problems?

*Mark only one  
oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

80. During the past three months, how often have you failed to do what was normally expected of you because of your use of Sedatives or Sleeping Pills (Valium, Rohypnol, Ativan, Xanax, Clonazepam, downers, tranks, blue heaven, yellow jackets, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

Sedative or Sleeping  
Pill use

Valium, Rohypnol, Ativan, Xanax, Clonazepam, downers, tranks, blue heaven, yellow jackets, etc.

81. Has a friend or relative or anyone else ever expressed concern about your use of Sedatives or Sleeping Pills (Valium, Rohypnol, Ativan, Xanax, Clonazepam, downers, tranks, blue heaven, yellow jackets, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

82. Have you ever tried and failed to control, cut down or stop using Sedatives or Sleeping Pills (Valium, Rohypnol, Ativan, Xanax, Clonazepam, downers, tranks, blue heaven, yellow jackets, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

LSD, acid, mushrooms, PCP, Special K, etc.

Hallucinogen use

83. In your life, have you ever used Hallucinogens (LSD, acid, mushrooms, PCP, Special K, etc.)? (NON-MEDICAL USE ONLY) \* *Mark only one oval.*

- ☐ No      *Skip to question 90*
- ☐ Yes

LSD, acid, mushrooms, PCP, Special K, etc.

Hallucinogen use

84. In the past three months, how often have you used Hallucinogens (LSD, acid, mushrooms, PCP, Special K, etc.)? \* *Mark only one oval.*

- ☐ Never      *Skip to question 88*
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

LSD, acid, mushrooms, PCP, Special K, etc.

### Hallucinogen use

85. During the past three months, how often have you had a strong desire or urge to use Hallucinogens (LSD, acid, mushrooms, PCP, Special K, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

86. During the past three months, how often has your use of Hallucinogens (LSD, acid, mushrooms, PCP, Special K, etc.) led to health, social, legal or financial problems?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

87. During the past three months, how often have you failed to do what was normally expected of you because of your use of Hallucinogens (LSD, acid, mushrooms, PCP, Special K, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

LSD, acid, mushrooms, PCP, Special K, etc.

Hallucinogen use

88. Has a friend or relative or anyone else ever expressed concern about your use of Hallucinogens (LSD, acid, mushrooms, PCP, Special K, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

89. Have you ever tried and failed to control, cut down or stop using Hallucinogens (LSD, acid, mushrooms, PCP, Special K, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

heroin, morphine, methadone, codeine, Percocet, Fentanyl, Ts, cody, vike, etc.

Opioid use

90. In your life, have you ever used Opioids (heroin, morphine, methadone, codeine, Percocet, Fentanyl, Ts, cody, vike, etc.)? (NON-MEDICAL USE ONLY) \*

*Mark only one oval.*

- ☐ No      *Skip to question 97*
- ☐ Yes

heroin, morphine, methadone, codeine, Percocet, Fentanyl, Ts, cody, vike, etc.

Opioid use

91. In the past three months, how often have you used Opioids (heroin, morphine, methadone, codeine, Percocet, Fentanyl, Ts, cody, vike, etc.)? \* *Mark only one oval.*

- ☐ Never      *Skip to question 95*
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

heroin, morphine, methadone, codeine, Percocet, Fentanyl, Ts, cody, vike, etc.

Opioid use

92. During the past three months, how often have you had a strong desire or urge to use Opioids (heroin, morphine, methadone, codeine, Percocet, Fentanyl, Ts, cody, vike, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

93. During the past three months, how often has your use of Opioids (heroin, morphine, methadone, codeine, Percocet, Fentanyl, Ts, cody, vike, etc.) led to health, social, legal or financial problems?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

94. During the past three months, how often have you failed to do what was normally expected of you because of your use of Opioids (heroin, morphine, methadone, codeine, Percocet, Fentanyl, Ts, cody, vike, etc.)?

*Mark only one oval.*

- ☐ Never
- ☐ Once or Twice
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or Almost Daily

heroin, morphine, methadone, codeine, Percocet, Fentanyl, Ts, cody, vike, etc.

Opioid use

95. Has a friend or relative or anyone else ever expressed concern about your use of Opioids (heroin, morphine, methadone, codeine, Percocet, Fentanyl, Ts, cody, vike, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months



96. Have you ever tried and failed to control, cut down or stop using Opioids (heroin, morphine, methadone, codeine, Percocet, Fentanyl, Ts, cody, vike, etc.)?

*Mark only one oval.*

- ☐ No, Never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

### Injection

97. Have you ever used any drug by injection? (NON-MEDICAL USE ONLY) \*

*Mark only one oval.*

- ☐ No, never
- ☐ Yes, in the past 3 months
- ☐ Yes, but not in the past 3 months

### Student Life and Experience

The following section will ask questions about how you feel about your universities policies and environment, and about your relationships with other people.

98. I find university's learning environment conducive. \*
- Conducive meaning: favourable, beneficial, advantageous, encouraging etc

*Mark only one oval.*

- ☐ Never
- ☐ Sometimes
- ☐ Always

99. I find academic policies of my university student-friendly. \*

*Mark only one oval.*

- ☐ Never
- ☐ Sometimes
- ☐ Always

100. I have close relationships that make me feel good. \*

*Mark only one oval.*

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Agree
- ☐ Strongly Agree

101. There is no one I feel comfortable talking about my problems with. \*

*Mark only one oval.*

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Agree
- ☐ Strongly Agree

General information

Demographic information

102. What is your marital status? \*

*Mark only  
one oval.*

- ☐ Single, never married
- ☐ Married/Common law
- ☐ Separated/Divorced
- ☐ Widowed

103. Number of Dependents \*

Dependent is a person who relies on another person for support (especially financial support)

*Mark only one oval.*

- ☐ 0 - None
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6 or more

104. What was your academic average in your last year? \*

If you are in 1st year, then report the average for your last year of high school. If you are in 2nd year, then report the average for your 1st year.

*Mark only*

☐ *one*

☐ *oval.*

☐ below

☐ 60

☐

☐

☐

☐

☐

between

n 60 to

65

between

n 66 to

69

between

n 70 to

75

between

n 76 to

79

between

n 80 to

85

between

n 86 to

89

between

n 90 to

95

between

n 95 to

100

105. What is your annual personal income?

*Mark only  
one oval.*

- ☐ \$0 - \$4,999
- ☐ \$5,000 - \$9,999
- ☐ \$10,000 - \$19,999
- ☐ Above \$20,000

106. What is your households' annual combined personal income?

*Mark only  
one oval.*

- ☐ \$0 - \$49,999
- ☐ \$50,000 - \$59,999
- ☐ \$60,000 - \$79,999
- ☐ Above \$80,000

107. How many hours a week do you work for pay? \*

During the academic calendar year (i.e. September - April)

*Mark only one oval.*

- ☐ 0
- ☐ 1 - 9 hours
- ☐ 10 - 19 hours
- ☐ 20 - 29
- ☐ hours
- ☐ 30 - 39
- hours more
- than 40
- hours

108. What is your current household living arrangement? \*

During the academic calendar year (i.e. September - April)

*Check all that apply.*

- ☐ Living with relatives
- ☐ Living with non-relatives (roommates/housemates)
- ☐ Living in a student residence
- ☐ Living alone
- ☐ Living with a partner

109. On average how long is your commute time to the University? \*

*Mark only  
one oval.*

- ☐ Less than 15 minutes
- ☐ 15 to 29 minutes
- ☐ 30 to 44 minutes
- ☐ 45 minutes or more

110. Were you born in Canada? \*

*Mark only  
one oval.*

- ☐ Yes      *Skip to question 111*
- ☐ No

111. Please check if you are registered at the University as: \*

*Mark only  
one oval.*

- ☐ An International student
- ☐ A Domestic student

112. What were the ethnic or cultural origins of your ancestors? \*

An ancestor is usually more distant than a grandparent.

*Check all that apply.*

- ☐ Aboriginal/First Nations/Métis
- ☐ Black
- ☐ Caucasian
- ☐ East Asian
- ☐ South Asian
- ☐ South East Asian
- ☐ Latin American
- ☐ Middle Eastern
- ☐ Don't know

Other: ☐ \_\_\_\_\_

113. What is your parents marital status? \*

*Mark only  
one oval.*

- ☐ Single, never married
- ☐ Separated/Divorced
- ☐ Married/Common law
- ☐ Widowed

114. What is the employment status of your primary guardian? \*Please check all that apply \*

*Check all that apply.*

- ☐ Full-time employment
- ☐ Part-time employment
- ☐ Homemaker
- ☐ Temporary or seasonal work
- ☐ Retired
- ☐ Disability leave
- ☐ Unemployed
- ☐ Student
- ☐ Not applicable
- ☐ I Don't know

115. What is the employment status of your secondary guardian? \*Please check all that apply \*

*Check all that apply.*

- ☐ Full-time employment
- ☐ Part-time employment
- ☐ Homemaker
- ☐ Temporary or seasonal work
- ☐ Retired
- ☐ Disability leave
- ☐ Unemployed
- ☐ Student
- ☐ Not applicable
- ☐



I Don't know

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