Modifiable behavioural factors and their association with depression and anxiety in Canadian undergraduate post-secondary students

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

ABSTRACT

Background

The mental health of post-secondary students is important for academic success and overall wellness. If post-secondary students are struggling with mental health concerns, these concerns can affect various aspects of university life including transitioning to post-secondary education, socialization and making connections, physical health, academic success, and student retention. Certain lifestyle behaviours identified as modifiable behavioural factors, or behaviours that are within the students' control, such as sleep, physical activity, and substance use, may be valuable commodities to explore to proactively and positively improve the mental health and academic achievements of post-secondary students.

Objective

This thesis explored the associations between depression and anxiety, and six modifiable behavioural factors (sleep, physical activity, cigarette smoking, e-cigarette use, marijuana use, and alcohol consumption) among female and male Canadian undergraduate post-secondary students.

Method

Data from the 2019 National College Health Assessment (NCHA) Canadian Reference Group was analyzed using logistic regression models. Models, stratified by sex at birth, explored the association between depression as a mental health indicator and six modifiable behavioural factors (sleep, physical activity, cigarette smoking, e-cigarette use, marijuana use, and alcohol consumption) while controlling for relevant covariates. The same approach, also stratified by sex at birth, explored the association between anxiety as a mental health indicator and the six modifiable behavioural factors and covariates.

Results

In this sample of Canadian undergraduate students, 53% of students reported depression and 71% of students reported anxiety. The main predictors of depression for female and male students were insufficient sleep, cigarette use, and marijuana use, but insufficient physical activity predicted depression only for female students. The main predictors of anxiety for female and male students were insufficient sleep, insufficient physical activity, cigarette use, and marijuana use. Alcohol consumption including binge drinking was either not significant or was found to have an inverse association with depression and anxiety for both sexes.

Conclusion

Mental health is a serious problem among Canadian undergraduate post-secondary students. Both depression and anxiety are linked to several modifiable behaviours: sleep, physical activity, cigarette use, and marijuana use. These finding warrant the need for effective health campaigns, programming, and institutional policies that support student well-being and decrease mental health prevalence at post-secondary institutions.

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LIST OF ABBREVIATIONS

ACHA	American College Health Association
CACUSS	Canadian Association of College and University Student Services
CCWS	Canadian Campus Well-being Survey
CCHS	Canadian Community Health Survey
CSEP	Canadian Society for Exercise Physiology
CTADS	Canadian Tobacco, Alcohol and Drug Survey
LRCUG	Canada's Lower-Risk Cannabis Use Guidelines
LRDG	Canada's Low-Risk Alcohol Drinking Guidelines
NCHA	National College Health Assessment
NIDA	National Institute on Drug Abuse
PEP-AH	Post-secondary Education Partnership-Alcohol Harms
PSI	Post-secondary Institutions
PSS	Post-secondary Students
PTSD	Post-traumatic stress disorder

Specific note regarding gender differences, sex differences, sex at birth differences, vs gender identity:

The majority of the previous studies didn't differentiate between sex and gender. For example, the first three references (64-66) utilized to support male/female differences used the term 'gender differences' to indicate mental health differences for males and females. Other studies have used the terms females and males interchangeably with women and men, respectively, when referencing 'gender' differences. For the purpose of this thesis, I have used the terminology/language researchers employed in their journal articles for the literature review and throughout this document to preserve their intention and the related context and references. However, if research was specific to gender 'identity', I have notably and clearly stated the self-determined context.

The NCHA tool utilized for this research asked, "What sex were you assigned at birth – female or male?". For this thesis and unless otherwise identified, the subsequent results and discussion sections state female sex at birth as 'female students' or 'females', and male sex at birth as 'male students' or 'males'.

SECTION ONE: Introduction

FOCUS: The mental health of post-secondary students is a concern that affects various aspects of a student's life including transitioning to post-secondary education, socialization, making connections, physical health, academic success, student retention, and overall well-being. Certain lifestyle behaviours that are within the students' control, such as sleep, physical activity, and substance use, can future exacerbate mental health issues or be utilized to improve the mental health of post-secondary students. This thesis explored the associations between depression and anxiety and six modifiable behaviours (sleep, physical activity, cigarette smoking, e-cigarette use, marijuana use, and alcohol consumption) among female and male Canadian undergraduate post-secondary students. It is imperative that post-secondary institutions advance programs and initiatives to support the mental health and well-being of post-secondary students.

1.1 Conceptualization of mental health

The World Health Organization defines mental health as "a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community"[1]. This is the current pedagogical definition of mental health widely accepted by many including health organizations[2], mental health professionals, and scholars. Although this definition has expanded from its earlier simplistic version, "absence of mental disorders"[3], the breadth of mental health is continuously evolving to include dichotomies on a mental health continuum such as flourishing vs languishing[4], or distinct variations on two mental health continuums representing mental wellness and mental illness[5],[6].

Keyes (2002) describes the continuum of mental health from languishing, or the absence of mental health toward mental illness, to flourishing, or the presence of positive mental health, with languishing and flourishing representing opposite ends of the spectrum[7],[8]. Keyes (2005) further identifies measures of mental health to include emotional, psychological, and social well-being, whereas mental illness was acknowledged as depression, anxiety, panic disorder, and substance use[9]. Beneficial components being linked to the conceptualization of mental well-being and gaining in recognition include positive psychology[10],[11], resilience[12], flourishing[13], mindfulness[14], and mental health literacy[15],[16].

1.2 Importance of mental health in post-secondary students

The mental health of young people has been identified as a health issue that peaks during the ages of 10-29 years[17] and is a mounting global public health challenge[18]. Other researchers are calling the state of mental health concerns an epidemic[19]. Mental health in post-secondary students has commonly measured mood disorders or depression, and anxiety[20],[21]. The

prevalence of mental health concerns in the post-secondary population has been increasing in number, range, and severity[22],[23]. According to the Canadian Community Health Survey, diagnosed mood or anxiety disorders increased from 3.7 million Canadians in 2015 to 4.4 million Canadians in 2019, with the largest difference, 13% in 2015 to 17% in 2019, attributed to young adults aged 18-34[24]. In Canada, people 15-24 years of age have the highest incidence of mental illness when compared to other age groups, with depression being the most common[25],[26]. The large-scale Center for Collegiate Mental Health[27] (CCMH) study stated anxiety and depression were the top two mental health concerns reported by students and identified by clinicians. The study showed that depression, social anxiety, and generalized anxiety all increased steadily from 2010-2016. Similarly, depression was found to be higher in university student than in the general population[28] and overall, the prevalence of mental illness reported by students has been identified as high[29],[30].

The mental well-being of post-secondary students is of importance at many post-secondary institutions and has been acknowledged as a priority in the recently developed and adopted Okanagan Charter[31].

The Ontario's Universities consortium characterized mental health challenges of post-secondary students as a societal issue that necessitates a "whole-community, comprehensive approach" [32]. Specifically, the approach recommends including educators, government, and health-care providers to effectively address and support students with mental health concerns.

A systematic review[33], comprised of twenty-four studies and an international consortium, regarding the prevalence of depression among university students over a 20-year period (1990-2010) reported depression prevalence was 30.6%, or experienced by almost 1/3rd of university students, and higher than those in the general population. An international study[34], with 21 countries represented, compared 1572 college students, 4178 non-students, and 702 college attritors to examined mental health (anxiety, depression, bipolar, PTSD) and reported mental health disorders were more common amongst college students than their non-college peers and that mental health issues were associated with college attrition.

The mental state of a student can impact their experiences throughout their years at university. Every aspect of university life can be subjectively affected when a student is struggling with mental health. Mental health concerns can affect them socially, physically, and academically[35] and may be detrimental or possibly fatal (suicide)[36]. Mental health issues seem to persist over time in the post-secondary student population. In a longitudinal research study, 60% of students with at least one mental health issue (depression, anxiety, eating disorder) at baseline, reported at least one mental health problem two years later[37].

To address the mental health crisis of the post-secondary student population, the Canadian Association of College and University Student Services (CACUSS) and the Canadian Mental Health Association (CMHA) published a systemic approach to guide post-secondary institutions in an

effort to strengthen post-secondary student mental health[38]. Canadian post-secondary institutions are following through with the development of mental health strategic planning initiatives (Western University[39]; University of British Columbia[40]), mental health frameworks (Queen's University[41]; Carleton University[42]), mental health strategies (University of Calgary[43]; University of Victoria[44], York University[45]), mental health task forces (University of Toronto[46]), and president's advisory committees on student mental health (University of Waterloo[47]). Many of these institutions are allocating significant resources to help understand the landscape, culture, needs of post-secondary students, and how best to support students as they transition to university and throughout their academic careers. The Association of Universities and Colleges of Canada developed a document, "Mental Health: A guide and checklist for presidents", to support post-secondary institution presidents and direct them to the policies, procedures, and programming that each institution can evaluate[48].

The emphasis on post-secondary student mental health planning and programming notably follows the increase in prevalence and severity of mental health concerns and the changing demographics of the post-secondary student population[49]. The state of mental health is imperative to senior administration at post-secondary institutions since the mental well-being of students contributes to retention of students and academic success[50].

1.2.1 Depression in post-secondary students

The Centre for Addiction and Mental Health in Canada defines depression as a mood disorder that is more than just feeling down but rather affects a person's interest in daily activities, social relationships, and their ability to perform regular work or school responsibilities[51],[52],[53]. Depression in university students has been attributed to many factors including anxiety, intrusive thoughts, and sleep[54], and substances such as tobacco and cannabis[55]. Both depression and anxiety have been attributed to academic performance, pressure to succeed, and post-graduate plans[56], perfectionism[57], and financial struggles and familial lower socio-economic status[58]. Depression has been linked to suicidal ideation, and for those that have attempted suicide, "depressive symptoms are almost always present"[59].

The definition of depression above is in line with the National College Health Assessment (NCHA) survey question to identity self-reported depression for post-secondary students: "Have you ever felt so depressed that it was difficult to function?"[60] According to the Canadian NCHA results depression has increased in prevalence from 37.5% of students feeling 'so depressed it was difficult to function' within the last 12 months in 2013[61], to 44.4% in 2016[62], and 51.6% in 2019[63].

1.2.1a Difference by sex/gender for depression

Researchers have been investigating the sex/gender difference related to depression for several decades. In 1991, almost thirty years ago, researchers found female colleges students reported

more depressive symptoms than male students[64]. This gender difference was noted to emerge between 13-15 years of age and further amplified between the ages of 15-18 with more females experiencing depression and being diagnosed with depression than males[65]. In accordance with the above findings, a review of research regarding gender differences in depression found the gender difference for depression emerges in adolescence and continues throughout the lifespan with females twice as likely to be diagnosed with depression and exhibit depressive symptoms when compared with males[66]. The results from the 2019 Canadian NCHA survey indicated the prevalence of feeling 'so depressed it was difficult to function' for females was 55% and for males 42%[67].

1.2.2 Anxiety in post-secondary students

Researchers have recognized that the definition of anxiety is varied but generally refers to subjective feelings of tension, apprehension, and worry that causes an uneasiness or panic[68]. The Centre for Addiction and Mental Health lists several types of anxiety disorders including generalized anxiety disorder, social anxiety disorder, panic disorder, and phobias which can cause such intense anxiousness and terror that the resulting anxiety can be debilitating and affect normal functioning[69].

In a clinical review paper[70], Generalized Anxiety Disorder (GAD) was defined as a condition that is characterized by excessive, uncontrollable worrying that may manifest itself with restlessness and sleep disturbances, muscle tension, and difficulty concentrating. These physiological responses to anxiety could make it challenging for post-secondary students to feel well, do well, and succeed academically.

The NCHA survey question related to self-reported anxiety is as follows: "Have you ever felt overwhelming anxiety?"[71]. As with depression, anxiety amongst post-secondary students increased according to the Canadian NCHA survey results: 56.5% of PSS reported that they felt 'overwhelming anxiety' in 2013[72], and this increased to 64.5% and 68.9% in 2016[73] and 2019[74], respectively.

1.2.2a Difference by sex/gender for anxiety

Anxiety disorders have also been found to have a sex/gender difference in prevalence rates and diagnoses with more females than males experiencing anxiety along with its debilitating effects[75]. Researchers have identified that females, even at the early age of six, may already be twice as likely than males to experience an anxiety disorder[76]. In 2018, the percentage of Canadians that had been diagnosed with an anxiety disorder was 36% for females and 24% for males[77]. This difference depicts the wide gap between males and females and the difference for anxiety by sex/gender for Canadians. The gender difference by age for anxiety continued to hold for all age ranges of the Canadian Community Health Survey with 167,000 females vs 103,000 males in the age range between 12-24 reporting having been diagnosed by a health professional

for anxiety[78]. The results from the 2019 Canadian NCHA survey indicated the prevalence of feeling 'overwhelming anxiety' for females was 75% and for males 54%[79]. In Canada, Robinson et al. (2016) investigated the academic and mental health needs of 400 university students at a western Canadian university[80]. They found 63.1% of students reported academic concerns, 36.1% of students reported anxiety concerns, 31.9% of students reported depressive concerns, and that 42% of males and 43% of females met the criteria for clinical psychological distress.

SECTION TWO: Literature Review of Modifiable Behavioural Factors

In 1861, Amherst College founded the first student 'physical' health service at a PSI and in 1910, Princeton University was the first to establish a 'mental' health service[81]. Researchers have been investigating various aspects of the mental health spectrum for post-secondary students for many years[82]. The research seems to be dichotomous with behaviours that are linked to deleterious mental health such as poor sleep[83], high stress load, little or no physical activity[84], use of tobacco, cannabis[85], and alcohol[86], and conversely, factors that improve mental health outcomes for post-secondary students: adequate sleep, low stress, participation in physical activity[87], no or low use of substances such as tobacco, alcohol or drugs.

Many other factors that are not specifically behaviours but are feelings and emotions have been investigated: hopelessness[88], loneliness[89], connectedness[90], and sense of belonging[91] just to name a few. Sexual orientation[92], gender identity[93], race and ethnicity[94], and socio-economic status[95] are additional areas that can be linked to mental health.

Areas of research connecting concurrent mental health issues such as abuse[96], sexual violence[97], post-traumatic stress disorder (PTSD)[98], eating disorders and self-harm[99], for example, can be physically life threatening and increases the severity and complexity of mental health issues. Some researchers examine differences between male and female students[100], graduate and undergraduate students[101], and/or year of study[102]. Transitioning from high school to college or university has also been investigated to determine if this milestone contributes negatively to the mental health of students[103],[104].

Some of the factors mentioned above are both serious and complex, and require professional expertise and ongoing support. Others can be classified as modifiable behaviours that are within the control of the student; adequate sleep and regular physical activity, for example, may have a positive association with mental health outcomes, whereas substance use, such as cigarette smoking, e-cigarette use, marijuana use, and alcohol consumption, may have a negative impact on mental health. Distinguishing which modifiable behavioural factors are helpful or protective, and which may be harmful or increase risk with regards to mental health outcomes, may be a step toward improving programs and services at post-secondary institutions to further support student mental health.

2.1 Physical activity in post-secondary students

Physical activity has been linked to mental health outcomes. Research has shown there is a decrease in physical activity during adolescence[105] and while in university[106]. The concern with physical inactivity has been described as a "pandemic requiring global action by public health"[107]. Physical activity has been positively associated with multiple physiological and psychological benefits including healthy body weight[108], self-esteem[109], less depression[110], reduced anxiety[111],

less stress[112], and adequate sleep[113]. Conversely, lack of physical activity has been associated with health risks similar to smoking[114], and a burden attributed to various diseases and pre-mature death[115]. The Canadian NCHA data shows a decrease in both the percentage of students participating in moderate physical activity within the past 1-4 days and 5-7 days (18.4% in 2013[116], 16.7% in 2016[117], and 16.4% in 2019[118]) and also an increase in students reporting zero days of physical activity for the past 7 days (23.5% in 2013, 25.1% in 2016, and 27.2% in 2019).

2.1a Physical activity & mental health (depression & anxiety): Post-secondary specific research

Researchers looking at the association between mental health and various health risk-factors in a Canadian sample of 837 undergraduate students reported that students who were classified as high-risk for various health behaviours including physical inactivity had poorer mental health outcomes (depression, anxiety, and psychological distress) and significantly higher levels of stress than those classified in the typical student category[119]. The link between depression and anxiety and physical activity was investigated in a Canadian population of 1527 post-secondary students[120]. The researchers found moderate-to-vigorous physical activity (MVPA) was inversely associated with anxiety and depression, and that students involved in team sports, vs doing physical activity alone, had better mental health outcomes. In 2014, Dinger et al.[121] investigated the associations between physical activity and health-related factors in a national sample of 67,861 college students from 157 PSI (NCHA). The researchers found that students who met the national recommendation of ≥ 150 minutes of moderate-to-vigorous physical activity (MVPA) per week reported less perceived depression. Similarly, depressive symptoms and physical activity were investigated (2012) in a US sample (NCHA) of 61,011 undergraduate students from 107 PSI. The researchers found that higher reported frequency of physical activity was related to lower reported levels of depressive symptoms, and that a gender difference was found for depression with more female students reporting depressive symptoms than male students[122].

Researchers have examined the association between physical activity and mental health segmented by gender/sex. Physical activity as a protective factor against depressive symptoms was studied using the US NCHA data with 43,499 college students aged 18-25. The researchers found that more women reported depression than men, and that physically active male and female students reported lower rates of depression compared to inactive male and female students[123]. In a US national sample of female college students[124] (2007), researchers looked at the relationship between physical activity and mental health and reported moderate to vigorous aerobic activity for female students was positively associated with perceived health and modestly negatively associated with depression. Finally, researchers conducted a literature review and found physical activity to be effective in the treatment of clinical depression and reduces anxiety[125]. This research points to the importance of studying the positive effects of physical activity, a modifiable behaviour, on the mental health of post-secondary students by gender/sex.

2.2 Sleep in post-secondary students

The Public Health Agency of Canada recommends 8-9 hours of sleep per night for adults aged 18-64[126] yet many PSS don't get enough sleep which is negatively associated with poor academics and mental health concerns such as depression[127].

Sleep quality, specifically good or adequate sleep, was associated with students participating in physical activity, having good relationships, performing better academically[128], and feeling less exhausted, and good sleep was associated with the absence of emotional or physical problems[129]. Conversely, students with depression or anxiety reported more sleep problems[130] or poor sleep[131].

Despite the associated benefits of sleep on learning and mental health, many university students are not getting enough sleep and the trend is worsening with time. In 2013, 10.9% of Canadian post-secondary students reported '0 days' out of 7 days for not getting enough sleep to feel rested in the morning (NCHA[132]). That percentage increased to 13.1% in 2016[133] and 14.3% in 2019[134]. On the other side of the spectrum, the percentage of students getting enough sleep to feel rested '6+ days' out of 7 days decreased from 11.8% in 2013, 11.3% in 2016, and 11.0% in 2019.

2.2a Sleep & mental health (depression & anxiety): Post-secondary specific research

Sleep is a behavioural factor that has been connected to mental well-being, and specifically depression and anxiety. In 2012, researchers conducted a study with 283 male and female US university students to investigate the associations between depressed and non-depressed students and anxiety and sleep disturbances. The researchers reported that the depressed group of university students had higher scores for anxiety and sleep disturbances. Anxiety and sleep disturbances, respectively, contributed the highest variances with depression[135]. In an Australian research study (2018) exploring sleep and mental health with 117 university students between the ages of 18 and 55, researchers found poor sleep was more common in university students with higher levels of depression, anxiety, and/or stress[136]. Researchers utilized a Canadian sample of 837 undergraduate students to investigate the association between mental health and high-risk health factors including insufficient sleep. The researchers reported that students who were classified as high-risk for health behaviours (marijuana, smoking, binge drinking, physical inactivity, insufficient sleep, drugs use, risky sex, and poor diet) had poorer mental health outcomes (depression and anxiety), and significantly higher levels of stress than those classified in the typical student category[137].

In 2015, researchers studied 374 US undergraduate university students between the ages of 18-24 and found depression, anxiety, and stress were significantly correlated with various sources of concern including sleep[138]. Depression and anxiety as impediments to sleep was explored (2016) in a US national college sample (NCHA) with 85,138 undergraduate and graduate students aged

18-25. More sleep problems were reported by students who used tobacco when compared to students that did not use tobacco, and students with depression or anxiety reported more sleep problems than students that did not report either depression or anxiety[139]. Sleep quality and mental health was investigated (2011) over four separate semesters from fall 2005 to spring 2007 with a combined sample of 4,513 US university students aged 18 and older. The Pittsburg Sleep Quality Index (PSQI) was used to assess the state of sleep among college students. Researchers found that students who reported experiencing anxiety or depression had higher PSQI scores indicating poor quality sleep[140].

2.3 Substance use in post-secondary students

Substance use among post-secondary students has been a concern for many years[141]. Commonly used and socially acceptable substances in the university population include alcohol, marijuana, cigarettes, and e-cigarettes. Not only is each substance a concern individually, substance use tends to increase during the transition period from high school to post-secondary[142], and simultaneous polysubstance use is a concern among university students with cigarettes, alcohol, and marijuana frequently being used together[143]. Since substance use and mental health are correlated[144],[145],[146],[147], it was imperative to include various substances in the research model to provide relevant data for the Canadian post-secondary student population.

2.3.1 Cigarette smoking

Cigarette smoking in young adults and in the post-secondary population continues to be an area of concern[148],[149]. More recently, the implementation of 'Smoke-Free Campuses' across North America[150],[151] has been adopted to help protect the health of all campus members from harmful second-hand smoke. The addictiveness[152] and harms[153] from cigarette smoking are steadfast. The relationship between mental health and substances, such as cigarette smoking, continues to be explored. Sun et al. (2011) reported that higher rates of stress and depression were associated with the likelihood to engage in smoking behaviour[154].

According to the 2017 Canadian Tobacco, Alcohol and Drugs Survey (CTADS)[155], youth were identified as people aged 15-19, and young adults were people aged 20-24. These two age groups cover the age range of most undergraduate post-secondary students. According to the results of the 2017 survey, 24% of youth and young adults combined were current smokers, with 12% being daily smokers, and 12% being occasional smokers. For each cigarette smoking status category, the prevalence of smoking cigarettes was higher for young adults: 16% vs 8% for current smokers, 9% vs 3% for daily smokers, and 7% vs 5% for occasional smokers. The results by sex showed a higher prevalence of smoking cigarettes for males when compared to females for all three categories and for both age groups. The cigarette smoking prevalence for 15–19 year-old males was 9.7%, 3.8%, and 5.9% for current smokers, daily smokers, and occasional smokers, respectively, and for 15–19 year old females the cigarette smoking prevalence was 5.9%, 2.0%, and 3.9%, respectively, for the same categories. The cigarette smoking prevalence

for male young adults aged 20-24 was 20.4%, 11.2%, and 9.2% for current smokers, daily smokers, and occasional smokers, respectively, and for female young adults aged 20-24 the cigarette smoking prevalence was 11.4%, 6.6%, and 4.8%, respectively, for the same categories.

2.3.1a Cigarette smoking & mental health (depression & anxiety): Post-secondary specific research

Prior research provided evidence of a link between poorer mental health outcomes and smoking. Researchers (2016) looked at the association between mental health (depression and anxiety) and various health risk-factors in a Canadian sample of 837 undergraduate students and reported that students who were classified as engaging in high-risk health behaviours (including cigarette smoking) had poorer mental health outcomes and significantly higher levels of stress than those classified in the typical student category[156]. Another researcher noted depressed college students were more likely to smoke cigarettes[157]. The association between depression, anxiety, and substance use among Canadian post-secondary students was investigated using the Canadian consortium NCHA data that represented 41 Canadian PSI and a sample size of 43,780 PSS[158]. The reported prevalence for the outcome variables were 14.7% for depression and 18.4% for anxiety. The prevalence for tobacco use was 11%. The researchers reported significant associations between depression and tobacco use.

In 2009, 2,843 undergraduate and graduate students in the US were part of a study that inquired about substance use and mental health. The researchers reported depression to be associated with high smoking rates for these post-secondary students[159]. In 2011, a study investigating the mediating effects of coping, personal belief, and social support on the relationship with stress, depression, and smoking behaviour reported that students with higher stress and depression levels were more likely to adopt disengagement coping strategies and to engage in smoking behaviour. The study population included 3,515 Australian university students aged 18-60[160]. A study[161] (2018) looking at quality of life and substance use with 1,132 college students between the ages of 18-26 identified that better psychological well-being was associated with lower use of cigarettes, and that tobacco use was associated with lower quality of life scores.

2.3.2 E-cigarette use (vaping)

Although initial cigarette use by Canadian youth has declined[162], the use of electronic cigarettes or e-cigarettes, as they are commonly referred as, has increased in use among younger adults aged 18-29 between 2014-2018 and notably among never smokers[163]. This study concluded that for some young adults, initial exposure to nicotine may commence with e-cigarettes as the primary source. Researchers found e-cigarette use among youth to be a gateway to smoking a whole cigarette and to daily smoking[164]. In university students, e-cigarette use has been associated with mental health problems including anxiety and use of other substances[165], and in a Canadian population-based study, dual users of both cigarettes and e-cigarettes had the

highest prevalence of adverse mental health status and worse mental health outcomes when compared to non-smokers[166].

According to the 2017 CTADS[167], the highest rates of e-cigarette use was for both youth and young adults (when compared to the other age groups 25-44, 25+, and 45+). The prevalence for ever tried was 22.8% and 29.3% for 15-19 year olds and 20-24 years olds, respectively; the prevalence for daily use was 1.6% and 1.3% for 15-19 year olds and 20-24 year olds, respectively; the prevalence for occasional use was 5.1% and 4.7% for 15-19 year olds and 20-24 year olds, respectively. When compared by sex including all age groups, male use was higher than female use for all categories: 18.8% vs 12.0% for ever-tried, 1.3% vs 0.3% for daily users, and 2.4% vs 2.1% for occasional users, all for males and females, respectively. When compared by sex for youth and young adults, e-cigarette use for each category (ever-tried, daily, and occasional) was higher for males than females for both youths aged 15-19 and young adults aged 20-24. Similarly, among college students, males were more likely than females to be e-cigarette users alone or in combination with traditional cigarettes, and e-cigarette use alone or combined with traditional cigarette use negatively affected psychological well-being and quality of life[168].

2.3.2a E-cigarette use & mental health (depression & anxiety): Post-secondary specific research

In 2019, e-cigarette use (vaping) and its association with mental health problems in 3,572 undergraduate and graduate university students was investigated[169]. The researchers reported e-cigarette use was associated with mental health problems including depression and anxiety. The PHQ-9 and GAD7 questionnaires were utilized to measure depression and anxiety, respectively. Another study in 2018, with 1,132 college students between the ages of 18-26 looked at differences in quality of life among college student e-cigarette users[170]. The quality-of-life measures included psychological health and the researchers concluded better psychological well-being was associated with lower use of e-cigarettes (and cigarettes).

2.3.3 Marijuana use

Marijuana use by college and university students, both in Canada and the US, has increased to "historic high" levels[171],[172], and is reported to be a mental health problem for undergraduate students[173]. Marijuana use among post-secondary students has been shown to negatively affect academic performance[174] and has a strong relationship with psychosis[175]. Marijuana use has been linked to mental health comorbidities such as depression[176] and anxiety[177].

According to the 2017 CTADS[178], overall cannabis use within the past year was 14.8%, with male past-year cannabis use at 18.7% and female past-year cannabis use at 11.1%. The prevalence of cannabis use within the past-year by age was 19.4% for 15-19 year olds, 33.2% for 20-24 year olds, and 12.7% for people aged 25 and up.

2.3.3a Marijuana use & mental health (depression & anxiety): Post-secondary specific research

Prior research provides evidence of the association between depression and cannabis use. Researchers looking at the association between mental health and various health risk-factors, including marijuana use, in a Canadian sample of 837 undergraduate students reported that students who were classified as high-risk for health behaviours had poorer mental health outcomes (depression, anxiety, and psychological distress), and significantly higher levels of stress than those classified in the typical student category[179]. The association between depression, anxiety, and substance use including cannabis among Canadian post-secondary students was investigated using the Canadian consortium NCHA data that represented 41 Canadian PSI and a sample size of 43,780 PSS[180]. Cannabis use prevalence was 17.9% and the researchers reported a significant association for depression and cannabis use.

Researchers (2019) investigated the link between unhealthy behaviours, including marijuana use, and mental health concerns, including depression and anxiety, in 105,781 college students from 129 PSI[181]. The researchers found students with drug use (and high alcohol use) reported the highest prevalence across all mental health categories and were more likely to also report a mental health diagnosis.

Canada's Lower-Risk Cannabis Use Guidelines (LRCUG)[182] are guidelines to help Canadians reduce the risks to their health if they choose to use cannabis. Recommendations include delaying use to, at least, later teenage years, choosing lower THC (tetrahydrocannabinol) products, avoiding deep inhalations if you smoke cannabis, or choosing non-smoking options, plus more. The guidelines are intended for non-medical cannabis users and reminds Canadians that all forms of cannabis have associated health risks.

2.3.4 Alcohol consumption

Alcohol is the most commonly used drug in Canada and continues to be a serious concern with young adults aged 18-24[183]. The concern regarding the culture of alcohol among post-secondary students has contributed to the inception of the Post-secondary Education Partnership-Alcohol Harms (PEP-AH)[184] consortium in Canada. This coalition is shedding light on the seriousness of alcohol-related harms and has developed a framework[185] that addresses multiple components related to alcohol consumption such as marketing, pricing, education, community, and services. Heavy-episodic drinking was researched in partnership with the Canadian Centre on Substance Use and Addiction and, in their report, heavy episodic drinking among post-secondary students was associated with social and academic stress and social anxiety[186]. In addition, alcohol use and depression has been identified to have a comorbid relationship among college students[187].

According to the 2017 CTADS[188], overall alcohol use (consuming an alcoholic beverage) within the last 12 months was 78.2%, with male alcohol use within the past 12 months at 79.5% and female use within the past 12 months at 76.9%. The prevalence of alcohol use by age within the

past 12 months was highest among young adults aged 20-24 at 83.5%, followed by adults aged 25 years and older at 79.4%, and finally by youth aged 15-19 years of age at 56.8%.

Canada's Low Risk Drinking Guidelines (LRDG)[189] are guidelines to help Canadians make responsible choices around alcohol including zero tolerance in some situations and limiting the quantity of alcohol, daily and weekly, and by sex/gender, to decrease the risks of alcohol-associated acute and chronic effects. For example, the LRDG recommends zero alcohol if pregnant or taking prescription drugs, no more than ten drinking per week with no more than two drinks per day, most days, for women, and no more than 15 drinking per week with no more than three drinks per day, most days, for men.

The 2017 CTADS[190] results show that among Canadians who consumed alcohol in the past year, more males than females exceeded the guidelines for chronic effects 22.3% vs 19.2%, respectively, and for acute effects the male and female prevalence for exceeding the LRDG was 16.6% vs 13.0%, respectively. In addition, young adults aged 20-24 had the highest prevalence rates when compared to other age groups for exceeding the guidelines and risking chronic effects (28.9%) and acute effects (23.6%).

2.3.4a Alcohol & mental health (depression & anxiety): Post-secondary specific research

Research evidence points to an association between increased alcohol use and increased levels of depression and anxiety for post-secondary students. In 2019, researchers investigated the link between health behaviours and mental health concerns in 105,781 college students from 129 PSI[191]. The researchers' included mental health variables, depression and anxiety, and binge drinking as an 'unhealthy' risk behaviour. The researchers found students with high alcohol (and drug use) reported the highest prevalence across all mental health categories and were more likely to also report a mental health diagnosis. Researchers looking at the association between mental health and various health risk-factors in a Canadian sample of 837 undergraduate students reported that students who were classified as high-risk for health behaviours (including binge drinking) had poorer mental health outcomes (depression, anxiety, and psychological distress)[192]. The association between depression, anxiety and substance use among Canadian post-secondary students was investigated using the 2016 Canadian consortium NCHA data that represented 41 Canadian PSI and a sample size of 43,780 PSS[193]. The substance use exposure variables included alcohol and the researchers reported a gender-specific association for anxiety and female alcohol-users.

Given the increase in prevalence and severity of student mental health issues and the consequences these have on student well-being and education, more research into the effects of modifiable behaviours is warranted for the post-eecondary student population. Existing research indicates that there are several modifiable behaviours associated with mental well-being, specifically anxiety and depression, including sleep, physical activity, and various substances. It is

also evident that there are significant gender differences in both the levels of anxiety and depression, and the various modifiable behaviours exhibited by gender/sex.

SECTION THREE: Study Rationale and Research Questions

3.1 Study Rationale

The goal of this thesis is to ascertain the association between several modifiable behavioural factors (sleep, physical activity, and substance use: cigarette smoking, e-cigarette use, marijuana use, and alcohol consumption) and how they affect two mental health concerns, depression and anxiety, in female and male Canadian undergraduate post-secondary students. Inspiration to focus on the mental health of undergraduate students came from a large US sample that utilized the NCHA to compare mental health among undergraduate and graduate students. The final sample utilized was 27,387 students from 55 PSI. The researchers reported that undergraduate students had higher rates of poor mental health when compared to graduate students, indicating, undergraduate students experienced more hopelessness, depression, and anxiety, amongst other feelings and behaviours, than graduate students[194]. Hence, the impetus to focus exclusively on depression and anxiety and the more vulnerable undergraduate student population at Canadian post-secondary institutions for this MSc research.

The American College Health Association's National College Health Assessment (ACHA-NCHA) survey has been administered in the United States for 20 years[195]. This has resulted in a rich data set that is used by researchers to provide valuable evidence-based data about post-secondary students' attitudes, health behaviours, and well-being to US post-secondary decision makers including administrations, senior staff, educators, and health professionals. The implementation of the same survey instrument is relatively new to Canada and has been underutilized as a research tool. The first time the NCHA tool was administered cooperatively to a consortium of Canadian post-secondary institutions was in 2013, then again in 2016, and in 2019. This secondary analysis utilized the largest NCHA Canadian Reference Group data (2019) to analyze behavioural characteristics that may affect mental health. The results of this research adds insight into the state of Canadian post-secondary undergraduate behaviours and mental well-being.

This secondary research analysis explored whether physical activity, sleep, and substance use (cigarettes, e-cigarettes, marijuana, and alcohol consumption) affect depression and anxiety in the Canadian undergraduate post-secondary student population and whether these associations differ by sex at birth. A Canadian paper outlining the prevalence of health risk-factors for Canadian post-secondary undergraduate students reported lower prevalence of smoking (13.1%) and marijuana (17.5%), higher prevalence of binge drinking (60%), and higher prevalence rates for physical inactivity (72.2%) and inadequate sleep (75.6%)[196] (e-cigarette use was not included). If adequate sleep and/or physical activity are associated with a lower likelihood of depression and anxiety, a comprehensive review of post-secondary programs and services that promote sleep health and physical activity should be initiated. Furthermore, post-secondary

programs and services encouraging these behaviours should be available to students and embedded into university-life initiatives seamlessly.

If substance use, particularly cigarette smoking, e-cigarette use, marijuana use, and alcohol consumption including binge drinking, are associated with a higher likelihood of depression and anxiety, institutions may want to evaluate the health-related medical interventions to decrease substance use and their associated harms including mental health outcomes and the risk of long-term dependency and substance use addiction. Institutions may want to establish harm reduction strategies and cessation programs and supports. For example, post-secondary institutions may want to consider institutional smoke- and vapour-free campus policies to decrease all types of smoking on their campus. Institutions may want to look at the alcohol culture for their campus and explore ways to cultivate a change in alcohol culture whereby excessive alcohol is not the norm.

Reducing modifiable behavioural risk factors and promoting protective behaviours could be a proactive way to mitigate negative mental health occurrences common to many post-secondary students. The results of this research can be used to recommend programming and services to improve student mental health and influence post-secondary decision makers regarding institutional policies in the quest to decrease the overall prevalence and negative impact of depression and anxiety among Canadian undergraduate post-secondary students.

Research related to post-secondary students and mental health dates back many years with the inception of the American College Health Association one-hundred years ago in 1920[197]. A 20-year systematic review reports the prevalence of depression is higher for post-secondary students when compared to the general population[198]. Longitudinal research tells us that many university students suffer from one or more mental health issue including depression and anxiety and that they often persist over time[199]. Since most of the literature and research presented here is from the US, this thesis and subsequent research contributes knowledge for the Canadian post-secondary student population regarding modifiable behavioural factors associated with depression and anxiety and any female/male sex at birth differences. The ultimate goals include contributing to the body of knowledge related to mental health and Canadian post-secondary students, and to provide evidence to support wellness programming and initiatives to enhance post-secondary student mental health.

3.2 Research Questions

This thesis explored the following research questions:

3.2.1 Depression

What modifiable behavioural factors are associated with depression among female students?

What modifiable behavioural factors are associated with depression among male students?

3.2.2 Anxiety

What modifiable behavioural factors are associated with anxiety among female students?

What modifiable behavioural factors are associated with anxiety among male students?

3.3 Hypotheses

The following outcomes for depression were hypothesized:

The variables hypothesized to be behavioural **protective** factors for depression among male and female students are sufficient physical activity and enough sleep to feel rested. The variables hypothesized to be behavioural **risk** factors for depression among female and male students are substances including cigarette smoking, e-cigarette use, marijuana use, and alcohol consumption including binge drinking.

The following outcomes for anxiety were hypothesized:

The variables hypothesized to be behavioural **protective** factors for anxiety among male and female students are sufficient physical activity and enough sleep to feel rested. The variables hypothesized to be behavioural **risk** factors for anxiety among female and male students are substances including cigarette smoking, e-cigarette use, marijuana use, and alcohol consumption including binge drinking.

SECTION FOUR: Methodology

4.1.1 SURVEY INSTRUMENT: National College Health Assessment (NCHA) Overview

The National College Health Assessment (NCHA) questionnaire is a nationally recognized health survey administered to post-secondary students. The development and inception of the survey in the United States was in the year 2000[200]. More recently, the survey has been gaining in popularity in Canada and has been administered at several Canadian post-secondary institutions[201]. The NCHA survey has been thoroughly tested for generalizability, validity, and reliability[202].

The NCHA survey instrument is comprised of over 60 questions across seven categories: 1) Health, Health Education, and Safety (safety and violence), 2) Alcohol, Tobacco, and Drugs, 3) Sex Behaviour and Contraception, 4) Mental Health, 5) Physical Health, 6) Impediments to Academic Performance, and 7) Demographic Characteristics.

The resulting data provides information about student health behaviours, perceptions, and habits that can impact overall wellness and academic performance. Each participating post-secondary institution receives institution specific results and can utilize their prevalence data to identify priority areas to support programming and services for post-secondary student populations. In addition, individual institutional data can be used to compare with the Canadian Reference Group.

4.1.2 NCHA Survey Implementation & Recruitment

4.1.2.1 Survey Administration

Each institution decides whether ACHA will be responsible for survey administration or whether an individual at their particular institution will administer the survey internally on their campus. Each institution may decide on a different protocol and the decision may be based on ethics approval and/or whether institutions are able to provide student email addresses directly to the ACHA.

4.1.2.2 Student Sampling

Each institution decides the number of students to be surveyed, whether the survey is sent to both undergraduates and graduate students, part-time and/or full-time students, and the type of sampling protocol conducted, for example systematic random sampling or stratified random sampling, etc. Only institutions that sample all students or employ a random sampling system were eligible to be included in the Canadian Reference Group.

4.1.2.3 Incentive to Participate

Each institution decides whether to offer any incentives for survey participation in hopes to

increase response rate. Some institutions decide not to offer an incentive; other may have a draw for a large prize such as cash or a tablet; others may offer an immediate incentive for submitted surveys such as $5 on their student card or a voucher for a coffee. Incentives are at the discretion and responsibility of each institution.

4.1.2.4 Survey Administration, Methodology & Procedures

Once the survey sample has been provided, selected students were sent an email on the start date inviting participation in the confidential survey. The email included a description of the survey, the data collection process, and the link to the survey. To protect privacy, a unique ID number is imbedded in the survey URL sent to each student in their Letter of Invitation/Consent email. Unique IDs are downloaded with student responses, preventing responses from the same student, and also preventing students outside the sample from submitting a survey.

Each institution decides the frequency and timeliness of reminder emails. Non-responders may be sent a reminder email to consider completing the survey, depending on each institutions protocol.

Once the student hits the "submit" button at the end of the NCHA survey, the students' browser re-directs them to a web page containing a thank you for participating message along with any additional information the institution deems important such as resources available should they require support following completion of the survey.

Once the collection period has ended, ACHA destroys all files containing unique ID numbers before NCHA results are shared with each institution to eliminate any possibility of linking survey responses to individual participants. Following dissemination of results to each individual institution that has participated, ACHA complies the data for the Canadian Reference Group.

4.1.3 NCHA 2019 Canadian Reference Group

Once every three years, the American College Health Association (ACHA), with the support of the Canadian Association of College and University Student Services (CACUSS), coordinates a consortium of Canadian post-secondary institutions to represent the Canadian Reference Group for a particular reiteration of the survey.

Each post-secondary institution is responsible to apply to the American College Health Association to implement the survey on their campus and must obtain institutional authorization through senior administration or formal ethics approval.

The National College Health Assessment (NCHA) web survey was administered to a Canadian consortium of post-secondary institutions in the winter semester of 2019 (January-April 2019). Each post-secondary institute individually runs the survey for three-weeks on their campus during the Winter semester. This coordinated implementation of the NCHA survey occurs every

three years with the results being provided in the Spring of the same year. The identification of the survey is labelled 'Spring' followed by the 'year' in which the survey is conducted.

Collectively, each participating post-secondary institution agrees to have the datasets amalgamated to establish the Canadian Reference Group. In Winter 2019, the data collected resulted in the 2019 NCHA Canadian Reference Group[203], which is comprised of *55,284 student responses* from *58 post-secondary institutions* across Canada. The Canadian Reference Group only included institutions that surveyed all students or applied a random sampling technique for their student population. The collective Canadian Reference Group mean response rate was 20% and the median response rate was 19% across participating PSI.

The demographic characteristics for the 58 post-secondary institutions representing the Canadian Reference Group is available in Appendix C.

Comprehensive National College Health Assessment survey implementation information is available in Appendix D.

4.1.3.1 NCHA 2019 Canadian Reference Group Sample

A secondary analysis utilizing the 2019 NCHA Canadian Reference Group responses was used to conduct this thesis. Inclusion criteria was undergraduate, full-time students between 18-25 years of age. This is consistent with other undergraduate student research populations[204]. To be an eligible case for the analysis, students must have answered all the questions related to the demographic characteristics, independent variables, dependent variables, and covariates of interest. The models were stratified by sex at birth for both depression and anxiety.

4.2 Data analyses

Two separate multivariate logistic regression analyses were conducted using SPSS software.

Model 1a: Depression and modifiable behavioural factors among female undergraduate students

Model 1b: Depression and modifiable behavioural factors among male undergraduate students

Each multivariate logistic regression model explored how depression relates to six modifiable behavioural factors: sleep, physical activity, cigarette smoking, e-cigarette use, marijuana use, and alcohol consumption including binge drinking among female and male Canadian undergraduate students, while controlling for relevant covariates.

Model 2a: Anxiety and modifiable behavioural factors among female undergraduate students

Model 2b: Anxiety and modifiable behavioural factors among male undergraduate students

A second multivariate logistic regression analysis was conducted to explore how anxiety relates to six modifiable behavioural factors: sleep, physical activity, cigarette smoking, e-cigarette use, marijuana use, and alcohol consumption including binge drinking among female and male Canadian undergraduate students, while controlling for relevant covariates.

Stress, sexual violence, sexual orientation, international student status, and racial/ethnicity identity were included as covariates in each model.

Mental health indicators, depression and anxiety, were the outcome variables or dependent variables in each model. Both depression and anxiety were binary YES/NO measures in the models.

Six modifiable behavioural factors were the predictors variables or independent variables in the models: 1) sleep, 2) physical activity, 3) cigarette use, 4) e-cigarette use, 5) marijuana use, and 6) alcohol consumption including binge drinking.

Sleep and physical activity were categorized into binary measures: for sleep, sufficient sleep and insufficient sleep, and for physical activity, sufficient physical activity and insufficient activity according to the Canadian Physical Activity Guidelines for adults 18-64[205].

Each of the four substance use measures were divided into three distinct categories. For cigarette use, e-cigarette use, and marijuana use the three categories were: never users, infrequent users (have used but not within the last 30 days), and current users (any use within the last 30 days). For alcohol/binge drinking the three distinct categories were: non-drinkers, non-binge drinkers (consume alcohol but did not binge drink), and binge drinkers (five or more alcohol drinks in one sitting).

Please see below for comprehensive details regarding all variables.

4.2.1 Variables

DEPENDENT VARIABLES

4.2.1.1 Depression

Self-reported ***depression*** was asked as follows: “Have you ever felt so depressed that it was difficult to function?” Depression responses were dichotomized into either NO depression or YES depression categories*. Coding ‘0’ for **NO depression** included (1) no, never, and (2) no, not in the last 12 months. Coding ‘1’ for **YES depression** included (3) yes, in the last 2 weeks, (4) yes, in the last 30 days, and (5) yes, in the last 12 months.

4.2.1.2 Anxiety

Self-reported *anxiety* was asked as follows: "Have you ever felt overwhelming anxiety?" Anxiety responses were dichotomized into either NO anxiety or YES anxiety categories*. Coding '0' for **NO anxiety** included (1) no, never, and (2) no, not in the last 12 months. Coding '1' for **YES anxiety** included (3) yes, in the last 2 weeks, (4) yes, in the last 30 days, and (5) yes, in the last 12 months.

*Consistent with other research utilizing the 2019 NCHA survey[206], the dependent variables, depression and anxiety, have been recoded exactly the same to narrow the five possible options into two dichotomous categories.

INDEPENDENT VARIABLES

4.2.1.3 Sleep

Sleep was measured by asking "On how many of the past 7 days did you get enough sleep so that you felt rested when you woke up in the morning?" Previous research[207] dichotomized the NCHA sleep variable to represent sufficient sleep and insufficient sleep. Feeling rested four nights or more per week was sufficient sleep; reporting less than four nights per week was categorized as insufficient sleep. Consistent with this research, respondents who selected enough sleep that you felt rested when you woke up in the morning (5) 4 days, (6) 5 days, (7) 6 days, or (8) 7 days within the past 7 days were combined to represent the dichotomous category of **sufficient sleep**. Respondents who selected enough sleep that you felt rested when you woke up in the morning (1) 0 days, (2) 1 day, (3) 2 days, or (4) 3 days of sleep within the past 7 days were combined to represent the dichotomous category of **insufficient sleep**. SPSS coding '0' for sufficient sleep and '1' for insufficient sleep.

4.2.1.4 Physical Activity

Students were asked about *physical activity* as follows: "Moderate to vigorous physical activity causes an increase in heart rate and can include brisk walking or jogging. Over the past 7 days: How many total minutes of moderate to vigorous physical activities did you do in at least 10-minute bouts?"

The Canadian Physical Activity Guidelines[208],[209] state adults 18-64 years of age should be getting a minimum of 150 minutes per week of moderate to vigorous physical activity. Consistent with these guidelines other researchers have applied these standards for insufficient vs sufficient physical activity[210] or meeting/not meeting the criteria for moderate-vigorous physical activity recommendations[211].

Based on the Canadian guidelines and previous research above, moderate to vigorous physical activity was separated into two dichotomous categories representing sufficient physical activity and insufficient physical activity. Respondents who selected (5) >150 minutes represented **sufficient physical activity** or students that met the Canadian Physical Activity Guidelines for adults 18-64 years of age. Respondents who selected (1) <30 minutes, (2) 30-60 minutes, (3) 61-90 minutes, or (4) 91-150 minutes were combined to represent **insufficient physical activity** or students that did not meet the Canadian Physical Activity Guidelines for adults 18-64 years of age. SPSS coding '0' for sufficient physical activity and '1' for insufficient physical activity.

Update: In October 2020, the newly developed 'Canadian 24-hour Movement Guidelines for Adults (aged 18-64 years)[212] by the Canadian Society for Exercise Physiology were released[213]. The guideline for adults remained the same encouraging adults 18-64 years of age to accumulate at least 150 minutes of moderate to vigorous physical activity per week.

4.2.1.5 Cigarette smoking, E-cigarette use, and Marijuana use (pot, weed, hashish, hash oil)

The NCHA question related to self-reported substance use is as follows: "Within the last 30 days, on how many days did you use…?" Cigarettes, E-cigarettes, Marijuana (i.e. pot, weed, hashish, hash oil).

For each substance (*cigarettes, e-cigarettes, and marijuana*), response options included: (1) never used, (2) have used, but not in the last 30 days, (3) 1–2 days, (4) 3–5 days, (5) 6–9 days, (6) 10–19 days, (7) 20–29 days, or (8) used daily.

Responses were coded into three categories for each substance: (1) **never users**, (2) **infrequent users** who have used but not within the last 30 days, and (3) **current users** who reported using at least 1-2 days to daily use within the last month (combined responses 3-8 identified above). SPSS coding was '0' for non-users, '1' for infrequent users, and '2' for current users.

4.2.1.6 Alcohol Consumption & Binge Drinking

Alcohol consumption as it relates to binge drinking was assessed as follows: "Over the last two weeks, how many times have you had five or more drinks of alcohol at a sitting?" One drink of alcohol was defined as a 12 oz. can or bottle of beer or wine cooler, a 4 oz. glass of wine, or a shot of liquor straight or in a mixed drink. Response options included (1) N/A, don't drink, (2) None, (3) 1 time, (4) 2 times, (5) 3 times, (6) 4 times, (7) 5 times, (8) 6 times, (9) 7 times, (10) 8 times, (11) 9 times, and (12) 10 or more times.

The responses were divided into three categories and coded as follows: **Non-drinkers** included students who responded '(1) N/A, don't drink' and were coded as '0'. **Non-binge drinkers** included students who consume alcohol but responded '(2) none' to binge drinking within the last two weeks and were coded as '1'. **Binge drinkers** included students who consumed five or

more drinks in one sitting at least '1 time and up to 10 times or more' over the last two weeks. Binge drinkers collectively included students who responded to the response options above 3-12 and were coded as '2'.

The focus on alcohol consumption related to binge drinking, and the categories as described above, rather than frequency of alcohol use within the last 30 days is consistent with other researchers that have identified binge drinking as more relevant to post-secondary students and associated with negative health outcomes[214],[215].

COVARIATES

Covariates that were controlled for in the statistical analysis models included stress, sexual violence, sexual orientation, racial/ethnic identity, and international student status.

4.2.1.7a Stress

Students were asked "Within the last 12 months, how would you rate the overall level of stress experienced?" Response options included: (1) no stress, (2) less than average stress, (3) average stress, (4) more than average stress, and (5) tremendous stress.

To control for stress, stress was dichotomized into binomial categories: *low/average stress* represented students who collectively responded (1) no stress, (2) less than average stress, and (3) average stress. Low/average stress was coded as '0'. *High stress* represented students that collectively responded (4) more than average stress, or (5) tremendous stress. High stress was coded as '1'.

4.2.1.7b Sexual Violence

Students were asked "Within the last 12 months: (a) Were you sexually touched without your consent? (b) Was sexual penetration attempted (vaginal, anal, oral) without your consent? And (c) Were you sexually penetrated (vaginal, anal, oral) without your consent?"

To control for sexual violence, the responses were combined to represent a binary YES/NO measure for sexual violence. If students report YES to any one of the sexual violence questions, they were categorized as YES for having had experienced sexual violence within the last 12 months. If students responded NO to all three sexual violence questions, they were categorized as NO for sexual violence indicating they had not experienced sexual violence within the last 12 months. NO sexual violence was coded as '0'; YES sexual violence was coded as '1'.

4.2.1.7c Sexual Orientation

Sexual orientation was ascertained by asking the following question: "What term best describes your sexual orientation?" Response options included (1) Asexual, (2) Bisexual, (3) Gay, (4) Lesbian, (5) Pansexual, (6) Queer, (7) Questioning, (8) Same Gender Loving, (9) Straight/Heterosexual, and (10) Another identity.

For the purpose of this research, sexual orientation was categorized as a binary measure representing either straight/heterosexual sexual orientation or another sexual orientation. Students that selected (9) Straight/Heterosexual were coded '0' to represent the Straight/Heterosexual category. Students that selected any other sexual orientation option (1) Asexual, (2) Bisexual, (3) Gay, (4) Lesbian, (5) Pansexual, (6) Queer, (7) Questioning, (8) Same Gender Loving, or (10) Another identity were coded '1' to represent 'Another sexual orientation'.

4.2.1.7d Race/Ethnicity

Students were asked "What is your racial or ethnic identification? The response options included: (A) Aboriginal (Inuit, Metis, North American Indian, etc.; status or non-status), (B) Arab, (C) Black, (D) Chinese, (E) Filipino, (F) Japanese, (G) Korean, (H) Latin American, (I) South Asian, (J) Southeast Asian, (K) West Asian, (L) White, (M) Multiracial, and (N) Other. Students could select all that apply.

For the purpose of this research, race or ethnicity was calibrated as a binary measure: White or Ethnic minority. Students that only selected '(L) White' were coded as '0' to represent White ethnicity. Students that responded to one or more of the other options were coded as '1' to represent ethnic minority for ethnicity. If a student answered (L) White plus one or more of the other options, they were coded as '1' indicating ethnic minority.

4.2.1.7e International Student Status

Students were asked "Are you an international student?" and could respond (1) No or (2) Yes. This variable remained a YES/NO binary measure. NO responses were recoded '0' to represent Canadian. YES responses were recoded '1' to represent an international student status.

4.3 Complete Case Study Algorithm

Below is the progression from the full sample (n=55 284) for the 2019 National College Health Assessment Canadian Cohort data to the final sample (n=34 874) for the complete case sample utilized for this research.

NCHA 2019		N = 55 284 and subsequent 'N' progression	# of surveys excluded	Total and % based on progression	Excluded based on missing data
Inclusion Criteria					
NQ51	Year of Study (undergraduate)	44 944	10 340	18 981	
NQ52	Enrollment Status (full-time)	42 311	2 633	34.3% (18981/55284)	
NQ46	Age (18-25)	36 303	6 008		
Missing Data (statistics model)					
NQ47A	Sex at Birth* (Male/Female) *Only male or female were options in 2019.	36 219	84	84 0.2% (84/36303)	
Missing Data (Dependent variables)					
NQ30F	Depression	36 052	167	218	
NQ30G	Anxiety	36 001	51	0.6% (218/36219)	
Missing Data (Independent variables)					
NQ42	Sleep	35 933	68		
NQ67	Physical Activity	35 812	121		1429
NQ8A(1)	Cigarettes	35 650	162	655	3.9% (1429/36303)
NQ8A(10)	E-Cigarettes	35 443	207	1.8% (655/36001)	
NQ8A(6)	Marijuana	35 396	47		
NQ13	Binge Drinking	35 346	50		
Missing Data (Covariates)					
NQ37	Stress	35 338	8		
NQ5_DEF	Sexual Violence	35 101	237	472	
NQ48	Sexual Orientation	35 000	101	1.3% (472/35346)	
NQ54	Ethnicity	34 919	81		
NQ55	International Student	**34 874**	45		

This is the complete sample used for:

1) Descriptive statistics (i.e. frequencies)
2) Chi-square analyses
3) Logistic Regression analyses/models

4.4 SPSS Coding

SAMPLE CHARACTERISTICS			
NQ51	Year of study	"What is your year in school?"	
Inclusion criteria: (1-5) undergraduate Exclusion criteria: (6-8) Graduate or professional, not seeking a degree, or other	Include: (1) 1st year undergraduate (2) 2nd year undergraduate (3) 3rd year undergraduate (4) 4th year undergraduate (5) 5th year or more undergraduate	Exclude: (6) Graduate or professional (7) Not seeking a degree (8) Other	
NQ52	Enrollment Status	"What is your enrollment status?"	
Inclusion criteria: (1) Full-time Exclusion criteria: (2) Part-time (3) Other	Include: (1) Full-time	Exclude: (2) Part-time (3) Other	
NQ46	Age	"How old are you?"	
Inclusion criteria: Age 18*-25 Exclusion criteria: Any age other than 18-25	Include: students who inputted 18-25 years of age	Exclude: Students who inputted 26 years of age or higher	*Note: Age 18 was the minimum age to complete the survey. If students inputted 17 or younger, they will be excluded.
STRATIFY DEPRESSION AND ANXIETY MODELS BY SEX AT BIRTH			
NQ47A	Sex at Birth	"What sex were you assigned at birth, such as on an original birth certificate?"	
Binary code: '0' Female '1' Male	'0' Female (1) Female	'1' Male (2) Male	

DEPENDENT VARIABLES		
NQ30F	Depression	
"Have you ever: Felt so depressed that it was difficult to function?"		
Binary code: '0' NO Depression '1' YES Depression	'0' NO Depression Combined responses 1&2 (1) no, never (2) no, not in the last 12 months	'1' YES Depression Combined responses 3-5 (3) yes, in the last 2 weeks (4) yes, in the last 30 days (5) yes, in the last 12 months
NQ30G	Anxiety	
"Have you ever: Felt overwhelming anxiety?"		
Binary code: '0' NO Anxiety '1' YES Anxiety	'0' NO Anxiety Combined responses 1&2 (1) no, never (2) no, not in the last 12 months	'1' YES Anxiety Combined responses 3-5 (3) yes, in the last 2 weeks (4) yes, in the last 30 days (5) yes, in the last 12 months

INDEPENDENT VARIABLES			
NQ42	Sleep		
"On how many of the past 7 days did you get enough sleep so that you felt rested when you woke up in the morning?"			
Binary code: '0' Sufficient sleep '1' Insufficient sleep	'0' Sufficient sleep Feeling rested four nights or more per week within the past 7 days Combined responses 3-5 (5) 4 days (6) 5 days (7) 6 days (8) 7 days	'1' Insufficient sleep Feeling rested less than four nights per week within the past 7 days Combined responses 3-5 (1) 0 days (2) 1 day (3) 2 days (4) 3 days	
NQ67	Physical Activity		
"Moderate to vigorous physical activity causes an increase in heart rate and can include brisk walking or jogging. Over the past 7 days: How many total minutes of moderate to vigorous physical activities did you do in at least 10-minute bouts?"			
Binary code: '0' Sufficient physical activity '1' Insufficient physical activity	'0' Sufficient physical activity (5) >150 minutes represented sufficient physical activity	'1' Insufficient physical activity Combined responses 1-4 (1) <30 minutes (2) 30-60 minutes (3) 61-90 minutes (4) 91-150 minutes	
SUBSTANCE USE			
"Within the last 30 days, on how many days did you use…?" Cigarettes, E-cigarettes, Marijuana (i.e. pot, weed, hashish, hash oil).			
NQ8A(1)	Cigarette smoking		
NQ8A(10)	E-cigarette use		
NQ8A(6)	Marijuana use (pot, weed, hashish, hash oil)		
Three categories & code: '0' Never users '1' Infrequent users '2' Current users	'0' Never users (1) never used	'1' Infrequent users (2) have used, but not in the last 30 days	'2' Current users Combined responses 3-8 (3) 1–2 days (4) 3–5 days (5) 6–9 days (6) 10–19 days (7) 20–29 days, or (8) used daily
NQ13	Alcohol Consumption including Binge Drinking		
"Over the last two weeks, how many times have you had five or more drinks of alcohol at a sitting?" One drink of alcohol was defined as a 12 oz. can or bottle of beer or wine cooler, a 4 oz. glass of wine, or a shot of liquor straight or in a mixed drink.			
Three categories & code: '0' Non-drinkers '1' Non-binge drinkers '2' Binge Drinkers	'0' Non-drinkers (1) N/A, don't drink	'1' Non-binge drinkers (2) None	'2' Binge drinkers Combined responses 3-12 (3) 1 time (4) 2 times (5) 3 times (6) 4 times (7) 5 times (8) 6 times

			(9) 7 times (10) 8 times (11) 9 times (12) 10 or more times
COVARIATES			
NQ37	Stress		
"Within the last 12 months, how would you rate the overall level of stress experienced?"			
Binary code: '0' Low/average stress '1' High stress	'0' Low/average stress Combined responses 1-3 (1) no stress (2) less than average stress (3) average stress	'1' High stress Combined responses 4&5 (4) more than average stress (5) tremendous stress.	
SEXUAL VIOLENCE			
"Within the last 12 months: (a) Were you sexually touched without your consent? (b) Was sexual penetration attempted (vaginal, anal, oral) without your consent? And (c) Were you sexually penetrated (vaginal, anal, oral) without your consent?"			
NQ5(D)	Sexually touched w/o consent		
NQ5(E)	Sexually penetration attempted w/o consent		
NQ5(F)	Sexually penetration w/o consent		
Binary code: '0' NO sexual violence '1' YES sexual violence	'0' NO Sexual Violence If students responded NO to all three sexual violence questions, they will be categorized as NO for sexual violence in that they have not experienced sexual violence within the last 12 months.	'1' YES Sexual Violence Combined responses If students report YES (1) to any one of the sexual violence questions, they will be categorized as YES for having had experienced sexual violence within the last 12 months.	
NQ48	Sexual Orientation		
"What term best describes your sexual orientation?"			
Binary code: '0' Straight/heterosexual sexual orientation '1' Another sexual orientation (other than heterosexual)	'0' Straight/Heterosexual (9) Straight/ Heterosexual	'1' Another Sexual Orientation Combined responses 1-8 & 10 (Not 9) (1) Asexual (2) Bisexual (3) Gay (4) Lesbian (5) Pansexual (6) Queer (7) Questioning (8) Same Gender Loving (10) Another identity	
NQ54	Race/Ethnicity		
"What is your racial or ethnic identification?" (Students could select all that apply.)			
Binary code: '0' White Ethnicity '1' Ethnic Minority '1' White + Ethnic Minority	'0' White Ethnicity Students that only select (L) White	'1' Ethnic Minority Combined responses 1-8 & 10 (A) Aboriginal (Inuit, Metis, North American	'1' White + Ethnic Minority (L) White (plus any other racial or ethnic identity: A-K and/or M-N

		Indian, etc.; status or non-status) (B) Arab (C) Black (D) Chinese (E) Filipino (F) Japanese (G) Korean (H) Latin American (I) South Asian (J) Southeast Asian (K) West Asian (M) Multiracial (N) Other	If a student answers (L) White plus one or more of the other options (A-K and/or M-N), they will be coded as '1'.
NQ55	International Student Status		
"Are you an international student?"			
Binary code: '0' NO Not Intl Student Status (therefore Canadian) '1' YES Intl Student Status	'0' NO Not Intl Student (1) No	'1' YES Intl Student Status (2) Yes	

SECTION FIVE: Results

5.1 DESCRIPTIVE STATISTICS FOR COMPLETE SAMPLE

5.1a Descriptive Statistics for Demographic Characteristics

The focus of this study was to investigate modifiable risk factors and their association with depression and anxiety. This secondary analysis utilized the 2019 Canadian National College Health Assessment (NCHA) results (n=34874).

As shown *below*, all students were full-time undergraduates with 31.6% in first year, 27.9% in 2nd year, 20.4% in 3rd year, and 14.8% and 5.2% in 4th and 5th year, respectively. The 18-25 age criteria included 14.6% students that were 18 years of age, 20.7% were 19 years of age, 20.3% were 20, 17.6% and 11.9% were 21 and 22 years of age, respectively, and 14.8% were between 23-25. The mean age was 20.5 with a SD of 1.85. Female sex at birth represented 70.7% of students and male sex at birth was 29.3%. International students comprised 11.6% of the sample. Ethnicity was dichotomized as white ethnicity (55.1%) or ethnic minority (44.9%). Student who identified as having another sexual orientation (other than straight/heterosexual) was 17.2% of the sample.

TABLE 1.1a Demographic Characteristics

VARIABLES	CATEGORIES	n	%
Enrollment Status	Full-time	34874	100.0
Year of Study	1st year undergraduate	11028	31.6
	2nd year undergraduate	9746	27.9
	3rd year undergraduate	7113	20.4
	4th year undergraduate	5166	14.8
	5th year undergraduate or more	1821	5.2
Age in Years	18	5107	14.6
	19	7214	20.7
	20	7086	20.3
	21	6134	17.6
	22	4165	11.9
	23	2386	6.8
	24	1570	4.5
	25	1212	3.5
		Mean	20.5
		Std Dev	1.85
Sex at Birth	Female	24640	70.7
	Male	10234	29.3
International Status	Not an international student	30832	88.4
	Yes, an international student	4042	11.6

Ethnicity	White ethnicity	19222	55.1
	Ethnic minority	15652	44.9
Sexual Orientation	Straight/heterosexual	28890	82.8
	Another sexual orientation	5984	17.2

Please note: International status, ethnicity, and sexual orientation, in addition to being demographic characteristics, are included in the adjusted and full logistic regression models as covariates.

5.1b Descriptive Statistics for Dependent Variables

As shown *below in Table 1.1b*, 53.3% of students reported feeling so depressed it was difficult to function in the last 12 months and 71.0% of students reported feeling overwhelming anxiety in the last 12 months.

TABLE 1.1b Dependent Variables

VARIABLES	CATEGORIES	n=34874	%
Depression	No depression	16270	46.7
	Yes depression	18604	53.3
Anxiety	No anxiety	10123	29.0
	Yes anxiety	24751	71.0
Both Depression and Anxiety		17450	50.0

5.1c Chi-Square test for DEPRESSION & ANXIETY

A chi-square test (2x2) was performed to examine the association between depression and anxiety (shown below and in Appendix H Table 2.1). The results indicate a statistically significant association for depression and anxiety, χ^2 (1, N = 34874) = 10083.71, p = .000, with a moderate effect (ϕ = .538). Co-occurring depression and anxiety is common among Canadian post-secondary undergraduate students with 50% or 17450 students reporting both depression and anxiety.

TABLE 2.1 Chi-Square test for DEPRESSION & ANXIETY

DEPENDENT VARIABLES n=34874	No Anxiety n	%	Yes Anxiety n	%	Total n	%	*Pearson Chi-square (df)*	*Significance p*	*Phi* ϕ
No Depression	8969	88.6	7301	29.5	16270	46.7	*10083.711 (1)*	*.000*	*.538*
Yes Depression	1154	11.4	17450	70.5	18604	53.3			
Total	10123	100.0	24751	100.00	34874	100.00			

Conclusion: Statistically significant association with a moderate effect at .538 for depression and anxiety. Co-occurring depression and anxiety is common among Canadian post-secondary undergraduate students with 50% or 17450 students in this sample reporting both depression and anxiety.

5.1d Descriptive Statistics for Independent Variables

The independent variables were six modifiable behaviours (sleep, physical activity, cigarette use, e-cigarette use, marijuana use, and alcohol consumption including binge drinking) with frequencies as shown in *Table 1.1c*: 63.0% of students reported insufficient sleep and 86.8% reported insufficient physical activity; 14.8% of students were infrequent cigarette users and 9.5% were current users; 11.4% of students were infrequent e-cigarette users and 12.9% were current e-cigarette users. Infrequent marijuana use was 19.4% and current marijuana use was 26.3% for this student sample. Students that consumed alcohol but did not binge drink represented 43.9% of students in this sample, and 32.4% were binge drinkers.

TABLE 1.1c Independent Variables

VARIABLES	CATEGORIES	n	%
Sleep	Sufficient sleep	12916	37.0
	Insufficient sleep	21958	63.0
Physical Activity	Sufficient physical activity	4618	13.2
	Insufficient physical activity	30256	86.8
Cigarettes	Never users	26376	75.6
	Infrequent users	5174	14.8
	Current users	3324	9.5
E-cigarettes	Never users	26384	75.7
	Infrequent users	3984	11.4
	Current users	4506	12.9
Marijuana	Never users	18926	54.3
	Infrequent users	6760	19.4
	Current users	9188	26.3
Alcohol	Non-drinkers	8287	23.8
	Non-binge drinkers	15295	43.9
	Binge drinkers	11292	32.4

5.1e Descriptive Statistics for Covariates

APPENDIX G Table 1.1d -- Five covariates (stress, sexual violence, sexual orientation, ethnicity, and international student status) were included in the analyses: 61.7% of students reporting high stress; 15.6% of students had been the victim of sexual violence; 11.6% of students were international; 44.9% were classified as an ethnic minority; and 17.2% of students had a sexual orientation other than heterosexual/straight.

5.2 DESCRIPTIVE STATISTICS BY SEX AT BIRTH (FEMALE/MALE)

5.2a Chi-square test for Dependent and Independent Variables by Sex at Birth

Table 2.2 in Appendix G shows the chi-square analyses performed to test the association between each variable and sex at birth (female/male). The results were significant for all variables indicating an association between sex at birth (female/male) and each dependent variable, independent variable, and covariate. Although all were statistically significant ($p<.001$), the associations were relatively weak if not negligible. The two dependent variables had the largest phi coefficients at -.136 for depression χ^2 (1, N = 34874) = 641.52, $p < .001$, and -.224 for anxiety χ^2 (1, N = 34874) = 1755.98, p = .000.

5.2b Descriptive Statistics for Demographic Characteristics by Sex at Birth

A key component of this research was to evaluate the data by sex at birth* as shown in *APPENDIX G Table 1.2*. Of the 34874 full-time undergraduate students included in the analyses, 70.7% identified as female at birth and 29.3% identified as male at birth. For both female and male sex at birth categories, the percentage of students by sex and birth declined with each successive year of study. For female sex at birth students, 31.0% were in 1st year, 27.9% 2nd, 20.6% 3rd, 15.3% 4th, and 5.2% of female sex at birth students were in 5th year or more but still an undergraduate student. For male sex at birth students, the year of study from 1st year to 5th or more was 33.2%, 28.2%, 19.9%,13.6%, and 5.2%, respectively. For age in years and for both female and male sex at birth, most students were between 19-21 (21.0%, 20.7%, 18.1% for females 19, 20, and 21 years of age, respectively; and 20.0%, 19.5%, 16.4% for males 19, 20, and 21 years of age, respectively).

**For this thesis and unless otherwise identified, the subsequent results and discussion sections state female sex at birth as 'female students' or 'females', and male sex at birth as 'male students' or 'males'.*

5.2c Descriptive Statistics for Dependent Variables by Sex at Birth

As shown in *Table 1.2a*, prevalence of both depression and anxiety were higher for female students with 57.7% of females vs 42.8% of males responding 'yes' to feeling so depressed it was difficult to function (YES depression), and 77.5% versus 55.2% responding 'yes' to feeling overwhelming anxiety (YES anxiety) for female and male students, respectively.

TABLE 1.2a Frequency for Dependent Variables by Sex at Birth

	FEMALE n = 24640		MALE n = 10234		TOTAL n = 34874	
	n	%	n	%	n	%
DEPRESSION						
No depression	10421	42.3	5849	57.2	16270	46.7
Yes depression	14219	57.7	4385	42.8	18604	53.3
ANXIETY						
No anxiety	5535	22.5	4588	44.8	10123	29.0
Yes anxiety	19105	77.5	5646	55.2	24751	71.0

5.2d Descriptive Statistics for Independent Variables by Sex at Birth

For the independent variables, as shown below in Table 1.2b, more female students versus male students reported insufficient sleep and insufficient physical activity. Insufficient sleep was reported by 66.0% of female students and 55.6% of male students. Insufficient physical activity was reported by 88.9% of female students and 81.5% of male students. For cigarette use, 14.5% of females and 15.6% of males were infrequent cigarette users, and 8.6% of females and 11.8% of males were current cigarette users. For e-cigarette use, 10.8% of females and 12.9% of males were infrequent e-cigarette users, and 11.0% of females and 17.5% of males were current e-cigarette users. For marijuana use, 20.1% of females and 17.7% of males were infrequent marijuana users, and 25.7% of females and 28.0% of males were current marijuana users. For alcohol consumption, 46.6% of female students and 37.2% of male students were non-binge drinkers in this sample, and 31.3% of female students and 35.0% of male students reported binge drinking.

TABLE 1.2b Frequency for Independent Variables by Sex at Birth

	FEMALE n = 24640		MALE n = 10234		TOTAL n = 34874	
	n	%	n	%	n	%
SLEEP						
Sufficient sleep	8373	34.0	4543	44.4	12916	37.0
Insufficient sleep	16267	66.0	5691	55.6	21958	63.0
PHYSICAL ACTIVITY						
Sufficient physical activity	2723	11.1	1895	18.5	4618	13.2
Insufficient physical activity	21917	88.9	8339	81.5	30256	86.8
CIGARETTES						
Never users	18950	76.9	7426	72.6	26376	75.6
Infrequent users	3578	14.5	1596	15.6	5174	14.8
Current users	2112	8.6	1212	11.8	3324	9.5
E-CIGARETTES						
Never users	19265	78.2	7119	69.6	26384	75.7
Infrequent users	2662	10.8	1322	12.9	3984	11.4

Current users	2713	11.0	1793	17.5	4506	12.9
MARIJUANA						
Never users	13371	54.3	5555	54.3	18926	54.3
Infrequent users	4945	20.1	1815	17.7	6760	19.4
Current users	6324	25.7	2864	28.0	9188	26.3
ALCOHOL CONSUMPTION						
Non-drinkers	5441	22.1	2846	27.8	8287	23.8
Non-binge drinkers	11488	46.6	3807	37.2	15295	43.9
Binge drinkers	7711	31.3	3581	35.0	11292	32.4

5.3 DESCRIPTIVE STATISTICS FOR DEPRESSION

5.3a Chi-square test for DEPRESSION by independent variables among female and male students

Chi-square tests were conducted for depression with independent variables for female students (Appendix G Table 2.3.1), and depression with independent variables for male students. (Appendix G Table 2.3.2). The results were statistically significant (p<.001) for all variables indicating an association between depression and each independent variable for both female and male students. For female students the strength of association with depression was greatest for sleep χ^2 (1, N = 24640) = 1068.81, p < .001 (phi .208), followed by cigarettes χ^2 (2, N = 24640) = 506.77, p < .001, albeit weak phi at .143, and marijuana χ^2 (2, N = 24640) = 488.39, p < .001, albeit weak phi at .141. For male students the strength of association with depression was also greatest for sleep χ^2 (1, N = 10234) = 392.16, p < .001 (phi .196), and then marijuana χ^2 (2, N = 10234) = 121.11, p < .001 (phi .109), followed by cigarettes χ^2 (2, N = 10234) = 95.80, p < .001, albeit weak phi at .097. In conclusion, although all associations between depression and the independent variables were statistically significant for both female and male students, the strength of association was weak or negligible for most.

5.3b Descriptive Statistics for students with DEPRESSION by Sex at Birth

As shown in *Table 1.3.3*, of the 57.7% or 14219 female students that reported feeling so depressed it was difficult to function, 95.5% (13581 female students) also reported feeling overwhelming anxiety. For the 42.8% or 4385 of male students that reported feeling depressed, 88.2% (3869) also reported overwhelming anxiety. More female students with depression had insufficient sleep and insufficient physical activity when compared to male students with depression, 74.5% and 90.0% versus 66.8% and 82.9%, respectively.

More male than female students with depression used cigarettes and e-cigarettes, both infrequently and currently with 17.3% and 14.8% for male infrequent and current cigarette use, respectively, versus 16.7% and 11.3% for female infrequent and current cigarette use, respectively. For students that reported depression, infrequent and current e-cigarette use for

males was 13.6% and 19.7%, respectively, and for females 12.3% and 13.0%, respectively. Combined infrequent and current marijuana use for students with depression were the same for male and female students, both at 51.2%. When separated, more female students with depression used marijuana infrequently when compared to male students, 20.9% versus 17.9%, respectively. Conversely, more male students with depression used marijuana currently when compared to female students with depression, 33.3% versus 30.3%, respectively. For students with depression, more female students were non-binge drinkers (46.3%) than male students at 39.0%; more male students with depression were binge drinkers than female students with depression, 35.1% versus 32.6%, respectively. With the alcohol consumption options combined (non-binge drinking and binge drinking), more female students with depression consumed alcohol, 78.9%, when compared to male students at 74.1%.

TABLE 1.3.3 Frequency comparison for DEPRESSION by Sex at Birth

	Yes Depression			
	Females n=14219 (57.7%)		Males n=4385 (42.8%)	
	n	%	n	%
Yes anxiety	13581	95.5	3869	88.2
Insufficient sleep	10588	74.5	2931	66.8
Insufficient physical activity	12804	90.0	3637	82.9
Cigarette infrequent users	2379	16.7	758	17.3
Cigarette current users	1604	11.3	651	14.8
E-cigarette infrequent users	1744	12.3	598	13.6
E-cigarette current users	1854	13.0	865	19.7
Marijuana infrequent users	2976	20.9	783	17.9
Marijuana current users	4314	30.3	1462	33.3
Non-binge drinkers	6588	46.3	1708	39.0
Binge drinkers	4636	32.6	1541	35.1

5.4 DESCRIPTIVE STATISTICS FOR ANXIETY

5.4a Chi-square test for ANXIETY by independent variables among female and male students

Chi-square analyses were conducted for anxiety and all independent variables for female students (Appendix G Table 2.4.1) and male students (Appendix G Table 2.4.2). For female students, the results were statistically significant ($p<.001$) for all variables indicating an association between anxiety and each independent variable for female students. The strength of association was greatest for anxiety and sleep χ^2 (1, N = 24640) = 773.79, $p < .001$, (phi .177), followed by marijuana χ^2 (2, N = 24640) = 510.25, $p < .001$, (phi .144), and then cigarette use χ^2 (2, N = 24640) = 284.96, $p < .001$, (phi .108). For male students the chi-square results followed the same pattern as female students with sleep having the strongest association with anxiety χ^2 (1, N = 10234) = 399.04 $p < .001$, (phi .197), followed by marijuana χ^2 (2, N = 10234) = 141.22, p <

.001, (phi .117), and then cigarette use χ^2 (2, N = 10234) = 82.21, p < .001, (phi .090). All male associations for anxiety and independent variables were significant at p<.001 except physical activity which was p =.005.

5.4b Descriptive Statistics for students with ANXIETY by Sex at Birth

As shown in *Table 1.4.3*, for female students with anxiety, 71.1% also reported depression, and for male students with anxiety, 68.5% also reported depression. More female students with anxiety had insufficient sleep and insufficient physical activity when compared to male students with anxiety, 70.5% and 89.4% versus 64.5% and 82.4%, respectively.

More male than female students with anxiety used cigarettes and e-cigarettes, both infrequently and currently. Infrequent cigarette use for male students with anxiety was 17.4% vs 15.8% for female students with anxiety. Current cigarette use for male students with anxiety was 13.7% vs 9.7% for female students with anxiety. Infrequent and current e-cigarette use for male students with anxiety was 13.9% and 19.6%, respectively, and for female students with anxiety, 11.5% and 12.2%, respectively. Combined infrequent and current marijuana use for students with anxiety were almost the same for male (50.8%) and female (49.5%) students. When separated, more female students with anxiety used marijuana infrequently when compared to male students, 21.1% versus 18.8%, respectively. More male students with anxiety used marijuana currently when compared to female students with anxiety, 32.0% versus 28.4%, respectively. For students with anxiety, more female students were non-binge drinkers, 47.3%, than male students at 38.9%. More male students with anxiety were binge drinkers than female students with anxiety, 36.1% versus 32.4%, respectively. When alcohol consumption options were combined, more female students with anxiety consumed alcohol, whether non-binge drinking or binge drinking, when compared to male students with anxiety, 79.7% vs 75.0%, respectively.

TABLE 1.4.3 Frequency comparison for ANXIETY by Sex at Birth

	Yes Anxiety			
	Females n=19105 (77.5%)		Males n=5646 (55.2%)	
	n	%	n	%
Yes depression	13581	71.1	3869	68.5
Insufficient sleep	13476	70.5	3639	64.5
Insufficient physical activity	17082	89.4	4655	82.4
Cigarette infrequent use	3023	15.8	980	17.4
Cigarette current use	1849	9.7	771	13.7
E-cigarette infrequent use	2200	11.5	782	13.9
E-cigarette current use	2328	12.2	1108	19.6
Marijuana infrequent use	4038	21.1	1059	18.8
Marijuana current use	5418	28.4	1809	32.0
Non-binge drinker	9045	47.3	2196	38.9
Binge drinker	6187	32.4	2036	36.1

In conclusion, the prevalence of depression and anxiety among post-secondary students warranted this research project to investigate how modifiable behavioural factors are associated with each of them. The chi-square analyses revealed that the stratification by sex at birth (females/males) with the variables selected for this research were justified given the statistically significant associations. The results of this thesis provides valuable information regarding Canadian undergraduate post-secondary students.

5.5 LOGISTIC REGRESSION STATISTICS

For this thesis, three types of logistic regression analyses were conducted for each of the dependent variables for the complete sample (combined females and males) and by sex at birth (females, males): 1) Univariate Logistic Regression, 2) Adjusted Logistic Regression, and 3) Full Logistic Regression. How the predictors changed with each successive model was of interest - first when ran individually with each response variable, then when adjusting for covariates, and finally when all variables were included in the full models.

5.5.1 UNIVARIATE LOGISTIC REGRESSION MODELS

I explored the univariate association for the complete sample, females, and males separately with each of the independent variables and each of the covariates for depression, and then repeated each analysis separately for anxiety. The results are presented in Appendix I.

For depression (Appendix I Table 3.1) and for anxiety (Appendix I Table 4.1), all the independent variables in each univariate logistic regression model were statistically significant for the combined sample, and when stratified by sex at birth. For depression, insufficient sleep and current cigarette use had the highest associations with depression across all models. For anxiety, insufficient sleep and two substances, cigarette use and marijuana use, had the highest associations with anxiety across all models.

5.5.2 ADJUSTED LOGISTIC REGRESSION MODELS

Adjusted logistic regression models were implemented for each independent variable with all five covariates for depression and, then again, separately for anxiety. The models were conducted for the complete sample and stratified by sex at birth (females/males). For example, Table 5.1A showcases the outcome variable ‘depression’ with the predictor variable ‘sleep’ while adjusted for all five covariates (stress, sexual violence, sexual orientation, ethnicity, and international status). The results are presented in Appendix I Tables 5.1A-5.1F for depression models and Appendix I Tables 6.1A-6.1F for anxiety models.

Adjusted Logistic Regression for DEPRESSION

For depression, five of the six independent variables were statistically associated with depression even when adjusting for the five covariates for the complete sample, female sample, and male sample. When compared to the univariate models, the addition of the covariates changed the statistical significance for depression and alcohol consumption, specifically, sex at birth differences emerged for non-binge drinking and binge drinking. The adjusted logistic regression analysis was only statistically significant for male students that were non-binge drinkers (OR=1.15, 95%CI [1.03, 1.28], p=.017) but not for female students or the complete sample. Thus, when compared to male students that don't drink alcohol, depression was more likely for male students that consumed alcohol but did not binge drink even when accounting for stress, sexual violence, sexual orientation, ethnicity, and international student status. This same association was not significant for female students or for the complete sample with females and males combined. When looking at binge drinking the opposite was statistically significant: depression and binge drinking while adjusting for covariates was statistically significant for female students (OR=1.11, 95%CI [1.02, 1.21], p=.013) but not for male students. Thus, when compared to female students that do not drink alcohol, depression was more likely to be present for female students that binge drink even when accounting for stress, sexual violence, sexual orientation, ethnicity, and international student status. The same association was not significant for male students. The results for all the adjusted models for depression are presented in Appendix I Tables 5.1A-5.1F.

Adjusted Logistic Regression for ANXIETY

All adjusted models, including the complete sample and the stratified by sex at birth samples, were statistically significant for anxiety even when adjusting for the five covariates, except one. When accounting for covariates in the adjusted models, only anxiety and infrequent e-cigarette use for the complete sample (females and males combined) was no longer statistically significant. The adjusted models for anxiety and e-cigarette use by sex at birth were both statistically significant. The results for all the adjusted models for anxiety are presented in Appendix I Tables 6.1A-6.1F.

5.5.3 LOGISTIC REGRESSION FULL MODELS

Full logistic regression models were performed for each of the two dependent variables (depression and anxiety) for the complete sample and by sex at birth (female and male samples) to ascertain the associations for insufficient sleep, insufficient physical activity, infrequent and current cigarette use, infrequent and current e-cigarette use, infrequent and current marijuana use, and non-binge drinking and binge drinking while accounting for stress, sexual violence, sexual orientation, ethnicity, and international status. Six models were executed: 1) Logistic Regression for DEPRESSION for the complete sample, 2) Logistic Regression for DEPRESSION for females, 3) Logistic Regression for DEPRESSION for males, 4) Logistic Regression for ANXIETY for

the complete sample, 5) Logistic Regression for ANXIETY for females, and 6) Logistic Regression for ANXIETY for males. Full models with the complete sample and stratified by sex at birth are presented below and in Appendix I Table 7.1 for depression and Table 8.1 for anxiety.

5.5.3A Logistic Regression for DEPRESSION (Full models)

Full model logistic regression analyses were conducted to investigate the association between depression and six predictor variables: sleep, physical activity, cigarette use, e-cigarette use, marijuana use, and alcohol consumption. Five covariates were controlled for in the models: stress, sexual violence, sexual orientation, ethnicity, and international student status. Three separate models, the complete sample, the female student sample, and the male student sample, were conducted. The results are as follows:

TABLE 7.1 Logistic Regression for DEPRESSION for complete sample and stratified by sex at birth

DEPRESSION												
	Column 7.1.1 *Complete sample* n=34874				Column 7.1.2 *Females* n=24640				Column 7.1.3 *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Insufficient sleep	1.78	1.70	1.87	**<.001**	1.80	1.69	1.91	**<.001**	1.67	1.53	1.83	**<.001**
Insufficient physical activity	1.20	1.12	1.29	**<.001**	1.18	1.07	1.29	**<.001**	1.11	0.99	1.24	.073
Infrequent cigarette use	1.29	1.19	1.40	**<.001**	1.32	1.20	1.45	**<.001**	1.23	1.06	1.42	**.007**
Current cigarette use	1.61	1.46	1.77	**<.001**	1.80	1.59	2.05	**<.001**	1.44	1.22	1.69	**<.001**
Infrequent e-cigarette use	0.98	0.90	1.07	.625	1.06	0.95	1.18	.276	0.90	0.77	1.05	.168
Current e-cigarette use	0.97	0.89	1.06	.464	1.08	0.96	1.20	.190	0.91	0.79	1.06	.236
Infrequent marijuana use	1.16	1.09	1.25	**<.001**	1.16	1.07	1.26	**<.001**	1.15	1.01	1.32	**.037**
Current marijuana use	1.49	1.39	1.60	**<.001**	1.48	1.36	1.60	**<.001**	1.57	1.38	1.79	**<.001**
Non-binge drinker	0.94	0.88	1.00	.066	0.89	0.82	0.96	**.002**	1.03	0.92	1.16	.643
Binge drinker	0.82	0.76	0.89	**<.001**	0.80	0.73	0.88	**<.001**	0.85	0.74	0.97	**.018**
COVARIATES												
Stress (high)	4.78	4.54	5.03	**<.001**	4.62	4.34	4.90	**.000**	4.74	4.33	5.19	**<.001**
Sexual violence (yes)	2.01	1.87	2.16	**<.001**	1.96	1.80	2.12	**<.001**	1.60	1.34	1.91	**<.001**
Sexual orientation (other)	2.17	2.02	2.32	**<.001**	2.24	2.07	2.42	**<.001**	1.77	1.54	2.03	**<.001**
Ethnic minority	1.42	1.35	1.50	**<.001**	1.47	1.38	1.57	**<.001**	1.38	1.26	1.53	**<.001**
International student	1.42	1.31	1.53	**<.001**	1.53	1.38	1.69	**<.001**	1.35	1.18	1.53	**<.001**

Bolded *p* values are statistically significant at *p* less than .05.
Covariates accounted for in the model include stress, sexual violence, sexual orientation, ethnicity, and international student status.

Logistic Regression for DEPRESSION for complete sample

A full model logistic regression analysis was conducted for the complete sample to investigate the associations between depression and six predictor variables: sleep, physical activity, cigarette use, e-cigarette use, marijuana use, and alcohol consumption. Five covariates were controlled for in the model: stress, sexual violence, sexual orientation, ethnicity, and international student status.

The results for the complete sample in the table above (column 7.1.1) indicate the odds of having depression is 1.8 times higher for students with insufficient sleep and 1.2 times higher for student with insufficient physical activity. Both infrequent and current cigarette use were associated with depression, with current cigarette use increasing the odds of depression by 1.6. Both infrequent and current marijuana use were statistically significant for increased odds for depression, 1.2 and 1.5 times, respectively. Non-binge drinking was not statistically significant. Binge drinking, although significant, had an inverse relationship with depression OR=0.82, 95%CI [0.76, 0.89], $p<.001$. Thus, with an odds ratio less than 1, this indicates that students who binge drink are less likely to have depression than non-drinkers or that binge drinking is protective against depression in the complete sample. Finally, both infrequent and current e-cigarette use were not statistically significant in the full model therefore not associated with depression.

In conclusion, even when controlling for stress, sexual, violence, sexual orientation, ethnicity, and international student status (all of which were statistically associated with increased odds of depression in the complete sample), insufficient sleep, insufficient physical activity, cigarette use, and marijuana use were still associated with an increased risk of depression for Canadian undergraduate students. E-cigarettes, both infrequent and current use, were not statistically significant for depression in the full model with the complete sample. Binge drinking was found to have a statistically significant inverse relationship with depression in the complete sample.

Logistic Regression for DEPRESSION for females

As can be seen in the above table for female students (column 7.1.2), insufficient sleep increased the odds of having depression by 1.8, and insufficient physical activity increased the odds for depression for female students by 1.2. Both infrequent and current cigarette use were associated with depression, with current cigarette use increasing the odds of depression by 1.8 for females. Both infrequent and current marijuana use was statistically significant for increased odds for depression, 1.2 and 1.5 times, respectively. Both non-binge drinking and binge drinking, although significant, had an inverse relationship with depression. Thus, with odds ratios less than one, 0.89 for non-binge drinking females, and 0.80 for binge drinking females, this indicates that for female students who non-binge drink or binge drink, they are less likely to report depression than female students who do not drink alcohol. Finally, both infrequent and current e-cigarette use were not significantly associated with depression for female students.

Therefore, in the full logistic regression model including all independent variables and covariates, insufficient sleep, insufficient physical activity, cigarette use, and marijuana use were associated with an increased risk of depression for Canadian female undergraduate students.

Logistic Regression for DEPRESSION for males

As seen in the above table for male students (column 7.1.3), insufficient sleep increased the likelihood of being depressed by 1.7 when compared to male students that get sufficient sleep. Both infrequent and current cigarette use was associated with an increased risk for depression, with infrequent cigarette use increasing the odds for depression by 1.2 and current cigarette use increasing the odds by 1.4 for male students. Both infrequent and current marijuana use was statistically significant for increasing the risk for depression by 1.2 and 1.6 times, respectively.

Non-binge drinking was not statistically significant. Binge drinking, although significant, had an inverse relationship with depression OR=0.85, 95%CI [0.74, 0.97], p=.018. Thus, with an odds ratio less than 1, this indicates that for male students who binge drink, they are less likely to have depression than non-drinkers. E-cigarette use, both infrequent and current, were not statistically associated with depression for male students. Finally, there was not a statistically significant association between insufficient physical activity and depression for male students in the full logistic regression model.

In conclusion, in the full model stratified by male sex at birth for depression, insufficient sleep, cigarette use, and marijuana use were associated with an increased risk of depression for male undergraduate students. Insufficient physical activity was not statistically associated with depression for male students, and binge drinking had a significant but inverse relationship with depression for Canadian male undergraduate students.

Sex at Birth (female/male) Full Logistic Regression Model comparison for DEPRESSION

Column 7.1.2 Logistic Regression for DEPRESSION for females (n=24640)
Column 7.1.3 Logistic Regression for DEPRESSION for males (n=10234)

An important component of this thesis was to compare the results by sex at birth. For this comparison female sex at birth was identified as female students or females, and male sex at birth was identified as male students or males. The results described below relate to the full logistic regression models that included all six independent variables (sleep, physical activity, cigarette use, e-cigarette use, marijuana use, and alcohol consumption) along with five covariates (stress, sexual violence, sexual orientation, ethnicity, and international student status). Depression was the dependent variable for the following results.

The prevalence for depression in this sample was 57.7% for females (n=14219) and 42.8% for males (n=4385).

Depression & Sleep

When comparing the independent variables that could be associated with depression, more female students reported insufficient sleep (66.0%) than male students (55.6%). The logistic regression results showed female students to be 1.8 times more likely to have depression when they have insufficient sleep, whereas male students with insufficient sleep were 1.7 times more likely to have depression.

Depression & Physical Activity

Lack of physical activity is a concern for both female and male students with 88.9% of female students reporting insufficient physical activity and 81.5% of male students reporting insufficient physical activity. The results of the logistic regression analysis showed the odds of depression was 1.2 times higher for female students with insufficient physical activity than for female students who get sufficient physical activity. The result of this association was not significant for male students.

Depression & Cigarette Use

The prevalence of cigarette use among female students was 14.5% for infrequent cigarette users and 8.6% for current cigarette users. For male students, infrequent cigarette use was 15.6% and current cigarette use was 11.8%. The results of the logistic regression analyses showed that for the substances, the highest risk for female students was the link between depression and current cigarette users at 1.8, whereas for male students who currently used cigarettes, they were 1.4 times more likely to have depression. For both female and male students who used cigarettes infrequently, the odds for depression were 1.3 and 1.2 times that of non-cigarette users respectively.

Depression & E-cigarette Use

E-cigarette use was 10.8% for female infrequent e-cigarette users and 11.0% for female current e-cigarette users. Male students had a higher prevalence of e-cigarette use than female students, with 12.9% of male students being infrequent e-cigarette users and 17.5% of male students being current e-cigarette users. Despite e-cigarette use prevalence, the results of the logistic regression analyses looking at depression and e-cigarette use were not statistically significant for either infrequent or current e-cigarette use, and for either of the full logistic regression models stratified by sex at birth.

Depression & Marijuana Use

Marijuana use had a higher prevalence across all categories than both cigarette use and e-cigarette use. The prevalence for female students was 20.1% for infrequent marijuana use and 25.7% for current marijuana use, and for male students the prevalence for infrequent marijuana use was 17.7% and 28.0% for current marijuana use. Thus, more female students than male students used marijuana infrequently, and more male students than female students were current marijuana users. The risk of depression for infrequent marijuana users was the same for females and males at 1.2 times that of non-marijuana users. The likelihood of depression for

current marijuana users was 1.6 times for male students and 1.5 times for female students when compared to students that do not use marijuana. All logistic regression results for marijuana use were statistically significant.

Depression & Alcohol Consumption

The prevalence for alcohol use was 46.6% for female students that consumed alcohol but were non-binge drinkers and 31.3% for female students that were binge drinkers. For male students, 37.2% consumed alcohol but were non-binge drinkers and 35.0% of male students were binge drinkers. Despite the prevalence of alcohol by these students, the logistic regression analyses were complex, and the results were not as expected. The association between depression and non-binge drinkers for males was not statistically significant. The associations for depression and binge drinking were statistically significant but inverse for both female and male students, and the same result, statistically significant but inverse, was found for depression and non-binge drinking female students. Thus, alcohol consumption, whether non-binge drinking for female students or binge drinking for female and male students, the results imply drinking alcohol is associated with less likelihood of depression when compared to their non-drinking peers.

5.5.3B Logistic Regression for ANXIETY (Full models)

Full model logistic regression analyses were conducted to investigate the association between anxiety and six predictor variables: sleep, physical activity, cigarette use, e-cigarette use, marijuana use, and alcohol consumption. Five covariates were controlled for in the models: stress, sexual violence, sexual orientation, ethnicity, and international student status. Three separate models, the complete sample, female sample, and male sample, were conducted. The results are as follows:

TABLE 8.1 Logistic Regression for ANXIETY for complete sample and stratified by sex at birth

ANXIETY												
	Column 8.1.1 *Complete sample* n=34874				Column 8.1.2 *Females* n=24640				Column 8.1.3 *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Insufficient sleep	1.66	1.57	1.75	**<.001**	1.60	1.50	1.72	**<.001**	1.61	1.47	1.76	**<.001**
Insufficient physical activity	1.32	1.23	1.43	**<.001**	1.21	1.09	1.34	**<.001**	1.15	1.03	1.29	**.017**
Infrequent cigarette use	1.21	1.10	1.33	**<.001**	1.26	1.12	1.43	**<.001**	1.17	1.00	1.36	**.045**
Current cigarette use	1.22	1.09	1.37	**<.001**	1.36	1.16	1.60	**<.001**	1.22	1.03	1.45	**.020**
Infrequent e-cigarette use	0.87	0.79	0.96	**.004**	0.94	0.82	1.07	.321	0.97	0.83	1.13	.688
Current e-cigarette use	0.92	0.83	1.02	.101	1.12	0.97	1.29	.125	1.02	0.87	1.18	.854
Infrequent marijuana use	1.27	1.17	1.37	**<.001**	1.30	1.18	1.44	**<.001**	1.20	1.05	1.37	**.009**
Current marijuana use	1.44	1.33	1.56	**<.001**	1.56	1.41	1.73	**<.001**	1.40	1.23	1.59	**<.001**

Non-binge drinker	1.12	1.05	1.20	**.001**	1.05	0.97	1.15	.247	1.07	0.95	1.20	.278
Binge drinker	0.93	0.86	1.01	.088	0.90	0.81	1.00	.060	0.92	0.80	1.05	.222
COVARIATES												
Stress (high)	5.86	5.56	6.19	**<.001**	5.76	5.38	6.17	**.000**	5.41	4.94	5.92	**<.001**
Sexual violence (yes)	1.82	1.67	1.99	**<.001**	1.55	1.40	1.72	**<.001**	1.43	1.19	1.73	**<.001**
Sexual orientation (other)	2.00	1.84	2.18	**<.001**	1.81	1.63	2.00	**<.001**	2.11	1.81	2.46	**<.001**
Ethnic minority	0.97	0.92	1.03	.369	0.99	0.92	1.06	.699	1.07	0.97	1.18	.157
International student	0.81	0.74	0.88	**<.001**	0.80	0.72	0.89	**<.001**	0.92	0.81	1.05	.197

Bolded *p* values are statistically significant at *p* less than .05.
Covariates accounted for in the model include stress, sexual violence, sexual orientation, ethnicity, and international student status.

Logistic Regression for ANXIETY for complete sample

As seen in the above table in column 8.1.1, the odds of having anxiety is 1.7 times higher for students with insufficient sleep and 1.3 times higher for students with insufficient physical activity. Cigarette use, both infrequent and current, increased the likelihood for anxiety by 1.2 times. Current e-cigarette use was not significantly related to anxiety, but infrequent e-cigarette use, albeit statistically significant, had an inverse relationship with anxiety. More specifically, students who used e-cigarettes were less likely to have anxiety than students who did not use e-cigarettes OR=0.87, 95%CI [0.79, 0.96], p=.004. Both infrequent and current marijuana use significantly increased the likelihood for anxiety, 1.3 and 1.4 times respectively. Binge drinking did not significantly increase the likelihood for anxiety, but non-binge drinking slightly, yet significantly increased the odds of having anxiety.

In conclusion, even among students who were stressed, experienced sexual violence, and had a sexual orientation other than straight or heterosexual, the likelihood for anxiety was significantly increased for students with insufficient sleep, insufficient physical activity, infrequent or current cigarette use, and infrequent or current marijuana use.

Logistic Regression for ANXIETY for females

As seen in the above table for female students (column 8.1.2), insufficient sleep increased the odds of having anxiety by 1.6, and insufficient physical activity increased the odds for anxiety by 1.2. Both infrequent and current cigarette use were associated with anxiety, with infrequent cigarette use increasing the odds by 1.3 and current cigarette use increasing the odds of anxiety by 1.4. Both infrequent and current marijuana use significantly increased the odds for anxiety by 1.3 and 1.6 times, respectively. Non-binge drinking, binge drinking, infrequent e-cigarette use, and current e-cigarette use did not significantly increase the risk for anxiety for females. The comparison groups are students that reported sufficient sleep, sufficient physical activity and did not use substances.

Three of the five covariates, stress, sexual violence, and sexual orientation, increased the risk for anxiety for female students. High stress increased the odds of anxiety by 5.8; sexual violence increased the odds of anxiety by 1.6 times; and having a sexual orientation other than straight/heterosexual increased the odds of anxiety by 1.8 when compared to students with no or low anxiety. Stress had the highest association with anxiety (OR=5.8, 95% CI [5.38, 6.179], p=.000) among all variables. Ethnic minority was not shown to be statistically associated with anxiety for female students. International student status was statistically significant but inversely related to anxiety for female students (OR=0.80, 95%CI [0.72, 0.89], p<.001), thus indicating female international students were less likely to experience anxiety than domestic students.

Therefore, female students who reported high stress, experienced sexual violence, and had a sexual orientation other than straight or heterosexual were more likely to have anxiety, and the likelihood for anxiety was significantly increased by insufficient sleep, insufficient physical activity, cigarette use, and marijuana use.

Logistic Regression for ANXIETY for males

As seen in the above table for male students (column 8.1.3), insufficient sleep increased the likelihood of anxiety by 1.6, and insufficient physical activity increased the odds for anxiety by 1.2. Both infrequent and current cigarette use increased the risk for anxiety by 1.2 for male students. Both infrequent and current marijuana use significantly increased the risk for anxiety for male students by 1.2 and 1.4 times, respectively. Non-binge drinking, binge drinking, infrequent e-cigarette use, and current e-cigarette use were not statistically significant and did not increase the risk for anxiety for male students.

In conclusion, for Canadian male undergraduate post-secondary students who were stressed, experienced sexual violence, and had a sexual orientation other than straight or heterosexual, the likelihood for anxiety was increased further by insufficient sleep, insufficient physical activity, cigarette use, and marijuana use.

Sex at Birth (female/male) comparison for ANXIETY

Table 8.1.2 Logistic Regression for ANXIETY for females (n=24640)
Table 8.1.3 Logistic Regression for ANXIETY for males (n=10234)

A priority for this thesis was to compare the results by sex at birth. For this comparison female sex at birth was identified as female students or females, and male sex at birth was identified as male students or males. The results described below relate to the full logistic regression models that included all six independent variables (sleep, physical activity, cigarette use, e-cigarette use, marijuana use, and alcohol consumption) along with five covariates (stress, sexual violence, sexual orientation, ethnicity, and international student status). Anxiety was the dependent variable for the following results.

The prevalence for anxiety in this sample was 77.5% for female students (n=19105) and 55.2% for male students (n=5646).

Anxiety & Sleep

The prevalence for insufficient sleep in this sample was 66.0% for female students and 55.6% for male students. The logistic regression results showed both female and male students with insufficient sleep to be 1.6 times more likely to have anxiety compared to students with sufficient sleep.

Anxiety & Physical Activity

The prevalence for insufficient physical activity in this sample was 88.9% for female students and 81.5% for male students. The results of the logistic regression analysis showed both female and male students with insufficient physical activity to be 1.2 times more likely to have anxiety compared to students with sufficient physical activity.

Anxiety & Cigarette Use

The prevalence of cigarette use among female students was 14.5% for infrequent cigarette users and 8.6% for current cigarette users. For male students, infrequent cigarette use was 15.6% and current cigarette use was 11.8%. The results of the logistic regression analyses showed that cigarette use was associated with increased risk for anxiety for female and male students in both smoking categories. For female students who were infrequent cigarette users, the risk for anxiety was 1.3 when compared to non-cigarette users. For female students who were current cigarette users, the increased risk for anxiety was 1.4 times when compared to female students that did not use cigarettes. For male students who were infrequent cigarette users or current cigarette users, the increased risk associated with anxiety was 1.2 times higher for both categories than for non-smoking male students.

Anxiety & E-cigarette Use

E-cigarette use was 10.8% for female infrequent e-cigarette users and 11.0% for female current e-cigarette users. For male students, e-cigarette use was 12.9% for infrequent e-cigarette users and 17.5% for current e-cigarette users. Despite the prevalence, e-cigarette use was not significantly associated with anxiety in the full logistic regression models stratified by sex at birth.

Anxiety & Marijuana

Marijuana use had a higher prevalence across all categories than both cigarette use and e-cigarette use. The prevalence for female students was 20.1% for infrequent marijuana use and 25.7% for current marijuana use. For male students, the prevalence for infrequent marijuana use was 17.7% and 28.0% for current marijuana use. The results of the logistic regression analyses showed that marijuana use was associated with increased risk for anxiety for female and male students in both categories. For female students who were infrequent marijuana users, the risk for anxiety was 1.3 times higher when compared to female non-marijuana users. For female students who were current marijuana users, the risk for anxiety was 1.6 time higher when

compared to female students that were non-marijuana users. For male students who were infrequent marijuana users or current marijuana users, the increased risk associated with anxiety was 1.2 times higher and 1.4 times higher, respectively, when compared to male students that did not use marijuana.

Anxiety & Alcohol

The prevalence for alcohol use was 46.6% for female students that consumed alcohol but were non-binge drinkers, and 31.3% for female students that were binge drinkers. For male students, 37.2% consumed alcohol but were non-binge drinkers and 35.0% of male students were binge drinkers. The logistic regression analyses for anxiety and alcohol consumption were not statistically significant for all categories when data was stratified by sex at birth for female and male students.

SECTION SIX: Discussion

6.1 Summary of Key Findings

Using data from the 2019 Canadian NCHA survey, the vast majority of undergraduate post-secondary students who participated in the survey were feeling depressed or anxious. Over half of students in the sample 'felt so depressed it was difficult to function' and almost three-quarters 'felt overwhelming anxiety'. Of those students, 50% reported feeling both so depressed it was difficult to function and overwhelmingly anxious. Students were more at risk for both depression and anxiety if they got insufficient sleep, insufficient physical activity, used cigarettes and/or used marijuana. Students were at decreased risk for depression if they were binge drinkers. This study found a difference between female student and male students for depression and two modifiable behavioural risk factors, insufficient physical activity and non-binge drinking. Given how prevalent depression and anxiety were in this sample of Canadian undergraduate students, there is opportunity for change, especially noting the "modifiable behaviours" identified in this study that impact mental health.

Generally, this study found that insufficient sleep, and both infrequent and current cigarette and marijuana use increased the risk for depression and anxiety for both female and male students. Insufficient physical activity was a risk factor for anxiety for both female and male students but only a risk factor for depression for female students. Insufficient physical activity was not associated with depression for male students. E-cigarette use was not associated with depression or anxiety for female or male students in all models. Neither non-binge drinking, nor binge drinking, were risk factors for anxiety for both female and male students. Unexpected results were found for alcohol consumption and depression. Non-binge drinking was not significantly related to depression for male students. Non-binge drinking had a significant but inverse relationship to depression for female students, thus moderate drinking was protective for depression for female students. For both female and male students who were binge drinkers, there was a significant inverse relationship with depression. Therefore, in this study, drinking five or more drinks in a sitting was associated with less depression for both female and male students when compared to students that do not drink alcohol. It is possible that students who engage in binge drinking may not have a tendency toward depression, but we want to be cautious and recommend it's an area for future research with the post-secondary student population as definite conclusions cannot be drawn.

Sleep

The prevalence of insufficient sleep among students is concerning and an area researchers continue to investigate ([216],[217],[218],[219]). In this study more than half of male students and two-thirds of female students reported insufficient sleep. The seriousness of inadequate sleep is confirmed by other researchers reporting substantial prevalence for inadequate sleep by students[220] and has been noted as an 'epidemic' with multiple consequences[221]. This research

found insufficient sleep to be associated with both depression and anxiety and for both female students and male students when compared to students who reported sufficient sleep. When compared to students who get sufficient sleep, female students who reported insufficient sleep are more likely to report feeling depressed and more likely to report anxiety. Similarly, male students who report insufficient sleep are more likely to report feeling depressed and more likely to report anxiety than male students who get sufficient sleep. These findings align with existing evidence that insufficient sleep is associated with depression and anxiety[222],[223] for both female and male post-secondary students[224]. Insufficient sleep may lead to mental health issues via the brain's emotional and cognitive functioning[225], neurotransmitter function[226], and/or ability to cope[227]. It is clear from these findings that insufficient sleep is a risk factor for depression and anxiety in post-secondary students. This research supports the importance of adequate sleep for supporting positive mental health and decreasing the risks for depression and anxiety.

Physical Activity

Insufficient physical activity was found for the majority of male students and for almost all female students. Considering the overwhelming majority of this sample is not getting sufficient physical activity, the opportunity to change is paramount. Post-secondary institutions should be providing initiatives to promote more physical activity programming and opportunities among the student population. It is possible that even incremental physical activity could have a substantial impact on improving the mental health within the student population. Other researchers have reported similar astonishing prevalence of physical inactivity for Canadian post-secondary students[228].

Results of this research found insufficient physical activity to be associated with an increased risk for anxiety for both female and male students, and an increased risk for depression for female students when compared to students who get sufficient physical activity. The lack of an association for insufficient physical activity and depression for male students was unexpected. We didn't expect this difference by sex at birth for physical activity and depression since other researchers found a link between physical activity and depression for both male and female students[229]. Although there was not an association for insufficient physical activity and depression for male students in this study, a meta-analysis supported the association between physical activity and both depression and anxiety and stated exercise/physical activity could be a treatment option for depression and anxiety and can enhance mental well-being[230]. Convincingly, research shows students that are more active do better physically and mentally while pursuing post-secondary studies. It is in the best interest of post-secondary institutions to create environments and opportunities that promote physical activity whether in a facility, in residence, through clubs and societies, or faculty connections. Many institutions have invested millions of dollars to build state of the art fitness facilities; it would be beneficial to invest in programming to encourage students to use the facilities or campus networks to promote physical activity in the student population.

Cigarette Use

This research found both infrequent and current cigarette use was associated with greater risk of depression and anxiety for female and male students. This is consistent with other research investigating cigarette use and mental health in undergraduate students[231],[232],[233]. Although a higher percentage of male students reported using cigarettes compared to female students, and both female and male students that used cigarettes had an increased risk for depression and anxiety, female cigarette users had higher odds for both depression and anxiety when compared to male cigarette users in both categories (infrequent and current cigarette users). The highest association was for depression and female students who were current cigarette users. Female current cigarette users were more likely to experience depression than female students who did not use cigarettes. The same association was true for male students who were current cigarette users when compared to male non-cigarette users but with the odds of depression slightly less than current female cigarette users. These findings are consistent with a study that used the 2016 NCHA Canadian dataset and found both current and infrequent, classified as former, cigarette use to be associated with increased risk for depression[234]. It is clear from these findings that cigarette use continues to be a risk factor for depression and anxiety for undergraduate post-secondary students and institutions need to implement programs and policies to decrease cigarette use on campuses. Institutions can offer students free nicotine replacement therapies to support smoking cessation efforts and review policies that are campus wide to reduce overall cigarette use, secondhand smoke, and the environmental impact of cigarettes.

E-cigarette Use

E-cigarette use has continuously increased in prevalence by Canadian youth[235],[236] and American youth and college students[237]. Despite the rise in e-cigarette use and the prevalence of mental health issues in post-secondary students increasing in number, range, and severity[238],[239], there were no significant associations for e-cigarette use in this study. E-cigarette use, whether infrequent or current, was not a risk factor for either depression or anxiety and for either female or male students in the full logistical regression models in this study. These results were not consistent with other literature that found e-cigarette use in university students was significantly associated with mental health problems such as anxiety[240]; e-cigarette use increased the risk of mental health issues including depression and anxiety in Canadian youth[241]; and finally, a gender difference for e-cigarette use and adverse mental health concerns among women[242]. The NCHA Canadian consortium survey first introduced the question regarding e-cigarette use in 2016[243] and again in 2019[244] which is the data set used for this secondary analysis study. More recently, the 2022 version of the Canadian NCHA[245] was modified and the question regarding e-cigarettes has been altered to incorporate many tobacco and nicotine products. The question(s) now combine tobacco or nicotine delivery products (cigarettes, e-cigarettes, Juul or other vape products, water pipe or hookah, chewing tobacco, cigars, etc.) together. For researchers and post-secondary staff utilizing the NCHA substance use data, it will be more challenging to examine substances separately, especially as e-cigarette use is increasing and cigarette use declining among youth[246].

Marijuana

Marijuana had the highest prevalence of all the smoking related substances at 46% when compared to cigarettes and e-cigarettes which were both 24% in this study. Marijuana use increased the probability for depression and anxiety for both female and male students when compared to students that did not use marijuana. These findings align with research that found marijuana use associated with anxiety[247],[248], and an association between marijuana (cannabis) and depression[249],[250]. In this study, female students who used marijuana, both infrequently and currently, were more likely to experience depression, and more likely to experience anxiety, than female students that did not use marijuana. Male students who were either infrequent or current marijuana users were more likely to experience depression and/or anxiety than male students that did not use marijuana. The results of this study confirmed that marijuana use is a risk factor for depression and anxiety in post-secondary students for both infrequent and current marijuana users.

Alcohol Consumption

The prevalence of alcohol was the highest for all the substances included in this investigated. In this study, 78% of female students and 72% of male students consumed alcohol. This is consistent with another Canadian study showcasing drinking had the highest prevalence for Canadian students[251]. Unexpectedly, the results for alcohol consumption and mental health were contradictory to other literature with post-secondary students. The results for alcohol consumption and mental health outcomes, depression and anxiety, were either not significant or inversely significant. Alcohol consumption, neither non-binge drinking nor binge drinking, was associated with anxiety for both female and male students. There was simply no association in this study for alcohol use and anxiety. These findings are somewhat similar to a cross-sectional analysis with secondary school students that found binge drinking was not associated with depression and anxiety[252].

For alcohol consumption and depression, there was no association for male students who consumed alcohol but did not binge drink (non-binge drinkers), however for female students, there was an inverse association indicating non-binge drinking female students were less likely to have depression than female students that were non-drinkers. Similarly, the same inverse relationship was found for both female and male students that were binge drinkers. Female and male students who were binge drinkers were less likely to experience depression than students who were non-drinkers. In other words, female students that did not drink alcohol had a greater likelihood for depression than female students who drank alcohol or were binge drinkers. These findings suggest female students who engage in casual and binge drinking may be at lower risk for depression, and male students who binge drink may be at lower risk for depression. Contrary to the results of this study, other researchers have shown binge drinking was associated with depression and anxiety, especially for male students[253].

In an effort to understand the finding that binge drinkers were at lower risk for depression, it's possible that the protective effect of social networks may offset the risk of depression when

binge drinking with peers. To support this notion, researchers found that post-secondary students with strong peer networks, even if alcohol-using peers, were protected against depression and anxiety[254]. In another study with Canadian secondary students, being part of a sports team was associated with a greater likelihood to binge drink[255]. Thus, it is reasonable to assume most students who binge drink are out with others socializing and not alone in isolation when binge drinking. It could be the socialization aspect, connecting with others, or feeling a sense of belonging when drinking alcohol with others that has positive associations with mental well-being. Once more, the socialization aspects of binge drinking may negate the association with depression, however, the data to examine those factors was not available in this study.

The unexpected inverse association for binge drinking and alcohol should be taken with caution. Despite the findings in this study that binge drinking was protective against depression, it would be inappropriate for institutions to promote binge drinking as a viable option to decrease the risk of depression. Although there is a protective effect of alcohol, there are other risk factors that come with binge drinking in the student population. Research associating binge drinking to numerous harmful impacts include, but are not limited to, academic challenges[256], physical and sexual violence, sexual health consequences, unplanned pregnancy, polysubstance use, alcohol use disorder[257], and brain development[258].

Further research is necessary to examine the associations between alcohol and mental health in the post-secondary student population. For the time being, it is the moral responsibility of institutions to adopt harm reduction strategies and promote responsible drinking and minimal or moderate alcohol consumption among students as outline in the current Canada's Guidance on Alcohol and Health[259].

Discussion Summary

This analysis supports the following key findings regarding modifiable behaviours for Canadian undergraduate students: 1) insufficient sleep is a risk factor for depression and anxiety for all students; 2) insufficient physical activity is a risk factor for anxiety for all students and for depression for female students; 3) cigarette use and marijuana use are risk factors for depression and anxiety for all students. These findings support several of the proposed hypotheses, but do not support others. This analysis did not support e-cigarette use as a risk factor for depression or anxiety, nor did it link alcohol consumption or binge drinking as risk factors for anxiety. Unexpectedly, binge drinking was found to be slightly protective against depression for both female and male undergraduate students.

6.2 Implications for Programming and Policies

Post-secondary education is an endeavour that can be both exciting and distressing for young people. Attending college or university provides development opportunities and independence that are not without challenges academically, socially, and personally. Unfortunately, many students report mental health issues such as depression and anxiety as an impediment to

learning[260] while attending post-secondary institutions. Reducing the frequency of depression and anxiety across post-secondary students in Canada will increase overall well-being and academic success. It is in the best interest of post-secondary institution administration to invest in programs and policies to promote positive lifestyle behaviours that will ultimately improve student well-being, student retention, and academic success.

The modifiable behavioural factor found to be relevant in this study included sleep, physical activity, cigarette use, and marijuana use. Based on these findings, post-secondary institutions can improve student well-being and decrease depression and anxiety by offering programs to improve sleep quality, promote physical activity especially for female students, offer smoking cessation programs, and offer programs to decrease or stop marijuana/cannabis use. Institutions should have a mandate to implement initiatives addressing student well-being.

Sleep

Insufficient sleep had the strongest association with depression and anxiety amongst all the independent variables. Insufficient sleep not only affects mental health, but it is also linked to trouble learning and concentrating, memory, moodiness, short-temperedness, dangerous driving, and hormonal imbalances. Prioritizing sleep for students is important and needs to be promoted through as many reasonable avenues as possible. If students' quality and quantity of sleep is better, not only will their mental health improve, but many other factors that are also associated with insufficient sleep or sleep deprivation will hopefully subside.

Awareness is an important first step. Sleep campaigns[261],[262] could involve simple messaging through social media, in class announcements, residence notices, peer health education channels, and through mentors and influencers to encourage students to pay attention to their sleep health and sleep cycles. Creating environments that support sleep would also be valuable. For example, reminding students to decrease brightness on devices at night, turn off their devices so they get uninterrupted sleep, and to keep their bedrooms darker and cooler at night to promote better quality of sleep[263]. Other helpful sleep tips might include avoiding procrastinating, limiting gaming, reducing unnecessary screen time, and avoid pulling all-nighters. Encouraging students to follow a sleep schedule where they go to bed at the same time each night and get up at the same time each morning can improve sleep. Policies in residences such as lowering the lights, ensuring quiet time, and maintaining noise reduction guidelines in the later evenings could be helpful to students. Quality mattresses[264] in residence beds, having access to ear plugs, and even sharing information about items such as weighted blankets especially for students with anxiety[265] can improve sleep. Finally, most institutions have health and counselling services where health professional could simply inquire about quantity and quality of sleep as a proactive educational opportunity even if the student appointment is for another issue.

Physical Activity

This research shows insufficient physical activity is a risk factor for depression and anxiety. The

vast majority of students are not getting enough physical activity which means post-secondary institutions need to do a better job of providing and promoting opportunities for students to be active. Having programs in residences could be a way to bring physical activity to first year students. This could be yoga or aerobic activities such as Zumba, or body weight activities to promote movement and strengthen muscles. For example, lunges, squats, push-ups, sit ups, and planks are all weight bearing activities that don't require equipment. Partner-based or group-based programs could not only promote physical activity and socialization but also connectedness, accountability, and less attrition among students in physical activity programs. Most institutions have invested millions of dollars in athletic facilities that are underutilized by students. Programs that encourage students to be physically active and social could be a double win for students and institutions. Often physical activity facility charges are included in student tuition fees thus students need to realize they pay for the facilities and should use them. Health Canada states physical activity can be done in small bouts throughout the day to be effective. Perhaps stretch breaks in large classes or walking challenges among students. Ironically, rather than walking to classes, several institutions are allowing profit companies to supply scooters on campuses so students can, with no physical exertion, move about their campus.

Substance Use: Cigarettes & Marijuana

Both cigarette and marijuana were found to be detrimental to student mental health and risk factors for depression and anxiety. Cigarette use was not the most common risk behaviour among students since fewer students are smoking cigarettes, but among students that do use cigarettes, it is a major risk factor for depression and anxiety. In this study 20% of female students and 30% of male students reported using cigarettes. Given the results that non-cigarette users have better mental health outcomes in this study, post-secondary institutions should provide mechanisms to help students quit smoking cigarettes. At the program level, post-secondary institutions could provide free smoking cessation aids and tools such as nicotine replacement gum and patches and offer support programs for quit attempts. Quit buddies and Run to Quit[266] programs are both feasible options for institutions and could help with smoking cessation, increasing social connections, and engaging in physical activity. For almost two decades an Ontario-wide tobacco awareness and cessation program called Leave The Pack Behind[267] was at many institutions and helped over 40,000 students quit smoking, encouraged others not to start, and provided support and cessation products. This program no longer has funding and has not been replaced with a viable alternative. At the policy level, post-secondary institutions could review their policies regarding substances and, if not already in place, adopt a smoke-free campus to limit smoking products such as cigarettes, marijuana, and vaping. Although cigarette smoking is becoming rare among students, vaping and cannabis use in multiple formats are on the rise and need to be addressed.

In this study almost half of students reported using marijuana and marijuana use was associated with depression and anxiety. Statistic Canada reported cannabis/marijuana use has steadily increased over the past three decades and is highest among 18–24-year-olds[268]. It seems that

the widespread prevalence of marijuana could be due to two possible perceptions: 1) marijuana is more socially accepted than cigarettes, and 2) marijuana is harmless[269],[270]. It seems students know cigarettes are 'bad' and cause cancer and heart disease, whereas students don't comprehend the connection between marijuana and physical and mental health impacts. The misinformation that marijuana is 'natural' and without risk is commonplace allowing students to rationalize their marijuana use. Marijuana use, and similarly binge drinking, are socially acceptable and come with less judgment than smoking cigarettes. Binge drinking is archaically seen as a rite of passage for students and an acceptable part of the student culture. Post secondary institutions need to combat the misinformation and propaganda related to substances including alcohol, cigarettes, and marijuana use. Educational programming to inform students of the risks associated with marijuana use is essential[271]. Smoke-and vape-free campuses that limit the opportunity for students to use marijuana would be beneficial. Services to help students quit using marijuana or to reduce the use of marijuana are fundamental to focusing of student well-being and could potentially decrease dependency and long-term marijuana use. In this study, marijuana use was associated with depression and anxiety, however cannabis use in young adults has been linked to suicidal ideation and attempts[272], cannabis use disorder (CUD)[273], and cannabis-induced psychosis[274]. Undoubtedly with the continuous increase in prevalence, the legalization of cannabis, and the variety of cannabis products available including smoking, vaping, edibles, and more harmful cannabinoids and cannabis concentrates, post-secondary institutions need to curb all forms of cannabis use on their campuses to support the well-being of their students.

6.3 Implications for Future Research

Future research with the Canadian data set could be used to conduct different statistical analyses to explore interactions between variables and/or direction of associations where possible. Since depression and anxiety were separate models in this research, future research could include them both in the same model since their association was so strong [10083(1), n=34874, p=.000, phi .538].

Although not the primary purpose of this thesis, a serendipitous finding was the high association between stress and depression (OR=4.78, 95%CI [4.54, 5.03], p<.001), and stress and anxiety (OR=5.86, 95%CI [5.56, 6.19], p<.001). In this research stress was a covariate in the models however stress had the strongest association of all the independent variables and covariate for both depression and anxiety. A suggestion would be to include stress as a third model or include stress along with the other independent variables.

This research focused on modifiable behavioural factors and their associations with depression and anxiety because modifiable behaviours are within the students' control. Several demographic characteristics were accounted for in the models as covariates including ethnicity, sexual orientation, and international student status. Future research could investigate the

demographic characteristics and their relationship with depression and anxiety or look at stratified models as part of an equity analysis. It was also not surprising to find sexual violence, a covariate in this study, to be significantly associated with depression and anxiety. This is another area that warrants more in-depth research and prevention.

Future research could look at evaluating programs that decrease depression and anxiety among post-secondary students. For example, mechanisms such as mindfulness[275] and resiliency[276] and how they impact the mental well-being of post-secondary students needs more research and evaluation. This will be discussed more in the following 'Calls to Action' section.

6.4 Calls to Action

1) Almost every journal article reviewed for this thesis that associated factors with adverse mental health outcomes for students stated institutions need more solutions and programming to decrease mental health issues. Despite this commonality of this statement, very little research has been conducted to showcase wellness programs, other than clinical interventions, that improve mental health among post-secondary students. The concern for mental health among post-secondary students was documented in 1920 when "mental hygiene" was acknowledged as critical and necessary for students to flourish[277]. One hundred years later and the mental health of students is still alarming. Now is the time for solutions.

2) As mentioned in the introduction, many post-secondary institutions have initiated committees, developed frameworks, and implemented surveys in response to student mental health concerns. Through this research project, a prominent framework was discovered: 'Simon Fraser University, Student Mental Health & Well-being Framework'. This comprehensive framework was developed in 2023 and was guided by other notable frameworks including the Okanagan Charter and National Standard for Post-Secondary Mental Health. The SJU framework is comprehensive and progressive with its inclusion of the following components: policies & organizational systems, creating physical spaces for well-being, embedding well-being in learning environments, equity, connection & inclusion, mental health & well-being literacy, evaluation, and recommendations. Post-secondary institutions are encouraged to prioritize student mental health and formulate or update frameworks continuously.

https://www.sfu.ca/healthycampuscommunity/about/well-being-framework.html

6.5 Strengths and Limitations of Research

There are several strengths associated with this research. Utilizing the 2019 NCHA Canadian cohort survey allowed us to look at undergraduate students who attended Canadian institutions vs utilizing research from the US. The number of institutions (58) and the 20% response rate subsequently resulted in another strength, that being the large initial sample size of over 50,000 students. The cross-sectional design with two mental health outcomes, six different independent

variables covering a range of modifiable behaviours and accounting for several covariates including demographic characteristics provided the framework to look at multiple factors related to student mental well-being. The sex stratified models were implemented to look at female/male comparisons. The diversity of the sample could be considered both a strength and a limitation. This study had 45% of students represented as ethnic minorities. With Canada being a multicultural nation, this could be seen as valuable and representative given the changing landscape of Canadian post-secondary institutions with more students identifying as ethnic minorities.

The main limitation of this research is the "self-reported" nature of the National College Health Assessment survey. The limitation is two-fold since students may over-estimate 'favourable' behaviours, or they may underreport behaviours, situations, or feelings that may be associated with perceived negativity or mental health stigma. Two limitations based on the sample characteristics include the large female influence and the ethnicity of the sample. The sample was comprised of 70% female students which may overrepresent females in the study and may not align with the male/female demographic at many institutions. The percentage of students that identified as an ethnic minority in this study was 45%. Some students that identify as an ethnic minority may not report mental health experiences due to cultural factors such as stigma.

While the NCHA survey has proven reliability and validity and has been widely used for many years in the US and more recently in Canada, the timeframes are different for various questions within the survey. For example, the questions related to substance use are for the last 30 days, the question related to physical activity is for the last 7 days, and the questions for anxiety and depression include options up to the last 12 months. This could be viewed as a limitation of the current study and an opportunity for future research or survey design.

This study provides literature specific to Canadian post-secondary populations and insight into protective behaviours that may help alleviate the frequency and severity of negative mental health experiences such as depression and anxiety. Furthermore, post-secondary institutions in Canada and abroad can utilize these results to advocate for programming and services on their campuses.

Finally, this research utilized the data provided for sex at birth which was identified as female or male. Future research could look at gender identity rather than sex at birth or include a third option for non-binary students.

6.6 Conclusion

The current study highlights modifiable behavioural factors associated with depression and anxiety in Canadian post-secondary students. Sleep, physical activity, cigarette use, and marijuana use were associated with depression for both female and male students. Sleep, cigarette use, and marijuana use were associated with anxiety for both female and male

students. Physical activity was associated with anxiety for female students and was the only viable difference found between female and male students.

These findings showcase a realistic picture of student behaviours and provides valuable evidence to post-secondary institutions to ensure programming that fosters student well-being and reduces risky behaviours associated with depression and anxiety in post-secondary students.

This research warrants post-secondary institutions to provide programs and policies to reduce risky behaviours and promote protective factors that could ultimately set in motion positive student experiences, increased retention, academic success, and favourable affiliation by alumni following completion of post-secondary studies.

Overall, the results of this research highlights student mental health as an ongoing, ominous issue that is getting worse despite the awareness of its rising prevalence for decades. These findings also point to the needs for quality health promotion programming and services that target insufficient sleep, lack of physical activity, and the use of harmful substances such as cigarettes and marijuana. Given the evidence that mental health affects overall well-being and academic success, institutions need to step up, develop and implement comprehensive frameworks, and prioritize their commitments to student mental health and well-being for Canadian undergraduate post-secondary students.

REFERENCES

[1] World Health Organization. Mental Health. (2014). http://www.who.int/features/factfiles/mental_health/en/

[2] Canadian Mental Health Association. What is Mental Health and Mental Illness. https://reddeer.cmha.ca/wp-content/uploads/2017/04/mental-health-and-mental-illness.pdf

[3] Galderisi, S., Heinz, A., Kastrup, M., Beezhold, J., & Sartorius, N. (2015). Toward a new definition of mental health. *World Psychiatry, 14*(2), 231-233. https://doi.org/10.1002/wps.20231

[4] Keyes, C. L. M. (2002). The mental health continuum: From languishing to flourishing in life. *Journal of Health and Behavior Research, 43*, 207-222.

[5] Canadian Mental Health Association. What is Mental Health and Mental Illness. https://reddeer.cmha.ca/wp-content/uploads/2017/04/mental-health-and-mental-illness.pdf

[6] Manderscheid, R. W., Ryff, C. D., Freeman, E. J., McKnight-Eily, L. R., Dhingra, S., & Strine, T. W. (2010). Evolving Definitions of Mental Illness and Wellness. *Preventing chronic disease, 7*, A19. https://www.researchgate.net/publication/40812045

[7] Keyes, C. L. M. (2002). The mental health continuum: From languishing to flourishing in life. *Journal of Health and Behavior Research, 43*, 207-222.

[8] Keyes, C. (2016). "Why Flourishing?" In Well-being and Higher Education: A Strategy for Change and the Realization of Education's Greater Purposes. Pages 99-107. Washington, DC: Bringing Theory to Practice.

[9] Keyes C. L. M. (2005). Mental illness and/or mental health? Investigating axioms of the complete state model of health. *Journal of consulting and clinical psychology*, *73*(3), 539–548. https://doi.org/10.1037/0022-006X.73.3.539

[10] Seligman, M. E. P., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist, 55*(1), 5-14. http://dx.doi.org/10.1037/0003-066X.55.1.5

[11] Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist, 56*(3), 218–226. https://doi.org/10.1037/0003-066X.56.3.218

[12] Pidgeon, A. M., Rowe, N., Stapleton, P., Magyar, H. B., & Lo, B. C. (2014). Examining characteristics of resilience among university students: An international study. *Open Journal of Social Sciences, 2*, 14-22. https://doi.org/10.4236/jss.2014.211003.

[13] Fink, J. E. (2014). Flourishing: exploring predictors of mental health within the college environment. *Journal of American College Health, 62*(6), 380-388. https://doi.org/10.1080/07448481.2014.917647

[14] Halladay, J. E., Dawdy, J. L., McNamara, I. F., Chen, A. J., Vitoroulis, I., McInnes, N., & Munn, C. (2019). Mindfulness for the mental health and well-being of post-secondary students: A systematic review and meta-analysis. *Mindfulness, 10*(3), 397–414. https://doi.org/10.1007/s12671-018-0979-z

[15] Kutcher, S., Wei, Y., & Morgan, C. (2016). Mental health literacy in post-secondary students. *Health Education Journal, 75*(6), 689–697. https://doi.org/10.1177/0017896915610144

[16] Spiker, D. A., & Hammer, J. H. (2019). Mental health literacy as theory: current challenges and future directions. *Journal of Mental Health (Abingdon, England)*, *28*(3), 238–242. https://doi.org/10.1080/09638237.2018.1437613

[17] Whiteford, H. A., Degenhardt, L., Rehm, J., Baxter, A. J., Ferrari, A. J., Erskine, H. E., Charlson, F. J., Norman, R. E., Flaxman, A. D., Johns, N., Burstein, R., Murray, C. J., & Vos, T. (2013). Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet (London, England)*, *382*(9904), 1575–1586. https://doi.org/10.1016/S0140-6736(13)61611-6

[18] Patel, V., Flisher, A. J., Hetrick, S., & McGorry, P. (2007). Mental health of young people: a global public-health challenge. *Lancet (London, England)*, *369*(9569), 1302–1313. https://doi.org/10.1016/S0140-6736(07)60368-7

[19] Kim, E. H., Coumar, A., Lober, W. B., & Kim, Y. (2011). Addressing mental health epidemic among university students via web-based, self-screening, and referral system: a preliminary study. *IEEE transactions on information technology in biomedicine: a publication of the IEEE Engineering in Medicine and Biology Society*, *15*(2), 301–307. https://doi.org/10.1109/TITB.2011.2107561

[20] Eisenberg, D., Golberstein, E., & Gollust, S. E. (2007). Help-seeking and access to mental health care in a university student population. *Medical care*, *45*(7), 594–601. https://doi.org/10.1097/MLR.0b013e31803bb4c1

[21] Zochil, M. L., & Thorsteinsson, E. B. (2018). Exploring poor sleep, mental health, and help-seeking intention in university students. *Australian Journal of Psychology, 70*(1), 41-47. https://doi.org/10.1111/ajpy.12160

[22] Kitzrow, M. A. (2003). The Mental Health Needs of Today's College Students: Challenges and Recommendations. *Journal of Student Affairs Research and Practice*, *41*(1), 167-181. https://doi.org/10.2202/1949-6605.1310

[23] Saleem, S., Mahmood, Z., & Naz, M. (2013). Mental Health Problems in University Students: A Prevalence Study. *FWU Journal of Social Sciences, 7*(2), 124-130. http://hdl.handle.net/123456789/1114

[24] Statistics Canada. (2019). Canadian Community Health Survey. https://www150.statcan.gc.ca/n1/en/daily-quotidien/200806/dq200806a-eng.pdf?st=oB18ZgDX

[25] Pearson, C., Janz, T., & Ali, J. (2013). Health at a glance: Mental and substance use disorders in Canada. *Statistics Canada. Catalogue no. 82-624-X.* https://www150.statcan.gc.ca/n1/pub/82-624-x/2013001/article/11855-eng.htm

[26] Centre for Addiction and Mental Health. Mental Illness and Addiction: Facts and Statistics. https://www.camh.ca/en/driving-change/the-crisis-is-real/mental-health-statistics

[27] Penn State. (2016). Center for Collegiate Mental Health (CCMH): 2016 Annual Report. http://sites.psu.edu/ccmh/files/2017/01/2016-Annual-Report-FINAL_2016_01_09-1gc2hj6.pdf

[28] Ibrahim, A. K., Kelly, S. J., Adams, C. E., & Glazebrook, C. (2013). A systematic review of studies of depression prevalence in university students. *Journal of Psychiatric Research, 47*(3), 391-400. https://doi.org/10.1016/j.jpsychires.2012.11.015.

[29] Robinson, A. M., Jubenville, T. M., Renny, K., & Cairns, S. L. (2016). Academic and mental health needs of students on a Canadian campus. *Canadian Journal of Counselling and Psychotherapy, 50*(2), 108–123. https://cjc-rcc.ucalgary.ca/article/view/61100

[30] Eisenberg, D., Gollust, S. E., Golberstein, E., & Hefner, J. L. (2007). Prevalence and correlates of depression, anxiety, and suicidality among university students. *The American journal of orthopsychiatry*, *77*(4), 534–542. https://doi.org/10.1037/0002-9432.77.4.534

[31] Canadian Health Promoting Campuses. (2015). Okanagan Charter: An International Charter for Health Promoting Universities and Colleges. https://healthpromotingcampuses.squarespace.com/okanagan-charter

[32] Council of Ontario Universities, Mental Health. Ensuring a whole-of-community approach to mental health. https://ontariosuniversities.ca/wp-content/uploads/2018/01/COU_Ensuring-a-Whole-of-Community-Approach-to-Mental-Health.pdf

[33] Ibrahim, A. K., Kelly, S. J., Adams, C. E., & Glazebrook, C. (2013). A systematic review of studies of depression prevalence in university students. *Journal of Psychiatric Research, 47*(3), 391-400. https://doi.org/10.1016/j.jpsychires.2012.11.015.

[34] Auerbach, R. P., Alonso, J., Axinn, W. G., Cuijpers, P., Ebert, D. D., et al. (2016). Mental disorders among college students in the World Health Organization World Mental Health Surveys. *Psychological medicine*, *46*(14), 2955–2970. https://doi.org/10.1017/S0033291716001665

[35] Eisenberg, D., Golberstein, E. & Hunt, J. (2009). Mental Health and Academic Success in College. *The B.E. Journal of Economic Analysis & Policy*, *9*(1). https://doi.org/10.2202/1935-1682.2191

[36] Kisch, J., Leino, E. V., & Silverman, M. M. (2005). Aspects of suicidal behavior, depression, and treatment in college students: results from the spring 2000 national college health assessment survey. *Suicide & life-threatening behavior*, *35*(1), 3–13. https://doi.org/10.1521/suli.35.1.3.59263

[37] Zivin, K., Eisenberg, D., Gollust, S. E., & Golberstein, E. (2009). Persistence of mental health problems and needs in a college student population. *Journal of Affective Disorders, 117*(3), 180–185. https://doi.org/10.1016/j.jad.2009.01.001

[38] Canadian Association of College & University Student Services and Canadian Mental Health Association. (2013). Post-Secondary Student Mental Health: Guide to a Systemic Approach. Vancouver, BC. *Collaboration by Canadian Association of College and University Student Services (CACUSS) & the Canadian Mental Health Association (CMHA).* https://healthycampuses.ca/wp-content/uploads/2014/09/The-National-Guide.pdf

[39] Western University. (2018). Western's Student Mental Health and Wellness Strategic Plan. http://studentexperience.uwo.ca/student_experience/strategic_planning/mental_health_strategic_plan/MH_Stratplan_DRAFT.pdf

[40] University of British Columbia. (2013). Mental Health & Well-being Strategy. https://facultystaff.students.ubc.ca/sites/facultystaff.students.ubc.ca/files/Student%20Mental%20Health%20Plan%20Brochure%20-%20V7.pdf

[41] Queen's University. (2012). Student Mental Health and Wellness: Framework and Recommendations for a Comprehensive Strategy. https://www.queensu.ca/principal/sites/webpublish.queensu.ca.opvcwww/files/files/CMHFinalReport.pdf

[42] Carleton University. Student Mental Health Framework 2.0: Building a Thriving Community. https://carleton.ca/studentsupport/wp-content/uploads/Student-Mental-Health-Framework-2.0.pdf

[43] University of Calgary. Campus Mental Health Strategy: Creating a community of caring. https://www.ucalgary.ca/live-uc-ucalgary-site/sites/default/files/teams/148/15-unv-018-mental_health_strategy_final.pdf

[44] University of Victoria. Student Mental Health Strategy. 2014-2017. https://www.uvic.ca/mentalhealth/assets/docs/StudentMentalHealthStrategy.pdf

[45] York University. Mental Health Strategy: Advancing a Mentally Healthy Campus. https://mhw.info.yorku.ca/files/2017/01/Mental-Health-Strategy_ENG.pdf

[46] University of Toronto. (2019). Presidential & Provostial Task Force on Student Mental Health – Final Report & Recommendations. https://www.provost.utoronto.ca/wp-content/uploads/sites/155/2020/01/Presidential-and-Provostial-Task-Force-Final-Report-and-Recommendations-Dec-2019.pdf

[47] University of Waterloo. (2018). President's Advisory Committee on Student Mental Health (PAC-SMH). https://uwaterloo.ca/mental-health-wellness/sites/ca.mental-health-wellness/files/uploads/files/pac-smh_final_report_final_march12.pdf

[48] AUCC Working Group on Campus Mental Health. (2012). Mental health: A guide and checklist for presidents. Association of Universities and Colleges of Canada. (Renamed: Universities Canada). www.univcan.ca/

[49] Kitzrow M. A. (2009). The Mental Health Needs of Today's College Students: Challenges and Recommendations, NASPA Journal. 46(4), 646-660. https://doi.org/10.2202/1949-6605.5037; Kitzrow, M.A. (2003). The Mental Health Needs of Today's College Students: Challenges and Recommendations. *Journal of Student Affairs Research and Practice*, *41*(1), 167-181. https://doi.org/10.2202/1949-6605.1310

[50] Auerbach, R. P., Alonso, J., Axinn, W. G., Cuijpers, P., Ebert, D. D., et al. (2016). Mental disorders among college students in the World Health Organization World Mental Health Surveys. *Psychological medicine*, *46*(14), 2955–2970. https://doi.org/10.1017/S0033291716001665

[51] Canadian Mental Health Association. Depression and Bipolar Disorder. https://cmha.ca/mental-health/understanding-mental-illness/bipolar-disorder

[52] Centre for Addiction and Mental Health. Depression. https://www.camh.ca/en/health-info/mental-illness-and-addiction-index/depression

[53] Bartha, C., Parker, C., Thomson, C., & Kitchen K. (2013). Depression: An Information Guide (Revised edition). Centre for Addiction and Mental Health. https://www.camh.ca/-/media/files/guides-and-publications/depression-guide-en.pdf

[54] Field, T., Diego, M., Pelaez, M., Deeds, O., & Delgado, J. (2012). Depression and related problems in university students. *College Student Journal, 46*(1), 193–202.

[55] Esmaeelzadeh, S., Moraros, J., Thorpe, L., & Bird, Y. (2018). The association between depression, anxiety and substance use among Canadian post-secondary students. *Neuropsychiatric disease and treatment*, *14*, 3241–3251. https://doi.org/10.2147/NDT.S187419

[56] Beiter, R., Nash, R., McCrady, M., Rhoades, D., Linscomb, M., Clarahan, M., & Sammut, S. (2015). The prevalence and correlates of depression, anxiety, and stress in a sample of college students. *Journal of affective disorders*, *173*, 90–96. https://doi.org/10.1016/j.jad.2014.10.054

[57] Hayward, L., & Arthur, N. (2007). Perfectionism and Post-Secondary Students. *Canadian Journal of Counselling and Psychotherapy, 32*(3), 187-199. https://files.eric.ed.gov/fulltext/EJ576965.pdf

[58] Eisenberg, D., Gollust, S. E., Golberstein, E., & Hefner, J. L. (2007). Prevalence and correlates of depression, anxiety, and suicidality among university students. *The American journal of orthopsychiatry*, *77*(4), 534–542. https://doi.org/10.1037/0002-9432.77.4.534

[59] Kisch, J., Leino, E. V., & Silverman, M. M. (2005). Aspects of suicidal behavior, depression, and treatment in college students: results from the spring 2000 national college health assessment survey. *Suicide & life-threatening behavior*, *35*(1), 3–13. https://doi.org/10.1521/suli.35.1.3.59263

[60] American College Health Association. American College Health Association-National College Health Assessment II. Depression question. Page 16. https://www.acha.org/documents/ncha/ACHA-NCHA_IIc_Web_Survey_2011_SAMPLE.pdf

[61] American College Health Association. (2013). American College Health Association-National College Health Assessment II: Canadian Consortium Reference Group Executive Summary Spring 2013. Hanover, MD: American College Health Association. https://uwaterloo.ca/institutional-analysis-planning/sites/ca.institutional-analysis-planning/files/uploads/files/ncha-ii_spring_2013_canadian_reference_group_executive_summary.pdf

[62] American College Health Association. (2016). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2016. Hanover, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202016%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[63] American College Health Association. (2019). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2019. Silver Spring, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202019%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[64] Boggiano, A. K., & Barrett, M. (1991). Gender differences in depression in college students. *Sex Roles: A Journal of Research, 25*(11-12), 595–605. https://doi.org/10.1007/BF00289566

[65] Hankin, B. L., Abramson, L. Y., Moffitt, T. E., Silva, P. A., McGee, R., & Angell, K. E. (1998). Development of depression from preadolescence to young adulthood: Emerging gender differences in a 10-year longitudinal study. *Journal of Abnormal Psychology, 107*(1), 128–140. https://doi.org/10.1037/0021-843X.107.1.128

[66] Girgus, J. S., & Yang, K., (2015). Gender and depression. *Current Opinion in Psychology, 4*, 53-60. https://doi.org/10.1016/j.copsyc.2015.01.019.

[67] American College Health Association. (2019). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2019. Silver Spring, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202019%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[68] Sarason, I. G., Sarason, B. R., & Pierce, G. R. (1990). Anxiety, cognitive interference, and performance. *Journal of Social Behavior & Personality, 5*(2), 1–18.

[69] Centre for Addiction and Mental Health. Anxiety Disorders. https://www.camh.ca/en/health-info/mental-illness-and-addiction-index/anxiety-disorders

[70] Hoge, E. A., Ivkovic, A., & Fricchione, G. L. (2012). Generalized anxiety disorder: diagnosis and treatment. *BMJ (Clinical research ed.)*, *345*, e7500. https://doi.org/10.1136/bmj.e7500

[71] American College Health Association. American College Health Association-National College Health Assessment II. Anxiety question. Page 16. https://www.acha.org/documents/ncha/ACHA-NCHA_IIc_Web_Survey_2011_SAMPLE.pdf

[72] American College Health Association. (2013). American College Health Association-National College Health Assessment II: Canadian Consortium Reference Group Executive Summary Spring 2013. Hanover, MD: American College Health Association. https://uwaterloo.ca/institutional-analysis-planning/sites/ca.institutional-analysis-planning/files/uploads/files/ncha-ii_spring_2013_canadian_reference_group_executive_summary.pdf

[73] American College Health Association. (2016). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2016. Hanover, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202016%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[74] American College Health Association. (2019). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2019. Silver Spring, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202019%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[75] McLean, C. P., Asnaani, A., Litz, B. T., & Hofmann, S. G. (2011). Gender differences in anxiety disorders: prevalence, course of illness, comorbidity and burden of illness. *Journal of Psychiatric Research, 45*(8), 1027–1035. https://doi.org/10.1016/j.jpsychires.2011.03.006

[76] Lewinsohn, P. M., Gotlib, I. H., Lewinsohn, M., Seeley, J. R., & Allen, N. B. (1998). Gender differences in anxiety disorders and anxiety symptoms in adolescents. *Journal of Abnormal Psychology, 107*(1), 109–117. https://doi.org/10.1037/0021-843X.107.1.109

[77] Elflein, J. (2019). Percentage of Canadians who had been diagnosed with anxiety as of 2018, by gender. https://www.statista.com/statistics/978423/anxiety-disorders-by-gender-canada/

[78] Turcotte, M. (2011). Women and Health - Women in Canada: A Gender-based Statistical Report. Statistics Canada, Catalogue no. 89-503-X. https://www150.statcan.gc.ca/n1/en/pub/89-503-x/2010001/article/11543-eng.pdf?st=mmn44kZ6

[79] American College Health Association. (2019). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2019. Silver Spring, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202019%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[80] Robinson, A. M., Jubenville, T. M., Renny, K., & Cairns, S. L. (2016). Academic and mental health needs of students on a Canadian campus. *Canadian Journal of Counselling and Psychotherapy, 50*(2), 108–123. https://cjc-rcc.ucalgary.ca/article/view/61100

[81] Kraft, D. P. (2011). One hundred years of college mental health. *Journal of American College Health*, *59*(6), 477–481. https://doi.org/10.1080/07448481.2011.569964

[82] Arnstein, R. L. (1995). Mental Health on the Campus Revisited. *Journal of American College Health, 43*(6), 248-252. https://doi.org/10.1080/07448481.1995.9940898

[83] Orzech, K. M., Salafsky, D. B., & Hamilton, L. A. (2011). The state of sleep among college students at a large public university. *Journal of American College Health, 59*(7), 612–619. https://doi.org/10.1080/07448481.2010.520051

[84] Elliot, C. A., Kennedy, C., Morgan, G., Anderson, S. K., Morris, D. (2012). Undergraduate physical activity and depressive symptoms: a national study. *American journal of health behavior*, *36*(2), 230–241. https://doi.org/10.5993/AJHB.36.2.8

[85] Esmaeelzadeh, S., Moraros, J., Thorpe, L., & Bird, Y. (2018). The association between depression, anxiety and substance use among Canadian post-secondary students. *Neuropsychiatric disease and treatment*, *14*, 3241–3251. https://doi.org/10.2147/NDT.S187419

[86] Cranford, J. A., Eisenberg, D., & Serras, A. M. (2009). Substance use behaviors, mental health problems, and use of mental health services in a probability sample of college students. *Addictive Behaviors, 34*(2), 134–145. https://doi.org/10.1016/j.addbeh.2008.09.004

[87] Doré, I., O'Loughlin, J. L., Beauchamp, G., Martineau, M., & Fournier, L. (2016). Volume and social context of physical activity in association with mental health, anxiety and depression among youth. *Preventive medicine*, *91*, 344–350. https://doi.org/10.1016/j.ypmed.2016.09.006

[88] Taliaferro, L. A., Rienzo, B. A., Pigg, R. M., Jr, Miller, M. D., & Dodd, V. J. (2009). Associations between physical activity and reduced rates of hopelessness, depression, and suicidal behavior among college students. *Journal of American College Health*, *57*(4), 427–436. https://doi.org/10.3200/JACH.57.4.427-436

[89] Richardson, T., Elliott, P., & Roberts, R. (2017). Relationship between loneliness and mental health in students. *Journal of Public Mental Health, 16*(2), 48–54. https://doi.org/10.1108/JPMH-03-2016-0013

[90] Farrell, L. C., Jorgenson, D., Fudge, J., & Pritchard, A. (2018). College connectedness: The student perspective. *Journal of the Scholarship of Teaching and Learning, 18*(1), 75-95. http://dx.doi.org/10.14434/josotl.v18i1.22371

[91] Hagerty, B. M., Williams, R. A., Coyne, J. C., & Early, M. R. (1996). Sense of belonging and indicators of social and psychological functioning. *Archives of psychiatric nursing*, *10*(4), 235–244. https://doi.org/10.1016/s0883-9417(96)80029-x

[92] Oswalt, S. B., & Wyatt, T. J. (2011). Sexual orientation and differences in mental health, stress, and academic performance in a national sample of U.S. college students. *Journal of homosexuality*, *58*(9), 1255–1280. https://doi.org/10.1080/00918369.2011.605738

[93] Lipson, S. K., Raifman, J., Abelson, S., & Reisner, S. L. (2019). Gender Minority Mental Health in the U.S.: Results of a National Survey on College Campuses. *American Journal of Preventive Medicine*, *57*(3), 293–301. https://doi.org/10.1016/j.amepre.2019.04.025

[94] Chen, J. A., Stevens, C., Wong, S., & Liu, C. H. (2019). Psychiatric Symptoms and Diagnoses Among U.S. College Students: A Comparison by Race and Ethnicity. *Psychiatric services (Washington, D.C.)*, *70*(6), 442–449. https://doi.org/10.1176/appi.ps.201800388

[95] Hefner, J., & Eisenberg, D. (2009). Social support and mental health among college students. *The American journal of orthopsychiatry*, *79*(4), 491–499. https://doi.org/10.1037/a0016918

[96] Oh, H. Y., Marinovich, C., Jay, S., Zhou, S., & Kim, J. (2021). Abuse and suicide risk among college students in the United States: Findings from the 2019 Healthy Minds Study. *Journal of Affective Disorders*, *282*, 554–560. https://doi.org/10.1016/j.jad.2020.12.140

[97] Carey, K. B., Norris, A. L., Durney, S. E., Shepardson, R. L., & Carey, M. P. (2018). Mental health consequences of sexual assault among first-year college women. *Journal of American College Health, 66*(6), 480–486. https://doi.org/10.1080/07448481.2018.1431915

[98] Shalka, T. R., & Leal, C. C. (2020). Sense of belonging for college students with PTSD: the role of safety, stigma, and campus climate. *Journal of American College Health*, 1–8. https://doi.org/10.1080/07448481.2020.1762608

[99] Wright, F., Bewick, B. M., Barkham, M., House, A. O., & Hill, A. J. (2009). Co-occurrence of self-reported disordered eating and self-harm in UK university students. *The British journal of clinical psychology*, *48*(Pt 4), 397–410. https://doi.org/10.1348/014466509X410343

[100] Bitsika, V., Sharpley, C. F., & Melham, T. C. (2009). Gender Differences in Factor Scores of Anxiety and Depression among Australian University Students: Implications for Counselling Interventions. *Canadian Journal of Counselling and Psychotherapy*, *44*(1). Retrieved from https://cjc-rcc.ucalgary.ca/article/view/58945

[101] Wyatt, T., & Oswalt, S. B. (2013). Comparing Mental Health Issues Among Undergraduate and Graduate Students. *American Journal of Health Education, 44*(2), 96-107. https://doi.org/10.1080/19325037.2013.764248

[102] Macaskill, A. (2013). The mental health of university students in the United Kingdom. *British Journal of Guidance & Counselling, 41*(4), 426–441. https://doi.org/10.1080/03069885.2012.743110

[103] Fisher, S., & Hood, B. M. (1987). The stress of the transition to university: A longitudinal study of psychological disturbance, absent-mindedness and vulnerability to homesickness. *British Journal of Psychology, 78*(4), 425–441. https://doi.org/10.1111/j.2044-8295.1987.tb02260.x

[104] Duffy, A., Saunders, K., Malhi, G. S., Patten, S., Cipriani, A., McNevin, S. H., MacDonald, E., & Geddes, J. (2019). Mental health care for university students: a way forward?. *The Lancet. Psychiatry*, *6*(11), 885–887. https://doi.org/10.1016/S2215-0366(19)30275-5

[105] Nelson, M. C., Neumark-Stzainer, D., Hannan, P. J., Sirard, J. S., & Story, M. (2006). Longitudinal and Secular Trends in Physical Activity and Sedentary Behavior During Adolescence. *Pediatrics, 118*(6), e1627-e1634. https://doi.org/10.1542/peds.2006-0926

[106] Nowak, P. F., Bożek, A., & Blukacz, M. (2019). Physical Activity, Sedentary Behavior, and Quality of Life among University Students. *BioMed Research International*, *2019*, 1-11. https://doi.org/10.1155/2019/9791281

[107] Kohl, H. W., 3rd, Craig, C. L., Lambert, E. V., Inoue, S., Alkandari, J. R., Leetongin, G., Kahlmeier, S., & Lancet Physical Activity Series Working Group (2012). The pandemic of physical inactivity: global action for public health. *Lancet (London, England)*, *380*(9838), 294–305. https://doi.org/10.1016/S0140-6736(12)60898-8

[108] Jakicic J. M. (2009). The effect of physical activity on body weight. *Obesity (Silver Spring, Md.)*, *17 Suppl 3*, S34–S38. https://doi.org/10.1038/oby.2009.386

[109] Fox K. R. (1999). The influence of physical activity on mental well-being. *Public health nutrition*, *2*(3A), 411–418. https://doi.org/10.1017/s1368980099000567

[110] Adams, T. B., Moore, M. T., & Dye, J. (2007). The relationship between physical activity and mental health in a national sample of college females. *Women & health*, *45*(1), 69–85. https://doi.org/10.1300/J013v45n01_05

[111] Doré, I., O'Loughlin, J. L., Beauchamp, G., Martineau, M., & Fournier, L. (2016). Volume and social context of physical activity in association with mental health, anxiety and depression among youth. *Preventive medicine*, *91*, 344–350. https://doi.org/10.1016/j.ypmed.2016.09.006

[112] Calfas, K. J., & Taylor, W. C. (1994). Effects of physical activity on psychological variables in adolescents. *Pediatric Exercise Science, 6*(4), 406–23. https://doi.org/10.1123/pes.6.4.406

[113] Dinger, M. K., Brittain, D. R., & Hutchinson, S. R. (2014). Associations between physical activity and health-related factors in a national sample of college students. *Journal of American College Health, 62*(1), 67–74. https://doi.org/10.1080/07448481.2013.849710

[114] King, A. (2012). Health risks of physical inactivity similar to smoking. *Nature Reviews Cardiology, 9*, 492. https://doi.org/10.1038/nrcardio.2012.115

[115] Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., & Lancet Physical Activity Series Working Group. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet, 380*(9838), 219–229. https://doi.org/10.1016/S0140-6736(12)61031-9

[116] American College Health Association. (2013). American College Health Association-National College Health Assessment II: Canadian Consortium Reference Group Executive Summary Spring 2013. Hanover, MD: American College Health Association. https://uwaterloo.ca/institutional-analysis-

planning/sites/ca.institutional-analysis-planning/files/uploads/files/ncha-ii_spring_2013_canadian_reference_group_executive_summary.pdf

[117] American College Health Association. (2016). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2016. Hanover, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202016%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[118] American College Health Association. (2019). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2019. Silver Spring, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202019%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[119] Kwan, M. Y., Arbour-Nicitopoulos, K. P., Duku, E., & Faulkner, G. (2016). Patterns of multiple health risk-behaviours in university students and their association with mental health: application of latent class analysis. *Health promotion and chronic disease prevention in Canada: Research, Policy and Practice*, *36*(8), 163–170. https://doi.org/10.24095/hpcdp.36.8.03

[120] Doré, I., O'Loughlin, J. L., Beauchamp, G., Martineau, M., & Fournier, L. (2016). Volume and social context of physical activity in association with mental health, anxiety and depression among youth. *Preventive medicine*, *91*, 344–350. https://doi.org/10.1016/j.ypmed.2016.09.006

[121] Dinger, M. K., Brittain, D. R., & Hutchinson, S. R. (2014). Associations between physical activity and health-related factors in a national sample of college students. *Journal of American College Health, 62*(1), 67–74. https://doi.org/10.1080/07448481.2013.849710

[122] Elliot, C. A., Kennedy, C., Morgan, G., Anderson, S. K., & Morris, D. (2012). Undergraduate physical activity and depressive symptoms: a national study. *American journal of health behavior*, *36*(2), 230–241. https://doi.org/10.5993/AJHB.36.2.8

[123] Taliaferro, L. A., Rienzo, B. A., Pigg, R. M., Jr, Miller, M. D., & Dodd, V. J. (2009). Associations between physical activity and reduced rates of hopelessness, depression, and suicidal behavior among college students. *Journal of American College Health*, *57*(4), 427–436. https://doi.org/10.3200/JACH.57.4.427-436

[124] Adams, T. B., Moore, M. T., & Dye, J. (2007). The relationship between physical activity and mental health in a national sample of college females. *Women & health*, *45*(1), 69–85. https://doi.org/10.1300/J013v45n01_05

[125] Fox K. R. (1999). The influence of physical activity on mental well-being. *Public health nutrition*, *2*(3A), 411–418. https://doi.org/10.1017/s1368980099000567

[126] Public Health Agency of Canada. (2019). Are Canadian Adults Getting Enough Sleep? https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-adults-getting-enough-sleep-infographic.html

[127] Orzech, K. M., Salafsky, D. B., & Hamilton, L. A. (2011). The state of sleep among college students at a large public university. *Journal of American College Health*, *59*(7), 612–619. https://doi.org/10.1080/07448481.2010.520051

[128] Lowry, M., Dean, K., & Manders, K. (2010). The Link Between Sleep Quantity and Academic Performance for the College Student. *Sentience: The University of Minnesota Undergraduate Journal of Psychology,* 3, 16-19. https://sites.oxy.edu/clint/physio/article/TheLinkBetweenSleepQuantityandAcademic.pdf

[129] Becker, C. M., Adams, T., Orr, C., & Quilter, L. (2008). Correlates of quality sleep and academic performance. *Health Educator, 40*(2), 82-89.

[130] Boehm, M. A., Lei, Q. M., Lloyd, R. M., & Prichard, J. R. (2016). Depression, anxiety, and tobacco use: Overlapping impediments to sleep in a national sample of college students. *Journal of American College Health, 64*(7), 565–574. https://doi.org/10.1080/07448481.2016.1205073

[131] Orzech, K. M., Salafsky, D. B., & Hamilton, L. A. (2011). The state of sleep among college students at a large public university. *Journal of American College Health*, *59*(7), 612–619. https://doi.org/10.1080/07448481.2010.520051

[132] American College Health Association. (2013). American College Health Association-National College Health Assessment II: Canadian Consortium Reference Group Executive Summary Spring 2013. Hanover, MD: American College Health Association. https://uwaterloo.ca/institutional-analysis-planning/sites/ca.institutional-analysis-planning/files/uploads/files/ncha-ii_spring_2013_canadian_reference_group_executive_summary.pdf

[133] American College Health Association. (2016). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2016. Hanover, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202016%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[134] American College Health Association. (2019). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2019. Silver Spring, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202019%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[135] Field, T., Diego, M., Pelaez, M., Deeds, O., & Delgado, J. (2012). Depression and related problems in university students. *College Student Journal, 46*(1), 193–202.

[136] Zochil, M. L., & Thorsteinsson, E. B. (2018). Exploring poor sleep, mental health, and help-seeking intention in university students. *Australian Journal of Psychology, 70*(1), 41-47. https://doi.org/10.1111/ajpy.12160

[137] Kwan, M. Y., Arbour-Nicitopoulos, K. P., Duku, E., & Faulkner, G. (2016). Patterns of multiple health risk-behaviours in university students and their association with mental health: application of latent class

analysis. *Health promotion and chronic disease prevention in Canada: Research, Policy and Practice*, *36*(8), 163–170. https://doi.org/10.24095/hpcdp.36.8.03

[138] Beiter, R., Nash, R., McCrady, M., Rhoades, D., Linscomb, M., Clarahan, M., & Sammut, S. (2015). The prevalence and correlates of depression, anxiety, and stress in a sample of college students. *Journal of affective disorders*, *173*, 90–96. https://doi.org/10.1016/j.jad.2014.10.054

[139] Boehm, M. A., Lei, Q. M., Lloyd, R. M., & Prichard, J. R. (2016). Depression, anxiety, and tobacco use: Overlapping impediments to sleep in a national sample of college students. *Journal of American College Health, 64*(7), 565–574. https://doi.org/10.1080/07448481.2016.1205073

[140] Orzech, K. M., Salafsky, D. B., & Hamilton, L. A. (2011). The state of sleep among college students at a large public university. *Journal of American College Health*, *59*(7), 612–619. https://doi.org/10.1080/07448481.2010.520051

[141] Jones, S. E., Oeltmann, J., Wilson, T. W., Brener, N. D., & Hill, C. V. (2001). Binge drinking among undergraduate college students in the United States: implications for other substance use. *Journal of American College Health, 50*(1), 33–38. https://doi.org/10.1080/07448480109595709

[142] Fromme, K., Corbin, W. R., & Kruse, M. I. (2008). Behavioral risks during the transition from high school to college. *Developmental Psychology, 44*(5), 1497–1504. https://doi.org/10.1037/a0012614

[143] Barrett, S. P., Darredeau, C., & Pihl, R. O. (2006). Patterns of simultaneous polysubstance use in drug using university students. *Human Psychopharmacology: Clinical & Experimental, 21*, 255-263. https://doi.org/10.1002/hup.766

[144] Canadian Mental Health Association. The Relationship between Mental health, Mental Illness and Chronic Physical Conditions. https://ontario.cmha.ca/documents/the-relationship-between-mental-health-mental-illness-and-chronic-physical-conditions/

[145] Cranford, J. A., Eisenberg, D., & Serras, A. M. (2009). Substance use behaviors, mental health problems, and use of mental health services in a probability sample of college students. *Addictive Behaviors, 34*(2), 134–145. https://doi.org/10.1016/j.addbeh.2008.09.004

[146] Skidmore, C. R., Kaufman, E. A., & Crowell, S. E. (2016). Substance Use Among College Students. *Child and Adolescent Psychiatric Clinics of North America, 25*(4), 735–753. https://doi.org/10.1016/j.chc.2016.06.004

[147] Billard, M., Bowers, S., & Gomes, J. (2012). Risk factors and correlates for stress and depression in university students in Canada and the United States. *American Journal of Epidemiology,* 176(1), 80.

[148] Cairney, J., & Lawrance, K. A. (2002). Smoking on campus. An examination of smoking behaviours among post-secondary students in Canada. *Canadian journal of public health*, *93*(4), 313–316. https://doi.org/10.1007/BF03405024

[149] Hammond, D., Reid, J. L., Rynard, V. L., Fong, G. T., Cummings, K. M., McNeill, A., et al. (2019). Prevalence of vaping and smoking among adolescents in Canada, England, and the United States: repeat national cross-sectional surveys. *BMJ*, *365*, l2219. https://doi.org/10.1136/bmj.l2219

[150] Canadian Cancer Society. (2018). University and College 100% Smoke-Free Campuses in Canada: National Status Report. https://www.cancer.ca/~/media/cancer.ca/CW/for%20media/Media%20releases/2018/University-college-100-percent-smoke-free-campus-national-report-2018-09-14.pdf?la=en

[151] American Nonsmokers' Rights Foundation (ANRF). (2020). Smoke-free and Tobacco-Free U.S. and Tribal Colleges and Universities. http://no-smoke.org/wp-content/uploads/pdf/smokefreecollegesuniversities.pdf

[152] McIvor, A. (2009). Tobacco control and nicotine addiction in Canada: current trends, management and challenges. *Canadian Respiratory Journal, 16*(1), 21-26. https://doi.org/10.1155/2009/485953

[153] Government of Canada. (2019). Effects of Smoking. Learn how smoking can impact your health. https://www.canada.ca/en/health-canada/services/smoking-tobacco/effects-smoking.html

[154] Sun, J., Buys, N., Stewart, D., & Shum, D. (2011). Mediating effects of coping, personal belief, and social support on the relationship among stress, depression, and smoking behaviour in university students. *Health Education, 111*(2), 133–146. https://doi.org/10.1108/09654281111108544

[155] Government of Canada. (2017). Smoking status and average number of cigarettes smoked per day, by age group and sex. Canadian Tobacco, Alcohol and Drug (CTADS) Survey, Table 1. https://www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2017-summary/2017-detailed-tables.html#t1

[156] Kwan, M. Y., Arbour-Nicitopoulos, K. P., Duku, E., & Faulkner, G. (2016). Patterns of multiple health risk-behaviours in university students and their association with mental health: application of latent class analysis. *Health promotion and chronic disease prevention in Canada: Research, Policy and Practice*, *36*(8), 163–170. https://doi.org/10.24095/hpcdp.36.8.03

[157] Lindsey, B. J., Fabiano, P., & Stark, C. (2009). The prevalence and correlates of depression among college students. *College Student Journal*, *43*(4).

[158] Esmaeelzadeh, S., Moraros, J., Thorpe, L., & Bird, Y. (2018). The association between depression, anxiety and substance use among Canadian post-secondary students. *Neuropsychiatric disease and treatment*, *14*, 3241–3251. https://doi.org/10.2147/NDT.S187419

[159] Cranford, J. A., Eisenberg, D., & Serras, A. M. (2009). Substance use behaviors, mental health problems, and use of mental health services in a probability sample of college students. *Addictive Behaviors, 34*(2), 134–145. https://doi.org/10.1016/j.addbeh.2008.09.004

[160] Sun, J., Buys, N., Stewart, D., & Shum, D. (2011). Mediating effects of coping, personal belief, and social support on the relationship among stress, depression, and smoking behaviour in university students. *Health Education, 111*(2), 133–146. https://doi.org/10.1108/09654281111108544

[161] Ridner, S. L., Keith, R. J., Walker, K. L., Hart, J. L., Newton, K. S., & Crawford, T. N. (2018). Differences in quality of life among college student electronic cigarette users. *AIMS Public Health, 5*(4), 454–462. https://doi.org/10.3934/publichealth.2018.4.454

[162] Reid, J. L., Hammond, D., Rynard, V. L., Madill, C. L., & Burkhalter, R. (2017). Tobacco Use in Canada: Patterns and Trends, 2017 Edition. Waterloo, ON: Propel Centre for Population Health Impact, University of Waterloo. https://uwaterloo.ca/tobacco-use-canada/sites/ca.tobacco-use-canada/files/uploads/files/2017_tobaccouseincanada_final_0.pdf

[163] Bandi, P., Cahn, Z., Goding Sauer, A., Douglas, C. E., Drope, J., Jemal, A., & Fedewa, S. A. (2021). Trends in E-Cigarette Use by Age Group and Combustible Cigarette Smoking Histories, U.S. Adults, 2014-2018. *American Journal of Preventive Medicine*, *60*(2), 151–158.

[164] Hammond, D., Reid, J. L., Cole, A. G., & Leatherdale, S. T. (2017). Electronic cigarette use and smoking initiation among youth: a longitudinal cohort study. *CMAJ: Canadian Medical Association Journal*, *189*(43), E1328–E1336. https://doi.org/10.1503/cmaj.161002

[165] Grant, J. E., Lust, K., Fridberg, D. J., King, A. C., & Chamberlain, S. R. (2019). E-cigarette use (vaping) is associated with illicit drug use, mental health problems, and impulsivity in university students. *Annals of clinical psychiatry: official journal of the American Academy of Clinical Psychiatrists*, *31*(1), 27–35.

[166] Pham, T., Williams, J., Bhattarai, A., Dores, A. K., Isherwood, L. J., & Patten, S. B. (2020). Electronic cigarette use and mental health: A Canadian population-based study. *Journal of affective disorders*, *260*, 646–652. https://doi.org/10.1016/j.jad.2019.09.026.

[167] Government of Canada. (2017). E-cigarette status, by age group and sex. Canadian Tobacco, Alcohol and Drug (CTADS) Survey, Table 9. https://www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2017-summary/2017-detailed-tables.html#t9

Government of Canada. (2017). Illegal drug use (past 12-month and lifetime), by age group and sex. Canadian Tobacco, Alcohol and Drug (CTADS) Survey, Table 13. https://www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2017-summary/2017-detailed-tables.html#t13

[168] Ridner, S. L., Keith, R. J., Walker, K. L., Hart, J. L., Newton, K. S., & Crawford, T. N. (2018). Differences in quality of life among college student electronic cigarette users. *AIMS Public Health, 5*(4), 454–462. https://doi.org/10.3934/publichealth.2018.4.454

[169] Grant, J. E., Lust, K., Fridberg, D. J., King, A. C., & Chamberlain, S. R. (2019). E-cigarette use (vaping) is associated with illicit drug use, mental health problems, and impulsivity in university students. *Annals of clinical psychiatry: official journal of the American Academy of Clinical Psychiatrists*, *31*(1), 27–35. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6420081/

[170] Ridner, S. L., Keith, R. J., Walker, K. L., Hart, J. L., Newton, K. S., & Crawford, T. N. (2018). Differences in quality of life among college student electronic cigarette users. *AIMS Public Health, 5*(4), 454–462. https://doi.org/10.3934/publichealth.2018.4.454

[171] National Institute on Drug Abuse (NIDA). (2019). Marijuana use at historic highs among college-age adults. https://www.drugabuse.gov/news-events/news-releases/2019/09/marijuana-use-at-historic-highs-among-college-age-adults.

[172] Brownell, C. (2019). Reported marijuana use 'higher' at Canadian universities in 2019: Survey. *Maclean's: In the annual Maclean's survey, Canadian university students report more frequent use of marijuana.* https://www.macleans.ca/education/reported-marijuana-use-higher-at-canadian-universities-in-2019-survey/

[173] Keith, D. R., Hart, C. L., McNeil, M. P., Silver, R., & Goodwin, R. D. (2015). Frequent marijuana use, binge drinking and mental health problems among undergraduates. *The American Journal on Addictions*, *24*(6), 499-506.

[174] Arria, A. M., Caldeira, K. M., Bugbee, B. A., Vincent, K. B., & O'Grady, K. E. (2015). The academic consequences of marijuana use during college. *Psychology of addictive behaviors: journal of the Society of Psychologists in Addictive Behaviors*, *29*(3), 564–575. https://doi.org/10.1037/adb0000108

[175] George, T., & Vaccarino, F. (Eds.). (2015). Substance abuse in Canada: The Effects of Cannabis Use during Adolescence. Ottawa, ON: Canadian Centre on Substance Abuse. https://www.ccsa.ca/sites/default/files/2019-04/CCSA-Effects-of-Cannabis-Use-during-Adolescence-Report-2015-en.pdf

[176] Armstrong, T. D., & Costello, E. J. (2002). Community studies on adolescent substance use, abuse, or dependence and psychiatric comorbidity. *Journal of consulting and clinical psychology*, *70*(6), 1224–1239. https://doi.org/10.1037//0022-006x.70.6.1224

[177] Buckner, J. D., Bonn-Miller, M. O., Zvolensky, M. J., & Schmidt, N. B. (2007). Marijuana use motives and social anxiety among marijuana-using young adults. *Addictive Behaviors*, *32*(10), 2238–2252. https://doi.org/10.1016/j.addbeh.2007.04.004

[178] Government of Canada. (2017). Illegal drug use (past 12-month and lifetime), by age group and sex. Canadian Tobacco, Alcohol and Drug (CTADS) Survey, Table 13. https://www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2017-summary/2017-detailed-tables.html#t13

[179] Kwan, M. Y., Arbour-Nicitopoulos, K. P., Duku, E., & Faulkner, G. (2016). Patterns of multiple health risk-behaviours in university students and their association with mental health: application of latent class analysis. *Health promotion and chronic disease prevention in Canada: Research, Policy and Practice*, *36*(8), 163–170. https://doi.org/10.24095/hpcdp.36.8.03

[180] Esmaeelzadeh, S., Moraros, J., Thorpe, L., & Bird, Y. (2018). The association between depression, anxiety and substance use among Canadian post-secondary students. *Neuropsychiatric disease and treatment*, *14*, 3241–3251. https://doi.org/10.2147/NDT.S187419

[181] Jao, N. C., Robinson, L. D., Kelly, P. J., Ciecierski, C. C., & Hitsman, B. (2019). Unhealthy behavior clustering and mental health status in United States college students. *Journal of American College Health*, *67*(8), 790–800. https://doi.org/10.1080/07448481.2018.1515744

[182] Centre for Addiction and Mental Health. (2018). Canada's Lower-Risk Cannabis Use Guidelines (LRCUG). https://www.camh.ca/-/media/files/pdfs---reports-and-books---research/canadas-lower-risk-guidelines-cannabis-pdf.pdf

[183] Canadian Centre on Substance Use and Addiction. (2019). Canadian Drug Summary-Alcohol. https://www.ccsa.ca/sites/default/files/2019-09/CCSA-Canadian-Drug-Summary-Alcohol-2019-en.pdf

[184] Canadian Centre on Substance Use and Addiction. Postsecondary Education Partnership-Alcohol Harms. https://pepah.ca/

[185] Canadian Centre on Substance Use and Addiction. Postsecondary Education Partnership-Alcohol Harms: Framework. https://pepah.ca/framework/

[186] Meister, S. R., Barker, B., & Flores Pajot, M. C. (2018). Heavy Episodic Drinking Among Post-secondary Students: Influencing Factors and Implications. Ottawa, Ontario: Canadian Centre on Substance Use and Addiction. https://www.ccsa.ca/sites/default/files/2019-04/CCSA-Heavy-Episodic-Drinking-Post-Secondary-Students-Report-at-a-Glance-2018-en.pdf

[187] New England Recovery Center. (2015). Drug and alcohol abuse and depression in college students. https://www.newenglandrecoverycenter.org/drug-and-alcohol-abuse-and-depression-college/

[188] Government of Canada. (2017). Alcohol indicators, by age group and sex. Canadian Tobacco, Alcohol and Drug (CTADS) Survey, Table 17. https://www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2017-summary/2017-detailed-tables.html#t17

[189] Canadian Centre on Substance Abuse. (2012). Canada's Low-Risk Alcohol Drinking Guidelines. http://ccsa.ca/Resource%20Library/2012-Canada-Low-Risk-Alcohol-Drinking-Guidelines-Brochure-en.pdf & https://ccsa.ca/sites/default/files/2020-07/2012-Canada-Low-Risk-Alcohol-Drinking-Guidelines-Brochure-en_0.pdf

[190] Government of Canada. (2017). Alcohol indicators, by age group and sex. Canadian Tobacco, Alcohol and Drug (CTADS) Survey, Table 17. https://www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2017-summary/2017-detailed-tables.html#t17

[191] Jao, N. C., Robinson, L. D., Kelly, P. J., Ciecierski, C. C., & Hitsman, B. (2019). Unhealthy behavior clustering and mental health status in United States college students. *Journal of American College Health*, *67*(8), 790–800. https://doi.org/10.1080/07448481.2018.1515744

[192] Kwan, M. Y., Arbour-Nicitopoulos, K. P., Duku, E., & Faulkner, G. (2016). Patterns of multiple health risk-behaviours in university students and their association with mental health: application of latent class analysis. *Health promotion and chronic disease prevention in Canada: Research, Policy and Practice*, *36*(8), 163–170. https://doi.org/10.24095/hpcdp.36.8.03

[193] Esmaeelzadeh, S., Moraros, J., Thorpe, L., & Bird, Y. (2018). The association between depression, anxiety and substance use among Canadian post-secondary students. *Neuropsychiatric disease and treatment*, *14*, 3241–3251. https://doi.org/10.2147/NDT.S187419

[194] Wyatt, T., & Oswalt, S. B. (2013). Comparing Mental Health Issues Among Undergraduate and Graduate Students. *American Journal of Health Education, 44*(2), 96-107. https://doi.org/10.1080/19325037.2013.764248

[195] American College Health Association. National College Health Assessment – Participation History. https://www.acha.org/NCHA/About_ACHA_NCHA/Participation_History/NCHA/About/Participation_History.aspx?hkey=992b3d9a-9d22-46b8-911c-1f187dd5fb6c

[196] Kwan, M. Y., Faulkner, G. E., Arbour-Nicitopoulos, K. P., & Cairney, J. (2013). Prevalence of health-risk behaviours among Canadian post-secondary students: descriptive results from the National College Health Assessment. *BMC Public Health*, *13*, 548–548. https://doi.org/10.1186/1471-2458-13-548

[197] American College Health Association. The History of ACHA. https://www.acha.org/ACHA/About/History/ACHA/About/History.aspx?hkey=29e97485-0afd-49fa-a061-b4dd3ac5fa29

[198] Ibrahim, A. K., Kelly, S. J., Adams, C. E., & Glazebrook, C. (2013). A systematic review of studies of depression prevalence in university students. *Journal of Psychiatric Research, 47*(3), 391-400. https://doi.org/10.1016/j.jpsychires.2012.11.015.

[199] Zivin, K., Eisenberg, D., Gollust, S. E., & Golberstein, E. (2009). Persistence of mental health problems and needs in a college student population. *Journal of Affective Disorders, 117*(3), 180– 185. https://doi.org/10.1016/j.jad.2009.01.001

[200] American College Health Association. National College Health Assessment – Participation History. https://www.acha.org/NCHA/About_ACHA_NCHA/Participation_History/NCHA/About/Participation_History.aspx?hkey=992b3d9a-9d22-46b8-911c-1f187dd5fb6c

[201] Canadian Association of College and University Students Services. NCHA Health Data. https://www.cacuss.ca/resources/health-data.html

[202] American College Health Association. National College Health Assessment – Generalizability, Reliability and Validity Analysis. https://www.acha.org/NCHA/NCHA/About/Generalizability__Reliability__and_Validity_Analysis_NCHA_I.aspx

[203] American College Health Association. (2019). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2019. Silver Spring, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202019%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[204] Oram, R., Rogers, M., & DuPaul, G. (2020). Explaining the Relationship Between ADHD Symptomatology and Amotivation in the Undergraduate Population: The Role of Basic Psychological Need Frustration. *Canadian Journal of School Psychology, 35*(2), 139–153. https://doi.org/10.1177/0829573519880063

[205] Canadian Society for Exercise Physiology. (2011). Canadian Physical Activity Guidelines. http://www.csep.ca/CMFiles/Guidelines/CSEP_PAGuidelinesQ&A_E.pdf

[206] Chen, J. A., Stevens, C., Wong, S., & Liu, C. H. (2019). Psychiatric Symptoms and Diagnoses Among U.S. College Students: A Comparison by Race and Ethnicity. *Psychiatric services (Washington, D.C.)*, *70*(6), 442–449. https://doi.org/10.1176/appi.ps.201800388

[207] Kwan, M. Y., Arbour-Nicitopoulos, K. P., Duku, E., & Faulkner, G. (2016). Patterns of multiple health risk-behaviours in university students and their association with mental health: application of latent class analysis. *Health promotion and chronic disease prevention in Canada: Research, Policy and Practice*, *36*(8), 163–170. https://doi.org/10.24095/hpcdp.36.8.03

[208] Canadian Society for Exercise Physiology. (2011). Canadian Physical Activity Guidelines. http://www.csep.ca/CMFiles/Guidelines/CSEP_PAGuidelinesQ&A_E.pdf

[209] Government of Canada. Canada's Food Guide: Physical Activity and Healthy Eating. https://food-guide.canada.ca/en/tips-for-healthy-eating/physical-activity-healthy-eating/

[210] Kwan, M. Y., Arbour-Nicitopoulos, K. P., Duku, E., & Faulkner, G. (2016). Patterns of multiple health risk-behaviours in university students and their association with mental health: application of latent class analysis. *Health promotion and chronic disease prevention in Canada: Research, Policy and Practice*, *36*(8), 163–170. https://doi.org/10.24095/hpcdp.36.8.03

[211] Dinger, M. K., Brittain, D. R., & Hutchinson, S. R. (2014). Associations between physical activity and health-related factors in a national sample of college students. *Journal of American College Health, 62*(1), 67–74. https://doi.org/10.1080/07448481.2013.849710

[212] Canadian Society for Exercise Physiology (CSEP). (2020). Canadian 24-Hour Movement Guidelines for Adults aged 18-64 years: An Integration of Physical Activity, Sedentary Behaviour, and Sleep. https://csepguidelines.ca/adults-18-64/ & https://csepguidelines.ca/wp-content/uploads/2020/10/24HMovementGuidelines-Adults18-64-2020-ENG.pdf

[213] Cision Communications. (2020). Canada's First Ever 24-Hour Movement Guidelines for Adults Help Make the Whole Day Matter. https://www.newswire.ca/news-releases/canada-s-first-ever-24-hour-movement-guidelines-for-adults-help-make-the-whole-day-matter-803413996.html

[214] Jao, N. C., Robinson, L. D., Kelly, P. J., Ciecierski, C. C., & Hitsman, B. (2019). Unhealthy behavior clustering and mental health status in United States college students. *Journal of American College Health*, *67*(8), 790–800. https://doi.org/10.1080/07448481.2018.1515744

[215] Courtney, K. E., & Polich, J. (2009). Binge drinking in young adults: Data, definitions, and determinants. *Psychological bulletin*, *135*(1), 142–156. https://doi.org/10.1037/a0014414

[216] Orzech, K. M., Salafsky, D. B., & Hamilton, L. A. (2011). The state of sleep among college students at a large public university. *Journal of American College Health*, *59*(7), 612–619. https://doi.org/10.1080/07448481.2010.520051

[217] Lowry, M., Dean, K., & Manders, K. (2010). The Link Between Sleep Quantity and Academic Performance for the College Student. *Sentience: The University of Minnesota Undergraduate Journal of Psychology,* 3, 16-19. https://sites.oxy.edu/clint/physio/article/TheLinkBetweenSleepQuantityandAcademic.pdf

[218] Becker, C. M., Adams, T., Orr, C., & Quilter, L. (2008). Correlates of quality sleep and academic performance. *Health Educator, 40*(2), 82-89.

[219] Boehm, M. A., Lei, Q. M., Lloyd, R. M., & Prichard, J. R. (2016). Depression, anxiety, and tobacco use: Overlapping impediments to sleep in a national sample of college students. *Journal of American College Health, 64*(7), 565–574. https://doi.org/10.1080/07448481.2016.1205073

[220] Kwan, M. Y., Faulkner, G. E., Arbour-Nicitopoulos, K. P., & Cairney, J. (2013). Prevalence of health-risk behaviours among Canadian post-secondary students: descriptive results from the National College Health Assessment. *BMC Public Health*, *13*, 548–548. https://doi.org/10.1186/1471-2458-13-548

[221] Richter, R. (October 8, 2015). Standford University School of Medicine. News Center. https://med.stanford.edu/news/all-news/2015/10/among-teens-sleep-deprivation-an-epidemic.html

[222] Sullivan, K., & Ordiah, C. (2018). Association of mildly insufficient sleep with symptoms of anxiety and depression. *Neurology, Psychiatry and Brain Research*, *30*, 1-4.

[223] Field, T., Diego, M., Pelaez, M., Deeds, O., & Delgado, J. (2012). Depression and related problems in university students. *College Student Journal, 46*(1), 193–202.

[224] Becker, S. P., Jarrett, M. A., Luebbe, A. M., Garner, A. A., Burns, G. L., & Kofler, M. J. (2018). Sleep in a large, multi-university sample of college students: sleep problem prevalence, sex differences, and mental health correlates. *Sleep health*, *4*(2), 174-181.

[225] Psycom. Is It Sleep Deprivation or Depression? (2017). https://www.psycom.net/depression/sleep-deprivation-depression

[226] Nutt, D., Wilson, S., & Paterson, L. (2008). Sleep disorders as core symptoms of depression. *Dialogues in clinical neuroscience*, *10*(3), 329–336. https://doi.org/10.31887/DCNS.2008.10.3/dnutt

[227] Columbia University Department of Psychiatry. (2022). How Sleep Deprivation Impacts Mental Health. https://www.columbiapsychiatry.org/news/how-sleep-deprivation-affects-your-mental-health

[228] Kwan, M. Y., Faulkner, G. E., Arbour-Nicitopoulos, K. P., & Cairney, J. (2013). Prevalence of health-risk behaviours among Canadian post-secondary students: descriptive results from the National College Health Assessment. *BMC Public Health*, *13*, 548–548. https://doi.org/10.1186/1471-2458-13-548

[229] Taliaferro, L. A., Rienzo, B. A., Pigg, R. M., Jr, Miller, M. D., & Dodd, V. J. (2009). Associations between physical activity and reduced rates of hopelessness, depression, and suicidal behavior among college students. *Journal of American College Health*, *57*(4), 427–436. https://doi.org/10.3200/JACH.57.4.427-436

[230] Fox K. R. (1999). The influence of physical activity on mental well-being. *Public health nutrition*, *2*(3A), 411–418. https://doi.org/10.1017/s1368980099000567

[231] Kwan, M. Y., Arbour-Nicitopoulos, K. P., Duku, E., & Faulkner, G. (2016). Patterns of multiple health risk-behaviours in university students and their association with mental health: application of latent class analysis. *Health promotion and chronic disease prevention in Canada: Research, Policy and Practice*, *36*(8), 163–170. https://doi.org/10.24095/hpcdp.36.8.03

[232] Cranford, J. A., Eisenberg, D., & Serras, A. M. (2009). Substance use behaviors, mental health problems, and use of mental health services in a probability sample of college students. *Addictive Behaviors, 34*(2), 134–145. https://doi.org/10.1016/j.addbeh.2008.09.004

[233] Lindsey, B. J., Fabiano, P., & Stark, C. (2009). The prevalence and correlates of depression among college students. *College Student Journal*, *43*(4).

[234] Esmaeelzadeh, S., Moraros, J., Thorpe, L., & Bird, Y. (2018). The association between depression, anxiety and substance use among Canadian post-secondary students. *Neuropsychiatric disease and treatment*, *14*, 3241–3251. https://doi.org/10.2147/NDT.S187419

[235] Cole, A. G., Aleyan, S., Battista, K., & Leatherdale, S. T. (2021). Trends in youth e-cigarette and cigarette use between 2013 and 2019: insights from repeat cross-sectional data from the COMPASS study. *Canadian Journal of Public Health*, *112*(1), 60–69. https://doi-org.proxy.lib.uwaterloo.ca/10.17269/s41997-020-00389-0

[236] Zuckermann, A. M. E., Williams, G., Battista, K., de Groh, M., Jiang, Y., & Leatherdale, S. T. (2019). Trends of poly-substance use among Canadian youth. *Addictive behaviors reports*, *10*, 100189. https://doi-org.proxy.lib.uwaterloo.ca/10.1016/j.abrep.2019.100189

[237] Schulenberg, J., Johnston, L., O'Malley, P., Bachman, J., Miech, R., & Patrick, M. (2019). Monitoring the Future national survey results on drug use, 1975-2018: Volume II, college students and adults ages 19-60.

[238] Kitzrow, M.A. (2003). The Mental Health Needs of Today's College Students: Challenges and Recommendations. *Journal of Student Affairs Research and Practice*, *41*(1), 167-181. https://doi.org/10.2202/1949-6605.1310

[239] Saleem, S., Mahmood, Z., & Naz, M. (2013). Mental Health Problems in University Students: A Prevalence Study. *FWU Journal of Social Sciences, 7*(2), 124-130. http://hdl.handle.net/123456789/1114

[240] Grant, J. E., Lust, K., Fridberg, D. J., King, A. C., & Chamberlain, S. R. (2019). E-cigarette use (vaping) is associated with illicit drug use, mental health problems, and impulsivity in university students. *Annals of clinical psychiatry : official journal of the American Academy of Clinical Psychiatrists*, *31*(1), 27–35.

[241] Nguyen, H. V., & Mital, S. (2022). Effects of e-cigarette use on mental health among youths: quasi-experimental evidence from Canada. *Addiction (Abingdon, England)*, *117*(10), 2673–2682. https://doi-org.proxy.lib.uwaterloo.ca/10.1111/add.15943

[242] Pham, T., Williams, J. V. A., Bhattarai, A., Dores, A. K., Isherwood, L. J., & Patten, S. B. (2020). Electronic cigarette use and mental health: A Canadian population-based study. *Journal of affective disorders*, *260*, 646–652. https://doi-org.proxy.lib.uwaterloo.ca/10.1016/j.jad.2019.09.026

[243] American College Health Association. (2016). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2016. Hanover, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202016%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[244] American College Health Association. (2019). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2019. Silver Spring, MD: American College Health Association. https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202019%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

[245] American College Health Association. (2022). American College Health Association-National College Health Assessment II: Canadian Reference Group Data Report Spring 2022. Silver Spring, MD: American College Health Association. https://www.acha.org/documents/ncha/NCHA-III_SPRING_2022_CANADIAN_REFERENCE_GROUP_DATA_REPORT.pdf

[246] Cole, A. G., Aleyan, S., Battista, K., & Leatherdale, S. T. (2021). Trends in youth e-cigarette and cigarette use between 2013 and 2019: insights from repeat cross-sectional data from the COMPASS study. *Canadian Journal of Public Health*, *112*(1), 60–69. https://doi-org.proxy.lib.uwaterloo.ca/10.17269/s41997-020-00389-0

[247] Esmaeelzadeh, S., Moraros, J., Thorpe, L., & Bird, Y. (2018). The association between depression, anxiety and substance use among Canadian post-secondary students. *Neuropsychiatric disease and treatment*, *14*, 3241–3251. https://doi.org/10.2147/NDT.S187419

[248] Keith, D. R., Hart, C. L., McNeil, M. P., Silver, R., & Goodwin, R. D. (2015). Frequent marijuana use, binge drinking and mental health problems among undergraduates. *The American journal on addictions*, *24*(6), 499–506. https://doi-org.proxy.lib.uwaterloo.ca/10.1111/ajad.12201

[249] Feingold, D., & Weinstein, A. (2021). Cannabis and Depression. *Advances in experimental medicine and biology*, *1264*, 67–80. https://doi-org.proxy.lib.uwaterloo.ca/10.1007/978-3-030-57369-0_5

[250] Keith, D. R., Hart, C. L., McNeil, M. P., Silver, R., & Goodwin, R. D. (2015). Frequent marijuana use, binge drinking and mental health problems among undergraduates. *The American journal on addictions*, *24*(6), 499–506. https://doi-org.proxy.lib.uwaterloo.ca/10.1111/ajad.12201

[251] Kwan, M. Y., Faulkner, G. E., Arbour-Nicitopoulos, K. P., & Cairney, J. (2013). Prevalence of health-risk behaviours among Canadian post-secondary students: descriptive results from the National College Health Assessment. *BMC Public Health*, *13*, 548–548. https://doi.org/10.1186/1471-2458-13-548

[252] Butler, A., Romano, I., Patte, K., Ferro, M. A., de Groh, M., Jiang, Y., & Leatherdale, S. T. (2019). Psychological correlates and binge drinking behaviours among Canadian youth: a cross-sectional analysis of the mental health pilot data from the COMPASS study. *BMJ open*, *9*(6), e028558. https://doi-org.proxy.lib.uwaterloo.ca/10.1136/bmjopen-2018-028558

[253] Cranford, J. A., Eisenberg, D., & Serras, A. M. (2009). Substance use behaviors, mental health problems, and use of mental health services in a probability sample of college students. *Addictive Behaviors, 34*(2), 134–145. https://doi.org/10.1016/j.addbeh.2008.09.004

[254] Mason, M. J., Zaharakis, N., & Benotsch, E. G. (2014). Social networks, substance use, and mental health in college students. *Journal of American college health*, *62*(7), 470–477. https://doi-org.proxy.lib.uwaterloo.ca/10.1080/0748481.2014.923428

[255] Butler, A., Romano, I., Patte, K., Ferro, M. A., de Groh, M., Jiang, Y., & Leatherdale, S. T. (2019). Psychological correlates and binge drinking behaviours among Canadian youth: a cross-sectional analysis of the mental health pilot data from the COMPASS study. *BMJ open*, *9*(6), e028558. https://doi-org.proxy.lib.uwaterloo.ca/10.1136/bmjopen-2018-028558

[256] Scholly, K., Katz, A. R., & Kehl, L. (2014). Examining Factors Associated with Heavy Episodic Drinking Among College Undergraduates. *Health psychology research*, *2*(2), 1457. https://doi-org.proxy.lib.uwaterloo.ca/10.4081/hpr.2014.1457

[257] Herrero-Montes, M., Alonso-Blanco, C., Paz-Zulueta, M., Pellico-López, A., Ruiz-Azcona, L., Sarabia-Cobo, C., Boixadera-Planas, E., & Parás-Bravo, P. (2022). Excessive alcohol consumption and binge drinking in college students. *PeerJ*, *10*, e13368. https://doi-org.proxy.lib.uwaterloo.ca/10.7717/peerj.13368

[258] Zeigler, D. W., Wang, C. C., Yoast, R. A., Dickinson, B. D., McCaffree, M. A., Robinowitz, C. B., Sterling, M. L., & Council on Scientific Affairs, American Medical Association (2005). The neurocognitive effects of alcohol on adolescents and college students. *Preventive medicine*, *40*(1), 23–32. https://doi-org.proxy.lib.uwaterloo.ca/10.1016/j.ypmed.2004.04.044

[259] Canadian Center on Substance Use and Addiction. (2023). Canada's Guidance on Alcohol and Health. https://www.ccsa.ca/canadas-guidance-alcohol-and-health

[260] Kernan W. D. (2019). Health-related impediments to learning among dental and oral surgery students. *Journal of prevention & intervention in the community*, *47*(1), 32–44. https://doi.org/10.1080/10852352.2018.1547307

[261] McCabe, B. E., Troy, A. S., Patel, H. H., Halstead, V., & Arana, M. (2018). Development of a University Campus Healthy Sleep Promotion Program. *Issues in mental health nursing*, *39*(3), 264–268. https://doi.org/10.1080/01612840.2017.1397231

[262] Semel Healthy Campus Initiative Center at UCLA. Sleep Well. https://mindwell.healthy.ucla.edu/resources/sleep-well/

[263] Columbia University Department of Psychiatry. (2022). How Sleep Deprivation Impacts Mental Health. https://www.columbiapsychiatry.org/news/how-sleep-deprivation-affects-your-mental-health

[264] Caggiari, G., Talesa, G. R., Toro, G., Jannelli, E., Monteleone, G., & Puddu, L. (2021). What type of mattress should be chosen to avoid back pain and improve sleep quality? Review of the literature. *Journal of orthopaedics and traumatology : official journal of the Italian Society of Orthopaedics and Traumatology*, *22*(1), 51. https://doi-org.proxy.lib.uwaterloo.ca/10.1186/s10195-021-00616-5

[265] Eron, K., Kohnert, L., Watters, A., Logan, C., Weisner-Rose, M., & Mehler, P. S. (2020). Weighted Blanket Use: A Systematic Review. *The American journal of occupational therapy: official publication of the American Occupational Therapy Association*, *74*(2), 7402205010p1–7402205010p14. https://doi-org.proxy.lib.uwaterloo.ca/10.5014/ajot.2020.037358

[266] Johnson & Johnson Inc.; HelpThemQuit.ca. (2023). Run to Quit: A double dose of risk reduction - A new tobacco cessation program. https://www.helpthemquit.ca/quitting-strategies/run-to-quit

[267] Adhopia, V. (2019). Ontario's anti-smoking program Leave The Pack Behind left behind by government cuts. *CBC News.* https://www.cbc.ca/news/health/ontario-cuts-youth-smoking-program-1.5158362

[268] Statistics Canada. (2023). Five years since legalization, what have we learned about cannabis in Canada? https://www150.statcan.gc.ca/n1/daily-quotidien/231016/dq231016c-eng.htm

[269] Glantz, S. A., Halpern-Felsher, B., & Springer, M. L. (2018). Marijuana, Secondhand Smoke, and Social Acceptability. *JAMA internal medicine*, *178*(1), 13–14. https://doi.org/10.1001/jamainternmed.2017.5301

[270] Roditis, M. L., Delucchi, K., Chang, A., & Halpern-Felsher, B. (2016). Perceptions of social norms and exposure to pro-marijuana messages are associated with adolescent marijuana use. *Preventive medicine*, *93*, 171–176. https://doi.org/10.1016/j.ypmed.2016.10.013

[271] Palmgreen, P., Donohew, L., Lorch, E. P., Hoyle, R. H., & Stephenson, M. T. (2001). Television campaigns and adolescent marijuana use: tests of sensation seeking targeting. *American journal of public health*, *91*(2), 292–296. https://doi.org/10.2105/ajph.91.2.292

[272] Gobbi, G., Atkin, T., Zytynski, T., Wang, S., Askari, S., Boruff, J., Ware, M., Marmorstein, N., Cipriani, A., Dendukuri, N., & Mayo, N. (2019). Association of Cannabis Use in Adolescence and Risk of Depression, Anxiety, and Suicidality in Young Adulthood: A Systematic Review and Meta-analysis. *JAMA psychiatry*, *76*(4), 426–434. https://doi-org.proxy.lib.uwaterloo.ca/10.1001/jamapsychiatry.2018.4500

[273] Connor, J. P., Stjepanović, D., Le Foll, B., Hoch, E., Budney, A. J., & Hall, W. D. (2021). Cannabis use and cannabis use disorder. *Nature reviews. Disease primers*, *7*(1), 16. https://doi-org.proxy.lib.uwaterloo.ca/10.1038/s41572-021-00247-4

[274] Pearson, N. T., & Berry, J. H. (2019). Cannabis and Psychosis Through the Lens of DSM-5. *International journal of environmental research and public health*, *16*(21), 4149. https://doi.org/10.3390/ijerph16214149

[275] Medlicott, E., Phillips, A., Crane, C., Hinze, V., Taylor, L., Tickell, A., Montero-Marin, J., & Kuyken, W. (2021). The Mental Health and Well-being of University Students: Acceptability, Effectiveness, and Mechanisms of a Mindfulness-Based Course. *International journal of environmental research and public health*, *18*(11), 6023. https://doi.org/10.3390/ijerph18116023

[276] Campbell, F., Blank, L., Cantrell, A., Baxter, S., Blackmore, C., Dixon, J., & Goyder, E. (2022). Factors that influence mental health of university and college students in the UK: a systematic review. *BMC public health*, *22*(1), 1778. https://doi.org/10.1186/s12889-022-13943-x

[277] Kraft D. P. (2011). One hundred years of college mental health. *Journal of American college health: J of ACH*, *59*(6), 477–481. https://doi.org/10.1080/07448481.2011.569964

APPENDICES

APPENDIX A: NCHA Canadian Reference Group Demographics

National College Health Assessment - Canadian Reference Group Demographics			
	2013	2016	2019
# INSTITUTIONS	32	41	58
# RESPONDENTS	34,039	43,780	55,284
RESPONSE RATE	20.4%	19.2%	20.0%
AGE:			
18-20 YEARS	39.9%	40.3%	39.4%
21-24 YEARS	38.5%	37.4%	34.9%
25-29 YEARS	12.3%	12.5%	13.8%
30+ YEARS	9.3%	9.8%	11.9%
GENDER:			
FEMALE	67.6%	67.9%	67.6%
MALE	30.9%	29.2%	29.7%
TRANSGENDER/NON-BINARY	0.2%	2.9%	2.7%
STUDENT STATUS:			
1ST YEAR UNDERGRADUATE	20.5%	23.0%	26.3%
2ND YEAR UNDERGRADUATE	20.4%	20.4%	22.9%
3RD YEAR UNDERGRADUATE	19.7%	18.6%	16.2%
4TH YEAR UNDERGRADUATE	16.9%	14.6%	12.0%
5TH YEAR OR MORE UNDERGRADUATE	6.6%	6.6%	4.9%
GRADUATE OR PROFESSIONAL	14.5%	13.9%	12.6%
NOT SEEKING A DEGREE OR OTHER	1.4%	2.8%	5.2%
ENROLMENT STATUS:			
FULL-TIME STUDENT	92.5%	93.3%	93.1%
PART-TIME STUDENT	6.6%	5.6%	5.9%
OTHER	0.8%	1.1%	1.0%
INTERNATIONAL STUDENT	10.5%	9.4%	14.2%
ETHNICITY:			
ABORIGINAL	3.3%	4.4%	4.6%
ARAB	1.9%	2.0%	2.3%
BLACK	3.1%	3.8%	4.7%
CHINESE	8.8%	9.0%	8.0%
FILIPINO	1.5%	2.6%	3.4%
JAPANESE	0.6%	0.6%	0.5%
KOREAN	1.0%	1.2%	1.1%
LATIN AMERICAN	1.9%	2.4%	3.2%
SOUTH ASIAN	6.8%	7.9%	11.4%
SOUTHEAST ASIAN	1.6%	2.0%	2.6%
WEST ASIAN	1.3%	1.3%	1.5%
WHITE	70.1%	65.4%	57.7%
MULTIRACIAL	3.6%	3.6%	3.6%
OTHER	3.1%	2.9%	3.5%

APPENDIX B: NCHA Prevalence Rates

Depression

National College Health Assessment – Canadian Reference Group			
Felt so depressed that it was difficult to function (%)	**2013**	**2016**	**2019**
No, never	41.4	34.8	29.5
No, not in the last 12 months	21.1	20.8	19.0
Yes, last 2 weeks	12.8	17.1	20.1
Yes, last 30 days	7.3	8.8	10.3
Yes, in the last 12 months	17.4	18.5	21.2
Anytime within the last 12 months	***37.5***	***44.4***	***51.6***

Anxiety

National College Health Assessment – Canadian Reference Group			
Felt overwhelming anxiety (%)	**2013**	**2016**	**2019**
No, never	29.5	22.7	19.7
No, not in the last 12 months	14.1	12.8	11.4
Yes, last 2 weeks	22.9	28.5	31.1
Yes, last 30 days	12.3	13.8	14.5
Yes, in the last 12 months	21.2	22.2	23.2
Anytime within the last 12 months	***56.5***	***64.5***	***68.9***

Sleep

National College Health Assessment – Canadian Reference Group			
Past 7 days, getting enough sleep to feel rested in the morning: (%)	**2013**	**2016**	**2019**
0 days	10.9	13.1	14.3
1-2 days	29.7	30.9	31.7
3-5 days	47.6	44.7	43.0
6+ days	11.8	11.3	11.0

Physical Activity: Moderate to Vigorous

National College Health Assessment – Canadian Reference Group			
Over the past 7 days: How many total minutes of moderate to vigorous physical activity did you do in at least 10-minute bouts? (%)	**2013**	**2016**	**2019**
<30 minutes	28.8	31.1	36.0
30-60 minutes	22.7	23.3	24.4
61-90 minutes	17.6	17.5	15.7
90-150 minutes	13.6	12.5	10.7
>150 minutes	17.4	15.7	13.3

Substance Use: Cigarettes

National College Health Assessment – Canadian Reference Group			
Within the last 30 days, on how many did you use: (%)	**2013**	**2016**	**2019**
Never used	70.8	73.1	73.8

Used but not within the last 30 days	17.6	15.9	15.4
Any use within the last 30 days	*11.6*	*11.0*	*10.8*

Substance Use: E-cigarettes

National College Health Assessment – Canadian Reference Group			
Within the last 30 days, on how many did you use: (%)	2013	2016	2019
Never used	n/a	86.1	78.8
Used but not within the last 30 days	n/a	10.0	10.4
Any use within the last 30 days	*n/a*	*3.9*	*10.7*

Substance Use: Marijuana

National College Health Assessment – Canadian Reference Group			
Within the last 30 days, on how many did you use: (%)	2013	2016	2019
Never used	60.1	58.4	55.6
Used but not within the last 30 days	23.8	23.7	19.7
Any use within the last 30 days	*16.0*	*17.9*	*24.7*

Substance Use: Alcohol Consumption

National College Health Assessment – Canadian Reference Group			
Over the last two weeks, how many times have you had five or more drinks of alcohol at a sitting: (%)	2013	2016	2019
N/A, don't drink	17.5	19.3	25.2
None	46.5	45.7	45.5
1-10 times or more	*36.3*	*34.9*	*29.4*

Stress

National College Health Assessment – Canadian Reference Group			
Within the last 12 months, how would you rate the overall level of stress experienced: (%)	2013	2016	2019
No stress	1.1	1.6	2.1
Less than average stress	7.0	6.5	7.2
Average stress	34.5	31.4	29.8
More than average stress	45.5	46.2	45.6
Tremendous stress	12.1	14.4	15.3
More than average + tremendous stress	*57.6*	*60.6*	*60.9*

Factors Affecting Academic Performance

National College Health Assessment – Canadian Reference Group					
Factors affecting academic performance (within the last 12 months)					
2013		2016		2019	
38.6%	*Stress*	42.2%	*Stress*	41.9%	*Stress*
28.4%	*Anxiety*	32.5%	*Anxiety*	34.6%	*Anxiety*
27.1%	*Sleep difficulties*	28.4%	*Sleep difficulties*	29.0%	*Sleep difficulties*
21.6%	Cold/Flu/Sore throat	20.9%	*Depression*	24.2%	*Depression*
21.0%	Internet use/computer games	20.6%	Cold/Flu/Sore throat	19.6%	Cold/Flu/Sore throat

17.3%	*Depression*	18.7%	Internet use/computer games	17.7%	Work
17.0%	Work	17.1%	Work	16.3%	Internet use/computer games
15.2%	Concern for a troubled friend or family member	13.0%	Relationship difficulties	15.8%	Concern for a troubled friend or family member
12.9%	Relationship difficulties	10.3%	Finances	12.2%	Relationship difficulties
9.5%	Participation in extracurricular activities	8.8%	Participation in extracurricular activities	11.3%	Finances
9.0%	Finances	7.4%	Death of a friend or family member	8.0%	Death of a friend or family member
6.9%	Death of a friend or family member	6.8%	Roommate difficulties	7.6%	Participation in extracurricular activities
6.4%	Sinus infection/Ear infection/Bronchitis/Strep throat	5.8%	Sinus infection/Ear infection/Bronchitis/Strep throat	6.5%	Attention Deficit/Hyperactivity Disorder
6.3%	Roommate difficulties	5.6%	Homesickness	6.3%	Homesickness
5.1%	Homesickness	5.1%	Attention Deficit/Hyperactivity Disorder	6.2%	Roommate difficulties
4.9%	Alcohol use	4.6%	Chronic health problem or serious illness	5.4%	Learning disability
4.2%	Attention Deficit/Hyperactivity Disorder	4.5%	Alcohol use	5.4%	Sinus infection/Ear infection/Bronchitis/Strep throat
4.2%	Chronic health problem or serious illness	4.5%	Chronic pain	5.2%	Chronic pain
4.0%	Chronic pain	4.3%	Learning disability	5.1%	Chronic health problem or serious illness
3.5%	Learning disability	3.4%	Other	3.6%	Alcohol use
2.9%	Other	2.9%	Injury	3.5%	Other
2.8%	Injury	2.2%	Drug use	3.2%	Injury
1.8%	Allergies	2.0%	Eating disorder/problem	2.5%	Eating disorder/problem
1.8%	Drug use	1.9%	Allergies	2.4%	Drug use
1.8%	Eating disorder/problem	1.8%	Discrimination	2.0%	Discrimination
1.2%	Discrimination	1.3%	Assault (sexual)	1.9%	Allergies
0.8%	Assault (sexual)	0.9%	Assault (physical)	1.9%	Assault (sexual)
0.8%	Pregnancy (yours or partner's)	0.9%	Pregnancy (yours or partner's)	1.1%	Assault (physical)
0.6%	Assault (physical)	0.9%	Concern for a troubled friend or family member	1.1%	Pregnancy (yours or partner's)
0.4%	Sexually transmitted disease/infection (STD/I)	0.5%	Sexually transmitted disease/infection (STD/I)	0.6%	Sexually transmitted disease/infection (STD/I)
0.3%	Gambling	0.3%	Gambling	0.4%	Gambling

APPENDIX C: Campus Characteristics of NCHA Canadian Reference Group (Spring 2019)

Location: Canada 58 Post-secondary Institutions n=55,284	
Type of Institution	
Public	52
Private	6
2-year	16
4-year or above	37
Other	5
Campus Size	
< 2,500 students	12
2,500 – 4,999 students	3
5,000 – 9,999 students	9
10,000 – 19,999 students	10
20,000 students or more	24
Campus Setting	
Very large city (population over 500,000)	29
Large city (population 250,000-499,999)	4
Small city (population 50,000-249,999)	19
Large town (population 10,000-49,999)	2
Small town (population 2,500-9,999)	3
Rural community (population under 2,500)	1
ACHA Membership Status	
Institutional Member	37
Nonmember	21
Religious Affiliation	
No	53
Yes	5
If yes:	
Catholic	1
Protestant or Other Christian	5

APPENDIX D: NCHA Canadian Consortium – Implementation (Spring 2019)

Foundation

National College Health Assessment (NCHA) is a nationally recognized online student health survey that helps post-secondary institutions examine students' behaviours, perceptions, and habits about a variety of health and wellness topics. The survey questions are based on salient issues and pertinent health problems in higher education that impact overall wellness, academic performance, student retention and campus life. Results of the NCHA survey generate prevalence rates of student behaviours and perceptions and can be used to identify health priorities.

Categories

The core* NCHA survey is comprised of 66 questions across seven categories:

1) Health, Health Education, and Safety (safety and violence)
2) Alcohol, Tobacco, and Drugs
3) Sex Behaviour & Contraception
4) Mental Health
5) Physical Health
6) Impediments to Academic Performance
7) Demographic Characteristics

*Additional questions can be added to the survey as a group or by individual institutions. For the 2019 run of the survey, additional questions deemed relevant for Canadian institutions were developed by the NCHA Canadian Consortium CACUSS (Canadian Association of College and University Student Services) committee.

The American College Health Association (ACHA) organizes the Canadian consortium of institutions that each individually run the survey for three-weeks on their campus during the Winter semester. This coordinated implementation of the NCHA survey throughout the Winter semester occurs every three years with the results being provided in the Spring of the same year. The identification of the survey is labelled 'Spring' followed by the 'year' in which the survey is conducted.

The ACHA collects the data, destroys any personal identifying information and then sends the compiled, aggregate data individually to each institution participating in the survey along with the aggregate data of the Canadian consortium. The individual institutional data is private, however in the interest of transparency, many institutions post their executive summaries or a NCHA result report on their website. The Canadian Reference Group data is public and can be requested from ACHA, viewed on the CACUSS website or found on various Canadian institutional websites that post it along with their individual institutional results. ACHA does not list or identify the institutions that make up the Canadian Reference Group, however the number of participating institutions, number of responses, and the response rate are published.

NCHA Generalizability, Reliability, and Validity

The ACHA-NCHA was first piloted in 1998-1999. Complete information regarding generalizability, reliability and validity can be reviewed on their website: https://www.acha.org/NCHA/About_ACHA_NCHA/Generalizability__Reliability__and_Validity_Analysis/NCHA/About/Generalizability__Reliability__and_Validity_Analysis.aspx?hkey=0d3e8e2b-561a-43da-a004-b3f4901c6956

Institutional Approval

Each institution planning on participating in the NCHA survey must provide senior administrative approval or approval by their Institutional Review Board (IRB). Participation requirements can be found on their website:
https://www.acha.org/NCHA/To_Participate/Order_Forms/NCHA/To_Participate/Order.aspx?hkey=90ced9f1-1d80-4967-badd-d8757b9cf4f0

Survey Administration

Each institution can decide whether ACHA will be responsible for survey administration or whether an individual at their particular institution will administer the survey internally on their campus. Each institution may decide on a different protocol and the decision may be based on ethics approval and/or whether institutions are able to provide student email addresses directly to the ACHA.

Student Sampling

Each institution will decide the number of students to be surveyed, whether the survey will be sent to both undergraduates and graduate students, part-time and/or full-time students, and the type of sampling protocol conducted, for example systematic random sampling or stratified random sampling, etc.

Incentive to Participate

Each institution decides whether to offer any incentives for survey participation in hopes to increase response rate. Some institutions decide not to offer an incentive; other may have a draw for a large prize such as cash or a tablet; others may offer an immediate incentive for submitted surveys such as $5 on their student card or a voucher for a coffee. Incentives are at the discretion and responsibility of each institution.

Survey Administration, Methodology & Procedures

Once the survey sample has been provided, selected students will be sent an email on the start date inviting participation in the confidential survey. The email will include a description of the survey, the data collection process, and the link to the survey. To protect privacy, a unique ID number is imbedded in the survey URL sent to each student in his or her Letter of Invitation/Consent email. Unique IDs are downloaded with student responses, preventing responses from the same student and also preventing students outside the sample from submitting a survey.

Each institution can decide the frequency and timeliness of reminder emails. Non-responders will be sent a reminder email to consider completing the survey.

Once the student hits the “submit” button at the end of the NCHA survey, the students’ browser will re-direct them to a web page containing a thank you for participating message along with any additional information the institution deems important such as resources available should they require support following completion of the survey.

Once the collection period has ended, ACHA will destroy all files containing unique ID numbers before NCHA results are shared with the institution to eliminate any possibility of linking survey responses to individual participants.

Potential Benefits of the Survey

Completion of the survey improves the body of knowledge regarding health behaviours, perceptions and

habits of post-secondary students. The benefits to students include contribution to improving health and wellness programming and service initiatives available on campus for themselves and for students, present and future. Students may benefit individually by participating in programming developed as a result of the survey and/or they may gain better access to care and wellness services on campus.

The survey results can be used to develop evidence-based programming specific to the post-secondary population and improve wellness services and delivery on campus.

Researchers, health professionals, senior staff and administration can benefit from the data through an increased understanding of the health and wellness habits, behaviours and perceptions of post-secondary students. Increased understanding of the student population can influence program development and improved student health services to better support post-secondary students and their health and wellness. Improved student health may further contribute to student retention and academic success for post-secondary students.

The American College Health Association will benefit from Canadian institutional participation as the data from the study will be added to the body of research of Canadian post-secondary students.

Risks to Participants

Minimal risks anticipated. Participant risk is considered minimal and efforts have been taken to address any concerns. The survey is collected confidentially by the American College Health Association. The data is compiled then sent to each institution without any identifying information. Individuals can divulge personal health information without fear of loss of confidentiality, educational consequences, or risk of discrimination or harassment.

The risk of an emotional response or distress based on some of the questions is possible. See section below – Safeguards to protect physical and psychological health.

Safeguards to protect physical and psychological health

Potential harm is considered minimal and unlikely. The survey is completed at the discretion of the student, and the risk of physical harm is nil. Potential emotional risk may arise as there are questions of some potential discomfort, such as illicit drug use and sexual behaviour. However, the nature of the questions is nonjudgmental.

The invitation email reminds students that participation is completely voluntary and confidential. The survey is collected confidentially by the American College Health Association. The data is compiled then sent to institutions without any identifying information. Individuals can divulge personal health information without fear of loss of confidentiality, educational consequences, or risk of discrimination or harassment.

To assist with possible emotional discomfort, students will receive a thank you page once they submit their survey. Each institution has the option to provide their institutions' resources on the thank you page. These may include on- and off-campus supports and health care resources that they can access if they have specific needs.

Data Collection and Security (Qualtrics)*(Source: ACHA-NCHA Web Version FAQ)*

ACHA administers the ACHA-NCHA web survey via the Qualtrics, LLC Research Suite product. Qualtrics is

an Application Service Provider (ASP) with a Software-as-a-Service (SaaS) platform for creating, distributing, and collecting data from online surveys.

Files stored on the servers at ACHA are password protected behind a firewall. All files, except those containing student email addresses, are backed up every night. ACHA and Qualtrics, LLC will use the student email addresses provided by your campus only for a single ACHA-NCHA administration. The addresses will not be used for any other purpose, retained after the data collection period, nor shared with any other organizations.
The Qualtrics Security Statement is here: http://www.qualtrics.com/security-statement/

Data Storage and/or Disposition of Data

Data is striped of any student identifiers approximately two weeks after the survey closes and stored indefinitely by the American College Health Association, Hanover, MD USA

APPENDIX E: NCHA Canadian Reference Group Datasets & Executive Summaries

NCHA 2013

In 2013, the Canadian Reference Group Data yielded a final data set consisting of 34,039 students and 32 schools. Response rate was 20.4%.

2013 NCHA Canadian Reference Group Executive Summary:
https://uwaterloo.ca/institutional-analysis-planning/sites/ca.institutional-analysis-planning/files/uploads/files/ncha-ii_spring_2013_canadian_reference_group_executive_summary.pdf

NCHA 2016

In 2016, the Canadian Reference Group Data yielded a final data set consisting of 43,780 students. Response rate was 19.2%.

2016 NCHA Canadian Reference Group Executive Summary:
https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202016%20CANADIAN%20REFERENCE%20GROUP%20EXECUTIVE%20SUMMARY.pdf

NCHA 2019

In 2019, the Canadian Reference Group Data yielded a final data set consisting of 55,284 students. Response rate was 20.0%.

2019 NCHA Canadian Reference Group Executive Summary:
https://www.cacuss.ca/files/Research/NCHA-II%20SPRING%202019%20CANADIAN%20REFERENCE%20GROUP%20EXECUTIVE%20SUMMARY.pdf

APPENDIX F: NCHA Demographic Variables

NQ46: How old are you? _____ (open ended)

NQ47A: What sex where you assigned at birth, such as on an original birth certificate?

(1) Female
(2) Male

NQ51: What is your year in school?

(1) 1st year undergraduate
(2) 2nd year undergraduate
(3) 3rd year undergraduate
(4) 4th year undergraduate
(5) 5th year or more undergraduate
(6) Graduate or professional
(7) Not seeking a degree
(8) Other

NQ52: What is your enrollment status?

(1) Full-time
(2) Part-time
(3) Other

NQ54: What is your racial or ethnic identification? (Select all that apply)

(A) Aboriginal (Inuit, Metis, North American, Indian, etc.; status or non-status)
(B) Arab
(C) Black
(D) Chinese
(E) Filipino
(F) Japanese
(G) Korean
(H) Latin American
(I) South Asian
(J) Southeast Asian
(K) West Asian
(L) White
(M) Multiracial
(N) Other

NQ55: Are you an international student?

(1) No
(2) Yes

APPENDIX G: Descriptive Statistics & Frequencies

Participants included in the data analyses have completed all selected variables of study including dependent variables, independent variables, and covariates.

Complete case study: n = 34874.

TABLE 1.1A Demographic Characteristics

VARIABLES	CATEGORIES	n	%
Enrollment Status	Full-time	34874	100.0
Year of Study	1st year undergraduate	11028	31.6
	2nd year undergraduate	9746	27.9
	3rd year undergraduate	7113	20.4
	4th year undergraduate	5166	14.8
	5th year undergraduate or more	1821	5.2
Age in Years	18	5107	14.6
	19	7214	20.7
	20	7086	20.3
	21	6134	17.6
	22	4165	11.9
	23	2386	6.8
	24	1570	4.5
	25	1212	3.5
		Mean	20.5
		Std Dev	1.85
Sex at Birth	Female	24640	70.7
	Male	10234	29.3
International Status	Not international student	30832	88.4
	Yes international student	4042	11.6
Ethnicity	White ethnicity	19222	55.1
	Ethnic minority	15652	44.9
Sexual Orientation	Straight/heterosexual	28890	82.8
	Another sexual orientation	5984	17.2

*International status, ethnicity, and sexual orientation, in addition to being demographic characteristics, are included in the adjusted and full logistic regression models as covariates.

TABLE 1.1B Dependent Variables

VARIABLES	CATEGORIES	n	%
Depression	No depression	16270	46.7
	Yes depression	18604	53.3
Anxiety	No anxiety	10123	29.0
	Yes anxiety	24751	71.0

TABLE 1.1C Independent Variables

VARIABLES	CATEGORIES	n	%
Sleep	Sufficient sleep	12916	37.0

	Insufficient sleep	21958	63.0
Physical Activity	Sufficient physical activity	4618	13.2
	Insufficient physical activity	30256	86.8
Cigarettes	Never users	26376	75.6
	Infrequent users	5174	14.8
	Current users	3324	9.5
E-cigarettes	Never users	26384	75.7
	Infrequent users	3984	11.4
	Current users	4506	12.9
Marijuana	Never users	18926	54.3
	Infrequent users	6760	19.4
	Current users	9188	26.3
Alcohol Consumption	Non-drinkers	8287	23.8
	Non-binge drinkers	15295	43.9
	Binge drinkers	11292	32.4

TABLE 1.1D Covariates

VARIABLES	CATEGORIES	n	%
Stress	Low or average stress	13369	38.3
	High stress	21505	61.7
Sexual Violence	No sexual violence	29437	84.4
	Yes sexual violence	5437	15.6
International Status	Not international student	30832	88.4
	Yes international student	4042	11.6
Ethnicity	White ethnicity	19222	55.1
	Ethnic minority	15652	44.9
Sexual Orientation	Straight/heterosexual	28890	82.8
	Another sexual orientation	5984	17.2

TABLE 1.2 Frequency by *Sex at Birth*

	FEMALE		MALE		TOTAL	
	n	%	n	%	n	%
SEX AT BIRTH	24640	70.7	10234	29.3	34874	100.0
DEPRESSION						
No depression	10421	42.3	5849	57.2	16270	46.7
Yes depression	14219	57.7	4385	42.8	18604	53.3
ANXIETY						
No anxiety	5535	22.5	4588	44.8	10123	29.0
Yes anxiety	19105	77.5	5646	55.2	24751	71.0
SLEEP						
Sufficient sleep	8373	34.0	4543	44.4	12916	37.0
Insufficient sleep	16267	66.0	5691	55.6	21958	63.0
PHYSICAL ACTIVITY						
Sufficient physical activity	2723	11.1	1895	18.5	4618	13.2
Insufficient physical activity	21917	88.9	8339	81.5	30256	86.8
CIGARETTES						

Never users	18950	76.9	7426	72.6	26376	75.6
Infrequent users	3578	14.5	1596	15.6	5174	14.8
Current users	2112	8.6	1212	11.8	3324	9.5
E-CIGARETTES						
Never users	19265	78.2	7119	69.6	26384	75.7
Infrequent users	2662	10.8	1322	12.9	3984	11.4
Current users	2713	11.0	1793	17.5	4506	12.9
MARIJUANA						
Never users	13371	54.3	5555	54.3	18926	54.3
Infrequent users	4945	20.1	1815	17.7	6760	19.4
Current users	6324	25.7	2864	28.0	9188	26.3
ALCOHOL CONSUMPTION						
Non-drinkers	5441	22.1	2846	27.8	8287	23.8
Non-binge drinkers	11488	46.6	3807	37.2	15295	43.9
Binge drinkers	7711	31.3	3581	35.0	11292	32.4
STRESS						
Low or average stress	8201	33.3	5168	50.5	13369	38.3
High stress	16439	66.7	5066	49.5	21505	61.7
SEXUAL VIOLENCE						
No sexual violence	19881	80.7	9556	93.4	29437	84.4
Yes sexual violence	4759	19.3	678	6.6	5437	15.6
SEXUAL ORIENTATION						
Straight/heterosexual	19820	80.4	9070	88.6	28890	82.8
Another sexual orientation	4820	19.6	1164	11.4	5984	17.2
ETHNICITY						
White ethnicity	14072	57.1	5150	50.3	19222	55.1
Ethnic minority	10568	42.9	5084	49.7	15652	44.9
INTERNATIONAL STATUS						
Not international	22199	90.1	8633	84.4	30832	88.4
Yes international	2441	9.9	1601	15.6	4042	11.6
ENROLLMENT STATUS						
Full-time	24640	100.0	10234	100.0	34874	100.0
YEAR OF STUDY						
1st year undergraduate	7635	31.0	3393	33.2	11028	31.6
2nd year undergraduate	6863	27.9	2883	28.2	9746	27.9
3rd year undergraduate	5078	20.6	2035	19.9	7113	20.4
4th year undergraduate	3775	15.3	1391	13.6	5166	14.8
5th year undergraduate or more	1289	5.2	532	5.2	1821	5.2
AGE IN YEARS						
18	3639	14.8	1468	14.3	5107	14.6
19	5170	21.0	2044	20.0	7214	20.7
20	5095	20.7	1991	19.5	7086	20.3
21	4455	18.1	1679	16.4	6134	17.6
22	2899	11.8	1266	12.4	4165	11.9
23	1572	6.4	814	8.0	2386	6.8
24	1028	4.2	542	5.3	1570	4.5
25	782	3.2	430	4.2	1212	3.5

TABLE 1.3.1 Frequency DEPRESSION by *Female* Sex at Birth for all Variables

	DEPRESSION Female					
	No Depression n=10421		Yes Depression n=14219		Total n=24640	
	n	%	n	%	n	%
ANXIETY						
No anxiety	4897	47.0	638	4.5	5535	22.5
Yes anxiety	5524	53.0	13581	95.5	19105	77.5
SLEEP						
Sufficient sleep	4742	45.5	3631	25.5	8373	34.0
Insufficient sleep	5679	54.5	10588	74.5	16267	66.0
PHYSICAL ACTIVITY						
Sufficient physical activity	1308	12.6	1415	10.0	2723	11.1
Insufficient physical activity	9113	87.4	12804	90.0	21917	88.9
CIGARETTES						
Never users	8714	83.6	10236	72.0	18950	76.9
Infrequent users	1199	11.5	2379	16.7	3578	14.5
Current users	508	4.9	1604	11.3	2112	8.6
E-CIGARETTES						
Never users	8644	82.9	10621	74.7	19265	78.2
Infrequent users	918	8.8	1744	12.3	2662	10.8
Current users	859	8.2	1854	13.0	2713	11.0
MARIJUANA						
Never users	6442	61.8	6929	48.7	13371	54.3
Infrequent users	1969	18.9	2976	20.9	4945	20.1
Current users	2010	19.3	4314	30.3	6324	25.7
ALCOHOL CONSUMPTION						
Non-drinkers	2446	23.5	2995	21.1	5441	22.1
Non-binge drinkers	4900	47.0	6588	46.3	11488	46.6
Binge drinkers	3075	29.5	4636	32.6	7711	31.3
STRESS						
Low or average stress	5630	54.0	2571	18.1	8201	33.3
High stress	4791	46.0	11648	81.9	16439	66.7
SEXUAL VIOLENCE						
No sexual violence	9217	88.4	10664	75.0	19881	80.7
Yes sexual violence	1204	11.6	3555	25.0	4759	19.3
SEXUAL ORIENTATION						
Straight/heterosexual	9265	88.9	10555	74.2	19820	80.4
Another sexual orientation	1156	11.1	3664	25.8	4820	19.6
ETHNICITY						
White ethnicity	6245	59.9	7827	55.0	14072	57.1
Ethnic minority	4176	40.1	6392	45.0	10568	42.9
INTERNATIONAL STATUS						
Not international	9442	90.6	12757	89.7	22199	90.1
Yes international	979	9.4	1462	10.3	2441	9.9
ENROLLMENT STATUS						
Full-time	10421	100.0	14219	100.0	24640	100.0
YEAR OF STUDY						

1st year undergraduate	3131	30.0	4504	31.7	7635	31.0
2nd year undergraduate	2847	27.3	4016	28.2	6863	27.9
3rd year undergraduate	2168	20.8	2910	20.5	5078	20.6
4th year undergraduate	1731	16.6	2044	14.4	3775	15.3
5th year undergraduate or more	544	5.2	745	5.2	1289	5.2
AGE IN YEARS						
18	1584	15.2	2055	14.5	3639	14.8
19	2139	20.5	3031	21.3	5170	21.0
20	2163	20.8	2932	20.6	5095	20.7
21	1959	18.8	2496	17.6	4455	18.1
22	1165	11.2	1734	12.2	2899	11.8
23	637	6.1	935	6.6	1572	6.4
24	441	4.2	587	4.1	1028	4.2
25	333	3.2	449	3.2	782	3.2

TABLE 1.3.2 Frequency DEPRESSION by *Male* Sex at Birth for all Variables

	DEPRESSION Male					
	No Depression n=5849		Yes Depression n=4385		Total n=10234	
	n	%	n	%	n	%
ANXIETY						
No anxiety	4072	69.6	516	11.8	4588	44.8
Yes anxiety	1777	30.4	3869	88.2	5646	55.2
SLEEP						
Sufficient sleep	3089	52.8	1454	33.2	4543	44.4
Insufficient sleep	2760	47.2	2931	66.8	5691	55.6
PHYSICAL ACTIVITY						
Sufficient physical activity	1147	19.6	748	17.1	1895	18.5
Insufficient physical activity	4702	80.4	3637	82.9	8339	81.5
CIGARETTES						
Never users	4450	76.1	2976	67.9	7426	72.6
Infrequent users	838	14.3	758	17.3	1596	15.6
Current users	561	9.6	651	14.8	1212	11.8
E-CIGARETTES						
Never users	4197	71.8	2922	66.6	7119	69.6
Infrequent users	724	12.4	598	13.6	1322	12.9
Current users	928	15.9	865	19.7	1793	17.5
MARIJUANA						
Never users	3415	58.4	2140	48.8	5555	54.3
Infrequent users	1032	17.6	783	17.9	1815	17.7
Current users	1402	24.0	1462	33.3	2864	28.0
ALCOHOL CONSUMPTION						
Non-drinkers	1710	29.2	1136	25.9	2846	27.8
Non-binge drinkers	2099	35.9	1708	39.0	3807	37.2
Binge drinkers	2040	34.9	1541	35.1	3581	35.0
STRESS						
Low or average stress	3929	67.2	1239	28.3	5168	50.5

High stress	1920	32.8	3146	71.7	5066	49.5
SEXUAL VIOLENCE						
No sexual violence	5569	95.2	3987	90.9	9556	93.4
Yes sexual violence	280	4.8	398	9.1	678	6.6
SEXUAL ORIENTATION						
Straight/heterosexual	5389	92.1	3681	83.9	9070	88.6
Another sexual orientation	460	7.9	704	16.1	1164	11.4
ETHNICITY						
White ethnicity	3034	51.9	2116	48.3	5150	50.3
Ethnic minority	2815	48.1	2269	51.7	5084	49.7
INTERNATIONAL STATUS						
Not international	4960	84.8	3673	83.8	8633	84.4
Yes international	889	15.2	712	16.2	1601	15.6
ENROLLMENT STATUS						
Full-time	5849	100.0	4385	100.0	10234	100.0
YEAR OF STUDY						
1st year undergraduate	1957	33.5	1436	32.7	3393	33.2
2nd year undergraduate	1663	28.4	1220	27.8	2883	28.2
3rd year undergraduate	1146	19.6	889	20.3	2035	19.9
4th year undergraduate	803	13.7	588	13.4	1391	13.6
5th year undergraduate or more	280	4.8	252	5.7	532	5.2
AGE IN YEARS						
18	903	15.4	565	12.9	1468	14.3
19	1187	20.3	857	19.5	2044	20.0
20	1115	19.1	876	20.0	1991	19.5
21	953	16.3	726	16.6	1679	16.4
22	720	12.3	546	12.5	1266	12.4
23	452	7.7	362	8.3	814	8.0
24	274	4.7	268	6.1	542	5.3
25	245	4.2	185	4.2	430	4.2

TABLE 1.4.1 Frequency ANXIETY by *Female* Sex at Birth for all Variables

	ANXIETY Female					
	No Anxiety n=5535		Yes Anxiety n=19105		Total n=24640	
	n	%	n	%	n	%
DEPRESSION						
No depression	4897	88.5	5524	28.9	10421	42.3
Yes depression	638	11.5	13581	71.1	14219	57.7
SLEEP						
Sufficient sleep	2744	49.6	5629	29.5	8373	34.0
Insufficient sleep	2791	50.4	13476	70.5	16267	66.0
PHYSICAL ACTIVITY						
Sufficient physical activity	700	12.6	2023	10.6	2723	11.1
Insufficient physical activity	4835	87.4	17082	89.4	21917	88.9
CIGARETTES						
Never users	4717	85.2	14233	74.5	18950	76.9

Infrequent users	555	10.0	3023	15.8	3578	14.5
Current users	263	4.8	1849	9.7	2112	8.6
E-CIGARETTES						
Never users	4688	84.7	14577	76.3	19265	78.2
Infrequent users	462	8.3	2200	11.5	2662	10.8
Current users	385	7.0	2328	12.2	2713	11.0
MARIJUANA						
Never users	3722	67.2	9649	50.5	13371	54.3
Infrequent users	907	16.4	4038	21.1	4945	20.1
Current users	906	16.4	5418	28.4	6324	25.7
ALCOHOL CONSUMPTION						
Non-drinkers	1568	28.3	3873	20.3	5441	22.1
Non-binge drinkers	2443	44.1	9045	47.3	11488	46.6
Binge drinkers	1524	27.5	6187	32.4	7711	31.3
STRESS						
Low or average stress	3786	68.4	4415	23.1	8201	33.3
High stress	1749	31.6	14690	76.9	16439	66.7
SEXUAL VIOLENCE						
No sexual violence	4953	89.5	14928	78.1	19881	80.7
Yes sexual violence	582	10.5	4177	21.9	4759	19.3
SEXUAL ORIENTATION						
Straight/heterosexual	4964	89.7	14856	77.8	19820	80.4
Another sexual orientation	571	10.3	4249	22.2	4820	19.6
ETHNICITY						
White ethnicity	2899	52.4	11173	58.5	14072	57.1
Ethnic minority	2636	47.6	7932	41.5	10568	42.9
INTERNATIONAL STATUS						
Not international	4715	85.2	17484	91.5	22199	90.1
Yes international	820	14.8	1621	8.5	2441	9.9
ENROLLMENT STATUS						
Full-time	5535	100.0	19105	100.0	24640	100.0
YEAR OF STUDY						
1st year undergraduate	1801	32.5	5834	30.5	7635	31.0
2nd year undergraduate	1548	28.0	5315	27.8	6863	27.9
3rd year undergraduate	1040	18.8	4038	21.1	5078	20.6
4th year undergraduate	871	15.7	2904	15.2	3775	15.3
5th year undergraduate or more	275	5.0	1014	5.3	1289	5.2
AGE IN YEARS						
18	884	16.0	2755	14.4	3639	14.8
19	1106	20.0	4064	21.3	5170	21.0
20	1128	20.4	3967	20.8	5095	20.7
21	999	18.0	3456	18.1	4455	18.1
22	633	11.4	2266	11.9	2899	11.8
23	359	6.5	1213	6.3	1572	6.4
24	244	4.4	784	4.1	1028	4.2
25	182	3.3	600	3.1	782	3.2

TABLE 1.4.2 Frequency ANXIETY by *Male* Sex at Birth for all Variables

	ANXIETY Male					
	No Anxiety n=4588		Yes Anxiety n=5646		Total n=10234	
	n	%	n	%	n	%
DEPRESSION						
No depression	4072	88.8	1777	31.5	5849	57.2
Yes depression	516	11.2	3869	68.5	4385	42.8
SLEEP						
Sufficient sleep	2536	55.3	2007	35.5	4543	44.4
Insufficient sleep	2052	44.7	3639	64.5	5691	55.6
PHYSICAL ACTIVITY						
Sufficient physical activity	904	19.7	991	17.6	1895	18.5
Insufficient physical activity	3684	80.3	4655	82.4	8339	81.5
CIGARETTES						
Never users	3531	77.0	3895	69.0	7426	72.6
Infrequent users	616	13.4	980	17.4	1596	15.6
Current users	441	9.6	771	13.7	1212	11.8
E-CIGARETTES						
Never users	3363	73.3	3756	66.5	7119	69.6
Infrequent users	540	11.8	782	13.9	1322	12.9
Current users	685	14.9	1108	19.6	1793	17.5
MARIJUANA						
Never users	2777	60.5	2778	49.2	5555	54.3
Infrequent users	756	16.5	1059	18.8	1815	17.7
Current users	1055	23.0	1809	32.0	2864	28.0
ALCOHOL CONSUMPTION						
Non-drinkers	1432	31.2	1414	25.0	2846	27.8
Non-binge drinkers	1611	35.1	2196	38.9	3807	37.2
Binge drinkers	1545	33.7	2036	36.1	3581	35.0
STRESS						
Low or average stress	3403	74.2	1765	31.3	5168	50.5
High stress	1185	25.8	3881	68.7	5066	49.5
SEXUAL VIOLENCE						
No sexual violence	4373	95.3	5183	91.8	9556	93.4
Yes sexual violence	215	4.7	463	8.2	678	6.6
SEXUAL ORIENTATION						
Straight/heterosexual	4292	93.5	4778	84.6	9070	88.6
Another sexual orientation	296	6.5	868	15.4	1164	11.4
ETHNICITY						
White ethnicity	2211	48.2	2939	52.1	5150	50.3
Ethnic minority	2377	51.8	2707	47.9	5084	49.7
INTERNATIONAL STATUS						
Not international	3751	81.8	4882	86.5	8633	84.4
Yes international	837	18.2	764	13.5	1601	15.6
ENROLLMENT STATUS						
Full-time	4588	100.0	5646	100.0	10234	100.0
YEAR OF STUDY						

1st year undergraduate	1606	35.0	1787	31.7	3393	33.2
2nd year undergraduate	1289	28.1	1594	28.2	2883	28.2
3rd year undergraduate	886	19.3	1149	20.4	2035	19.9
4th year undergraduate	590	12.9	801	14.2	1391	13.6
5th year undergraduate or more	217	4.7	315	5.6	532	5.2
AGE IN YEARS						
18	701	15.3	767	13.6	1468	14.3
19	964	21.0	1080	19.1	2044	20.0
20	864	18.8	1127	20.0	1991	19.5
21	729	15.9	950	16.8	1679	16.4
22	549	12.0	717	12.7	1266	12.4
23	339	7.4	475	8.4	814	8.0
24	235	5.1	307	5.4	542	5.3
25	207	4.5	223	3.9	430	4.2

APPENDIX H: CHI-SQUARE STATISTICS

TABLE 2.1 Chi-Square test for DEPRESSION & ANXIETY

DEPENDENT VARIABLES n=34874	No Anxiety n	%	Yes Anxiety n	%	Total n	%	*Pearson Chi-square (df)*	*Significance p*	*Phi ϕ*
No Depression	8969	88.6	7301	29.5	16270	46.7	*10083.711 (1)*	*.000*	*.538*
Yes Depression	1154	11.4	17450	70.5	18604	53.3			
Total	10123	100.0	24751	100.00	34874	100.00			

Conclusion: Statistically significant association with a moderate effect at .538 for depression and anxiety. Co-occurring depression and anxiety is common among Canadian post-secondary undergraduate students with 50% or 17450 students reporting both depression and anxiety.

TABLE 2.2 Chi-Square test for SEX AT BIRTH for dependent, independent variables, and covariates

	Female n =24640 n	%	Male n=10234 n	%	Total n=34874 n	%	*Pearson Chi-square (df)*	*Significance p*	*Phi ϕ*
DEPENDENT VARIABLES									
DEPRESSION									
No depression	10421	42.3	5849	57.2	16270	46.7	*641.518 (1)*	*<.001*	*-.136*
Yes depression	14219	57.7	4385	42.8	18604	53.3			
ANXIETY									
No anxiety	5535	22.5	4588	44.8	10123	29.0	*1755.982 (1)*	*.000*	*-.224*
Yes anxiety	19105	77.5	5646	55.2	24751	71.0			
INDEPENDENT VARIABLES									
SLEEP									
Sufficient	8373	34.0	4543	44.4	12916	37.0	*336.017 (1)*	*<.001*	*-.098*
Insufficient	16267	66.0	5691	55.6	21958	63.0			
PHYSICAL ACTIVITY									
Sufficient	2723	11.1	1895	18.5	4618	13.2	*350.791 (1)*	*<.001*	*-.100*
Insufficient	21917	88.9	8339	81.5	30256	86.8			
CIGARETTES									
Never users	18950	76.9	7426	72.6	26376	75.6	*104.865 (2)*	*<.001*	*.055*
Infrequent users	3578	14.5	1596	15.6	5174	14.8			
Current users	2112	8.6	1212	11.8	3324	9.5			
E-CIGARETTES									
Never users	19265	78.2	7119	69.6	26384	75.7	*336.497 (2)*	*<.001*	*.098*
Infrequent users	2662	10.8	1322	12.9	3984	11.4			
Current users	2713	11.0	1793	17.5	4506	12.9			
MARIJUANA									
Never users	13371	54.3	5555	54.3	18926	54.3	*35.087 (2)*	*<.001*	*.032*
Infrequent users	4945	20.1	1815	17.7	6760	19.4			
Current users	6324	25.7	2864	28.0	9188	26.3			
ALCOHOL CONSUMPTION									
Non-drinkers	5441	22.1	2846	27.8	8287	23.8	*276.745 (2)*	*<.001*	*.089*
Non-binge drinkers	11488	46.6	3807	37.2	15295	43.9			

Binge drinkers	7711	31.3	3581	35.0	11292	32.4			
COVARIATES									
STRESS									
Low/Average	8201	33.3	5168	50.5	13369	38.3	*906.497 (1)*	*<.001*	*-.161*
High	16439	66.7	5066	49.5	21505	61.7			
SEXUAL VIOLENCE									
No sexual violence	19881	80.7	9556	93.4	29437	84.4	*884.708 (1)*	*<.001*	*-.159*
Yes sexual violence	4759	19.3	678	6.6	5437	15.6			
SEXUAL ORIENTATION									
Straight/heterosexual	19820	80.4	9070	88.6	28890	82.8	*341.026 (1)*	*<.001*	*-.099*
Another sexual orientation	4820	19.6	1164	11.4	5984	17.2			
ETHNICITY									
White	14072	57.1	5150	50.3	19222	55.1	*134.677 (1)*	*<.001*	*.062*
Ethnic minority	10568	42.9	5084	49.7	15652	44.9			
INTERNATIONAL STATUS									
Not international student	22199	90.1	8633	84.4	30832	88.4	*232.274 (1)*	*<.001*	*.082*
Yes international student	2441	9.9	1601	15.6	4042	11.6			

TABLE 2.3.1 Chi-square test for DEPRESSION by independent variables and covariates among students identifying as *female* at birth

SEX AT BIRTH: FEMALE	DEPENDENT VARIABLE						*Pearson Chi-square (df)*	*Significance p*	*Phi ϕ*
	No depression		Yes depression		Total				
	n	%	n	%	n	%			
	10421	42.3	14219	57.7	24640	100.0			
INDEPENDENT VARIABLES									
SLEEP									
Sufficient	4742	19.2	3631	14.7	8373	34.0	*1068.810 (1)*	*<.001*	*.208*
Insufficient	5679	23.0	10588	43.0	16267	66.0			
PHYSICAL ACTIVITY									
Sufficient	1308	5.3	1415	5.7	2723	11.1	*41.359 (1)*	*<.001*	*.041*
Insufficient	9113	37.0	12804	52.0	21917	88.9			
CIGARETTES									
Never users	8714	35.4	10236	41.5	18950	76.9	*506.774 (2)*	*<.001*	*.143*
Infrequent users	1199	4.9	2379	9.7	3578	14.5			
Current users	508	2.1	1604	6.5	2112	8.6			
E-CIGARETTES									
Never users	8644	35.1	10621	43.1	19265	78.2	*244.490 (2)*	*<.001*	*.100*
Infrequent users	918	3.7	1744	7.1	2662	10.8			
Current users	859	3.5	1854	7.5	2713	11.0			
MARIJUANA									
Never users	6442	26.1	6929	28.1	13371	54.3	*488.393 (2)*	*<.001*	*.141*
Infrequent users	1969	8.0	2976	12.1	4945	20.1			
Current users	2010	8.2	4314	17.5	6324	25.7			
ALCOHOL CONSUMPTION									
Non-drinkers	2446	9.9	2995	12.2	5441	22.1	*34.833 (2)*	*<.001*	*.038*
Non-binge drinkers	4900	19.9	6588	26.7	11488	46.6			

Binge drinkers	3075	12.5	4636	18.8	7711	31.3			
COVARIATES									
STRESS									
Low/Average	5630	22.8	2571	10.4	8201	33.3	*3498.902 (1)*	*<.001*	*.377*
High	4791	19.4	11648	47.3	16439	66.7			
SEXUAL VIOLENCE									
No sexual violence	9217	37.4	10664	43.3	19881	80.7	*697.897 (1)*	*<.001*	*.168*
Yes sexual violence	1204	4.9	3555	14.4	4759	19.3			
SEXUAL ORIENTATION									
Straight/heterosexual	9265	37.6	10555	42.8	19820	80.4	*823.087 (1)*	*<.001*	*.183*
Another sexual orientation	1156	4.7	3664	14.9	4820	19.6			
ETHNICITY									
White	6245	25.3	7827	31.8	14072	57.1	*58.491 (1)*	*<.001*	*.049*
Ethnic minority	4176	16.9	6392	25.9	10568	42.9			
INTERNATIONAL STATUS									
Not international student	9442	38.3	12757	51.8	22199	90.1	*5.307 (1)*	*.021*	*.015*
Yes international student	979	4.0	1462	5.9	2441	9.9			

TABLE 2.3.2 Chi-square test for DEPRESSION by independent variables and covariates among students identifying as *male* at birth

SEX AT BIRTH: MALE	DEPENDENT VARIABLE						*Pearson Chi-square (df)*	*Significance p*	*Phi ϕ*
	No depression		Yes depression		Total				
	n	%	n	%	n	%			
	5849	57.2	4385	42.8	10234	100.0			
INDEPENDENT VARIABLES									
SLEEP									
Sufficient	3089	30.2	1454	14.2	4543	44.4	*392.162 (1)*	*<.001*	*.196*
Insufficient	2760	27.0	2931	28.6	5691	55.6			
PHYSICAL ACTIVITY									
Sufficient	1147	11.2	748	7.3	1895	18.5	*10.818 (1)*	*<.001*	*.033*
Insufficient	4702	45.9	3637	35.5	8339	81.5			
CIGARETTES									
Never users	4450	43.5	2976	29.1	7426	72.6	*95.802 (2)*	*<.001*	*.097*
Infrequent users	838	8.2	758	7.4	1596	15.6			
Current users	561	5.5	651	6.4	1212	11.8			
E-CIGARETTES									
Never users	4197	41.0	2922	28.6	7119	69.6	*33.836 (2)*	*<.001*	*.058*
Infrequent users	724	7.1	598	5.8	1322	12.9			
Current users	928	9.1	865	8.5	1793	17.5			
MARIJUANA									
Never users	3415	33.4	2140	20.9	5555	54.3	*121.108 (2)*	*<.001*	*.109*
Infrequent users	1032	10.1	783	7.7	1815	17.7			
Current users	1402	13.7	1462	14.3	2864	28.0			
ALCOHOL CONSUMPTION									
Non-drinkers	1710	16.7	1136	11.1	2846	27.8	*16.366 (2)*	*<.001*	*.040*

Non-binge drinkers	2099	20.5	1708	16.7	3807	37.2			
Binge drinkers	2040	19.9	1541	15.1	3581	35.0			
COVARIATES									
STRESS									
Low/Average	3929	38.4	1239	12.1	5168	50.5	*1518.519 (1)*	*<.001*	*.385*
High	1920	18.8	3146	30.7	5066	49.5			
SEXUAL VIOLENCE									
No sexual violence	5569	54.4	3987	39.0	9556	93.4	*74.534 (1)*	*<.001*	*.085*
Yes sexual violence	280	2.7	398	3.9	678	6.6			
SEXUAL ORIENTATION									
Straight/heterosexual	5389	52.7	3681	36.0	9070	88.6	*166.770 (1)*	*<.001*	*.128*
Another sexual orientation	460	4.5	704	6.9	1164	11.4			
ETHNICITY									
White	3034	29.6	2116	20.7	5150	50.3	*13.113 (1)*	*<.001*	*.036*
Ethnic minority	2815	27.5	2269	22.2	5084	49.7			
INTERNATIONAL STATUS									
Not international student	4960	48.5	3673	35.9	8633	84.4	*2.046 (1)*	*.153*	*.014*
Yes international student	889	8.7	712	7.0	1601	15.6			

TABLE 2.4.1 Chi-square test for ANXIETY by independent variables and covariates among students identifying as *female* at birth

	DEPENDENT VARIABLE								
SEX AT BIRTH: FEMALE	No anxiety		Yes anxiety		Total		*Pearson*	*Significance*	*Phi*
	n	%	n	%	n	%	*Chi-square (df)*	*p*	ϕ
	5535	22.5	19105	77.5	24640	100.0			
INDEPENDENT VARIABLES									
SLEEP									
Sufficient	2744	11.1	5629	22.8	8373	34.0	*773.793 (1)*	*<.001*	*.177*
Insufficient	2791	11.3	13476	54.7	16267	66.0			
PHYSICAL ACTIVITY									
Sufficient	700	2.8	2023	8.2	2723	11.1	*18.490 (1)*	*<.001*	*.027*
Insufficient	4835	19.6	17082	69.3	21917	88.9			
CIGARETTES									
Never users	4717	19.1	14233	57.8	18950	76.9	*284.962 (2)*	*<.001*	*.108*
Infrequent users	555	2.3	3023	12.3	3578	14.5			
Current users	263	1.1	1849	7.5	2112	8.6			
E-CIGARETTES									
Never users	4688	19.0	14577	59.2	19265	78.2	*185.188 (2)*	*<.001*	*.087*
Infrequent users	462	1.9	2200	8.9	2662	10.8			
Current users	385	1.6	2328	9.4	2713	11.0			
MARIJUANA									
Never users	3722	15.1	9649	39.2	13371	54.3	*510.253 (2)*	*<.001*	*.144*
Infrequent users	907	3.7	4038	16.4	4945	20.1			
Current users	906	3.7	5418	22.0	6324	25.7			
ALCOHOL CONSUMPTION									
Non-drinkers	1568	6.4	3873	15.7	5441	22.1	*167.877 (2)*	*<.001*	*.083*

Non-binge drinkers	2443	9.9	9045	36.7	11488	46.6			
Binge drinkers	1524	6.2	6187	25.1	7711	31.3			
COVARIATES									
STRESS									
Low/Average	3786	15.4	4415	17.9	8201	33.3	*3964.653 (1)*	*<.001*	*.401*
High	1749	7.1	14690	59.6	16439	66.7			
SEXUAL VIOLENCE									
No sexual violence	4953	20.1	14928	60.6	19881	80.7	*354.672 (1)*	*<.001*	*.120*
Yes sexual violence	582	2.4	4177	17.0	4759	19.3			
SEXUAL ORIENTATION									
Straight/heterosexual	4964	20.1	14856	60.3	19820	80.4	*387.797 (1)*	*<.001*	*.125*
Another sexual orientation	571	2.3	4249	17.2	4820	19.6			
ETHNICITY									
White	2899	11.8	11173	45.3	14072	57.1	*65.330 (1)*	*<.001*	*-.051*
Ethnic minority	2636	10.7	7932	32.2	10568	42.9			
INTERNATIONAL STATUS									
Not international student	4715	19.1	17484	71.0	22199	90.1	*192.676 (1)*	*<.001*	*-.088*
Yes international student	820	3.3	1621	6.6	2441	9.9			

TABLE 2.4.2 Chi-square test for ANXIETY by independent variables and covariates among students identifying as *male* at birth

SEX AT BIRTH: MALE	DEPENDENT VARIABLE						*Pearson*	*Significance*	*Phi*
	No anxiety		Yes anxiety		Total				
	n	%	n	%	n	%	*Chi-square (df)*	*p*	ϕ
	4588	44.8	5646	55.2	10234	100.0			
INDEPENDENT VARIABLES									
SLEEP									
Sufficient	2536	24.8	2007	19.6	4543	44.4	*399.039 (1)*	*<.001*	*.197*
Insufficient	2052	20.1	3639	35.6	5691	55.6			
PHYSICAL ACTIVITY									
Sufficient	904	8.8	991	9.7	1895	18.5	*7.764 (1)*	*.005*	*.028*
Insufficient	3684	36.0	4655	45.5	8339	81.5			
CIGARETTES									
Never users	3531	34.5	3895	38.1	7426	72.6	*82.213 (2)*	*<.001*	*.090*
Infrequent users	616	6.0	980	9.6	1596	15.6			
Current users	441	4.3	771	7.5	1212	11.8			
E-CIGARETTES									
Never users	3363	32.9	3756	36.7	7119	69.6	*57.020 (2)*	*<.001*	*.075*
Infrequent users	540	5.3	782	7.6	1322	12.9			
Current users	685	6.7	1108	10.8	1793	17.5			
MARIJUANA									
Never users	2777	27.1	2778	27.1	5555	54.3	*141.220 (2)*	*<.001*	*.117*
Infrequent users	756	7.4	1059	10.3	1815	17.7			
Current users	1055	10.3	1809	17.7	2864	28.0			
ALCOHOL CONSUMPTION									
Non-drinkers	1432	14.0	1414	13.8	2846	27.8	*48.471 (2)*	*<.001*	*.069*

Non-binge drinkers	1611	15.7	2196	21.5	3807	37.2			
Binge drinkers	1545	15.1	2036	19.9	3581	35.0			
COVARIATES									
STRESS									
Low/Average	3403	33.3	1765	17.2	5168	50.5	*1864.459 (1)*	*<.001*	*.427*
High	1185	11.6	3881	37.9	5066	49.5			
SEXUAL VIOLENCE									
No sexual violence	4373	42.7	5183	50.6	9556	93.4	*50.535 (1)*	*<.001*	*.070*
Yes sexual violence	215	2.1	463	4.5	678	6.6			
SEXUAL ORIENTATION									
Straight/heterosexual	4292	41.9	4778	46.7	9070	88.6	*199.887 (1)*	*<.001*	*.140*
Another sexual orientation	296	2.9	868	8.5	1164	11.4			
ETHNICITY									
White	2211	21.6	2939	28.7	5150	50.3	*15.114 (1)*	*<.001*	*-.038*
Ethnic minority	2377	23.2	2707	26.5	5084	49.7			
INTERNATIONAL STATUS									
Not international student	3751	36.7	4882	47.7	8633	84.4	*42.578 (1)*	*<.001*	*-.065*
Yes international student	837	8.2	764	7.5	1601	15.6			

APPENDIX I: LOGISTIC REGRESSION MODELS

UNIVARIATE LOGISTIC REGRESSION MODELS

TABLE 3.1 Univariate Logistic Regression for DEPRESSION for each independent variable and each covariate (individually)

Column 3.1.1 Complete sample

Column 3.1.2 Females

Column 3.1.3 Males

DEPRESSION												
	Column 3.1.1, *Complete sample* n=34874				Column 3.1.2, *Females* n=24640				Column 3.1.3, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Insufficient sleep	2.47	2.36	2.58	**.000**	2.44	2.31	2.57	**<.001**	2.26	2.08	2.45	**<.001**
Insufficient physical activity	1.35	1.27	1.44	**<.001**	1.30	1.20	1.41	**<.001**	1.19	1.07	1.31	**.001**
Infrequent cigarette use	1.53	1.44	1.63	**<.001**	1.69	1.57	1.82	**<.001**	1.35	1.21	1.51	**<.001**
Current cigarette use	2.10	1.95	2.27	**<.001**	2.69	2.42	2.98	**<.001**	1.74	1.54	1.96	**<.001**
Infrequent e-cigarette use	1.35	1.26	1.45	**<.001**	1.55	1.42	1.68	**<.001**	1.19	1.05	1.34	**.005**
Current e-cigarette use	1.44	1.35	1.54	**<.001**	1.76	1.61	1.91	**<.001**	1.34	1.21	1.49	**<.001**
Infrequent marijuana use	1.36	1.29	1.44	**<.001**	1.41	1.32	1.50	**<.001**	1.21	1.09	1.35	**<.001**
Current marijuana use	1.84	1.75	1.94	**<.001**	2.00	1.87	2.13	**<.001**	1.66	1.52	1.82	**<.001**
Non-binge drinker	1.19	1.13	1.26	**<.001**	1.10	1.03	1.17	**.005**	1.23	1.11	1.35	**<.001**
Binge drinker	1.22	1.15	1.29	**<.001**	1.23	1.15	1.32	**<.001**	1.14	1.03	1.26	**.012**
COVARIATES												
Stress (high)	5.53	5.28	5.80	**<.001**	5.32	5.03	5.64	**<.001**	5.20	4.77	5.66	**<.001**
Sexual violence (yes)	2.69	2.52	2.87	**<.001**	2.55	2.38	2.74	**<.001**	1.99	1.70	2.33	**<.001**
Sexual orientation (other)	2.78	2.62	2.96	**<.001**	2.78	2.59	2.99	**<.001**	2.24	1.98	2.54	**<.001**
Ethnic minority	1.16	1.11	1.21	**<.001**	1.22	1.16	1.29	**<.001**	1.16	1.07	1.25	**<.001**
International student	1.02	0.96	1.09	.552	1.11	1.02	1.20	**.021**	1.08	0.97	1.20	.153

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 4.1 Univariate Logistic Regression for ANXIETY for each independent variable and each covariate (individually)

Column 4.1.1 Complete sample

Column 4.1.2 Females

Column 4.1.3 Males

ANXIETY												
	Column 4.1.1, *Complete sample* n=34874				Column 4.1.2, *Females* n=24640				Column 4.1.3, *Males* n=10234			
	Exp(B) Odds	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds	95% CI Lower	95% CI Upper	*Signif p*

	Ratio				Ratio				Ratio			
INDEPENDENT VARIABLES												
Insufficient sleep	2.44	2.33	2.56	**<.001**	2.35	2.21	2.50	**<.001**	2.24	2.07	2.43	**<.001**
Insufficient physical activity	1.36	1.27	1.45	**<.001**	1.22	1.12	1.34	**<.001**	1.15	1.04	1.27	**.005**
Infrequent cigarette use	1.56	1.45	1.67	**<.001**	1.81	1.64	1.99	**<.001**	1.44	1.29	1.61	**<.001**
Current cigarette use	1.69	1.55	1.85	**<.001**	2.33	2.04	2.66	**<.001**	1.59	1.40	1.80	**<.001**
Infrequent e-cigarette use	1.31	1.21	1.41	**<.001**	1.53	1.38	1.70	**<.001**	1.30	1.15	1.46	**<.001**
Current e-cigarette use	1.41	1.31	1.52	**<.001**	1.95	1.74	2.18	**<.001**	1.45	1.30	1.61	**<.001**
Infrequent marijuana use	1.60	1.51	1.71	**<.001**	1.72	1.58	1.86	**<.001**	1.40	1.26	1.56	**<.001**
Current marijuana use	1.93	1.82	2.04	**<.001**	2.31	2.13	2.50	**<.001**	1.71	1.56	1.88	**<.001**
Non-binge drinker	1.57	1.49	1.67	**<.001**	1.50	1.39	1.61	**<.001**	1.38	1.25	1.52	**<.001**
Binge drinker	1.52	1.43	1.62	**<.001**	1.64	1.52	1.78	**<.001**	1.34	1.21	1.47	**<.001**
COVARIATES												
Stress (high)	7.36	6.99	7.75	**<.001**	7.20	6.74	7.69	**<.001**	6.32	5.79	6.89	**<.001**
Sexual violence (yes)	2.70	2.50	2.92	**<.001**	2.38	2.17	2.61	**<.001**	1.82	1.54	2.15	**<.001**
Sexual orientation (other)	2.78	2.58	3.00	**<.001**	2.49	2.27	2.73	**<.001**	2.63	2.29	3.03	**<.001**
Ethnic minority	0.77	0.73	0.81	**<.001**	0.78	0.74	0.83	**<.001**	0.86	0.79	0.93	**<.001**
International student	0.55	0.51	0.58	**<.001**	0.53	0.49	0.58	**<.001**	0.70	0.63	0.78	**<.001**

Bolded *p* values are statistically significant at *p* less than .05.

ADJUSTED LOGISTIC REGRESSION MODELS

Adjusted Logistic Regression for DEPRESSION for each independent variable and covariates

Column 5.1.1 Complete sample

Column 5.1.2 Females

Column 5.1.3 Males

TABLE 5.1A Depression and sleep and all covariates

DEPRESSION												
	Column 5.1.1A, *Complete sample* n=34874				Column 5.1.2A, *Females* n=24640				Column 5.1.3A, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*
INDEPENDENT VARIABLES												
Insufficient sleep	1.79	1.70	1.88	**<.001**	1.81	1.70	1.917	**<.001**	1.67	1.53	1.83	**<.001**
COVARIATES												
Stress (high)	4.85	4.61	5.10	**<.001**	4.70	4.42	5.00	**<.001**	4.83	4.42	5.29	**<.001**
Sexual violence (yes)	2.17	2.02	2.33	**<.001**	2.17	2.01	2.35	**<.001**	1.71	1.44	2.04	**<.001**
Sexual orientation (other)	2.28	2.13	2.44	**<.001**	2.39	2.21	2.58	**<.001**	1.83	1.59	2.10	**<.001**
Ethnic minority	1.37	1.30	1.44	**<.001**	1.41	1.33	1.50	**<.001**	1.32	1.20	1.44	**<.001**
International student	1.40	1.30	1.52	**<.001**	1.51	1.37	1.67	**<.001**	1.32	1.16	1.50	**<.001**

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 5.1B Depression and physical activity and all covariates

DEPRESSION												
	Column 5.1.1B, *Complete sample* n=34874				Column 5.1.2B, *Females* n=24640				Column 5.1.3B, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*
INDEPENDENT VARIABLES												
Insufficient physical activity	1.24	1.16	1.33	**<.001**	1.24	1.13	1.36	**<.001**	1.13	1.01	1.26	**.034**
COVARIATES												
Stress (high)	5.39	5.13	5.67	**<.001**	5.22	4.91	5.54	**<.001**	5.34	4.89	5.83	**<.001**
Sexual violence (yes)	2.23	2.08	2.39	**<.001**	2.23	2.06	2.41	**<.001**	1.73	1.45	2.06	**<.001**
Sexual orientation (other)	2.27	2.13	2.43	**<.001**	2.39	2.21	2.58	**<.001**	1.81	1.58	2.07	**<.001**
Ethnic minority	1.40	1.33	1.47	**<.001**	1.44	1.36	1.53	**<.001**	1.34	1.22	1.47	**<.001**
International student	1.34	1.24	1.45	**<.001**	1.45	1.32	1.61	**<.001**	1.28	1.13	1.45	**<.001**

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 5.1C Depression and cigarette use and all covariates

DEPRESSION												
	Column 5.1.1C, *Complete sample* n=34874				Column 5.1.2C, *Females* n=24640				Column 5.1.3C, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*
INDEPENDENT VARIABLES												
Infrequent cigarette use	1.40	1.31	1.50	**<.001**	1.51	1.39	1.64	**<.001**	1.30	1.15	1.46	**<.001**
Current cigarette use	1.80	1.65	1.96	**<.001**	2.13	1.90	2.38	**<.001**	1.61	1.40	1.84	**<.001**
COVARIATES												
Stress (high)	5.38	5.12	5.65	**<.001**	5.16	4.86	5.48	**<.001**	5.29	4.85	5.78	**<.001**
Sexual violence (yes)	2.09	1.94	2.24	**<.001**	2.04	1.89	2.21	**<.001**	1.60	1.34	1.91	**<.001**
Sexual orientation (other)	2.26	2.11	2.41	**<.001**	2.33	2.15	2.52	**<.001**	1.82	1.59	2.09	**<.001**
Ethnic minority	1.47	1.40	1.55	**<.001**	1.53	1.44	1.62	**<.001**	1.41	1.28	1.55	**<.001**
International student	1.34	1.24	1.45	**<.001**	1.46	1.32	1.61	**<.001**	1.27	1.12	1.44	**<.001**

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 5.1D Depression and e-cigarette use and all covariates

DEPRESSION												
	Column 5.1.1D, *Complete sample* n=34874				Column 5.1.2D, *Females* n=24640				Column 5.1.3D, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*
INDEPENDENT VARIABLES												
Infrequent e-cigarette use	1.25	1.16	1.35	**<.001**	1.37	1.24	1.50	**<.001**	1.15	1.01	1.31	**.033**
Current e-cigarette use	1.35	1.26	1.45	**<.001**	1.53	1.39	1.69	**<.001**	1.29	1.15	1.45	**<.001**
COVARIATES												
Stress (high)	5.40	5.14	5.67	**<.001**	5.19	4.88	5.51	**<.001**	5.31	4.86	5.80	**<.001**

Sexual violence (yes)	2.14	1.99	2.29	**<.001**	2.09	1.93	2.26	**<.001**	1.66	1.39	1.97	**<.001**
Sexual orientation (other)	2.30	2.15	2.46	**<.001**	2.39	2.21	2.58	**<.001**	1.85	1.61	2.11	**<.001**
Ethnic minority	1.46	1.38	1.53	**<.001**	1.52	1.43	1.61	**<.001**	1.39	1.27	1.53	**<.001**
International student	1.37	1.27	1.49	**<.001**	1.49	1.35	1.65	**<.001**	1.31	1.15	1.49	**<.001**

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 5.1E Depression and marijuana use and all covariates

DEPRESSION												
	Column 5.1.1E, *Complete sample* n=34874				Column 5.1.2E, *Females* n=24640				Column 5.1.3E, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*
INDEPENDENT VARIABLES												
Infrequent marijuana use	1.21	1.14	1.29	**<.001**	1.24	1.15	1.34	**<.001**	1.17	1.04	1.32	**.010**
Current marijuana use	1.57	1.48	1.66	**<.001**	1.63	1.51	1.75	**<.001**	1.59	1.43	1.76	**<.001**
COVARIATES												
Stress (high)	5.34	5.08	5.61	**<.001**	5.12	4.82	5.44	**<.001**	5.26	4.81	5.74	**<.001**
Sexual violence (yes)	2.05	1.91	2.20	**<.001**	2.02	1.87	2.18	**<.001**	1.60	1.34	1.90	**<.001**
Sexual orientation (other)	2.24	2.09	2.39	**<.001**	2.32	2.14	2.51	**<.001**	1.80	1.57	2.07	**<.001**
Ethnic minority	1.51	1.43	1.59	**<.001**	1.56	1.47	1.66	**<.001**	1.45	1.32	1.60	**<.001**
International student	1.42	1.32	1.54	**<.001**	1.55	1.40	1.71	**<.001**	1.35	1.19	1.54	**<.001**

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 5.1F Depression and binge drinking and all covariates

DEPRESSION												
	Column 5.1.1F, *Complete sample* n=34874				Column 5.1.2F, *Females* n=24640				Column 5.1.3F, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	Upper	*Signif p*
INDEPENDENT VARIABLES												
Non-binge drinker	1.05	0.99	1.12	.106	1.00	0.93	1.07	.940	1.15	1.03	1.28	**.017**
Binge drinker	1.10	1.03	1.18	**.005**	1.11	1.02	1.21	**.013**	1.12	1.00	1.26	.051
COVARIATES												
Stress (high)	5.40	5.14	5.67	**<.001**	5.22	4.92	5.55	**<.001**	5.32	4.87	5.81	**<.001**
Sexual violence (yes)	2.19	2.04	2.35	**<.001**	2.17	2.00	2.34	**<.001**	1.71	1.43	2.03	**<.001**
Sexual orientation (other)	2.30	2.15	2.46	**<.001**	2.42	2.24	2.61	**<.001**	1.82	1.58	2.08	**<.001**
Ethnic minority	1.44	1.37	1.52	**<.001**	1.49	1.40	1.58	**<.001**	1.38	1.26	1.52	**<.001**
International student	1.37	1.27	1.48	**<.001**	1.47	1.33	1.63	**<.001**	1.31	1.15	1.49	**<.001**

Bolded *p* values are statistically significant at *p* less than .05.

Adjusted Logistic Regression for ANXIETY for each independent variable and covariates

Column 6.1.1 Complete sample

Column 6.1.2 Females

Column 6.1.3 Males

TABLE 6.1A Anxiety and sleep and all covariates

ANXIETY												
	Column 6.1.1A, *Complete sample* n=34874				Column 6.1.2A, *Females* n=24640				Column 6.1.3A, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Insufficient sleep	1.67	1.58	1.76	**<.001**	1.61	1.51	1.73	**<.001**	1.62	1.48	1.77	**<.001**
COVARIATES												
Stress (high)	5.99	5.68	6.32	**<.001**	5.92	5.53	6.34	**<.001**	5.52	5.04	6.03	**<.001**
Sexual violence (yes)	1.93	1.77	2.11	**<.001**	1.73	1.57	1.91	**<.001**	1.52	1.27	1.84	**<.001**
Sexual orientation (other)	2.11	1.94	2.29	**<.001**	1.92	1.74	2.12	**<.001**	2.16	1.86	2.52	**<.001**
Ethnic minority	0.94	0.89	0.99	**.030**	0.93	0.87	1.00	**.044**	1.02	0.93	1.12	.659
International student	0.78	0.72	0.85	**<.001**	0.76	0.69	0.85	**<.001**	0.89	0.79	1.01	.077

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 6.1B Anxiety and physical activity and all covariates

ANXIETY												
	Column 6.1.1B, *Complete sample* n=34874				Column 6.1.2B, *Females* n=24640				Column 6.1.3B, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Insufficient physical activity	1.35	1.25	1.45	**<.001**	1.25	1.13	1.39	**<.001**	1.16	1.03	1.29	**.012**
COVARIATES												
Stress (high)	6.60	6.27	6.96	**<.001**	6.48	6.06	6.93	**<.001**	6.06	5.55	6.62	**<.001**
Sexual violence (yes)	1.99	1.83	2.17	**<.001**	1.78	1.61	1.97	**<.001**	1.55	1.29	1.86	**<.001**
Sexual orientation (other)	2.10	1.93	2.28	**<.001**	1.93	1.74	2.13	**<.001**	2.13	1.83	2.48	**<.001**
Ethnic minority	0.95	0.90	1.01	.090	0.95	0.89	1.02	.143	1.04	0.95	1.14	.436
International student	0.76	0.70	0.82	**<.001**	0.75	0.67	0.83	**<.001**	0.87	0.76	0.98	**.026**

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 6.1C Anxiety and cigarette use and all covariates

ANXIETY	Column 6.1.1C, *Complete sample* n=34874				Column 6.1.2C, *Females* n=24640				Column 6.1.3C, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Infrequent cigarette use	1.29	1.19	1.39	**<.001**	1.47	1.33	1.64	**<.001**	1.29	1.14	1.46	**<.001**
Current cigarette use	1.34	1.21	1.47	**<.001**	1.68	1.46	1.94	**<.001**	1.42	1.23	1.63	**<.001**
COVARIATES												
Stress (high)	6.58	6.24	6.94	**<.001**	6.41	6.00	6.86	**<.001**	6.01	5.50	6.56	**<.001**
Sexual violence (yes)	1.90	1.74	2.07	**<.001**	1.65	1.49	1.83	**<.001**	1.45	1.20	1.74	**<.001**
Sexual orientation (other)	2.11	1.94	2.29	**<.001**	1.89	1.71	2.09	**<.001**	2.15	1.85	2.50	**<.001**
Ethnic minority	1.00	0.94	1.05	.910	1.00	0.93	1.07	.917	1.09	0.99	1.20	.079
International student	0.76	0.70	0.83	**<.001**	0.75	0.67	0.83	**<.001**	0.87	0.76	0.98	**.026**

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 6.1D Anxiety and e-cigarette use and all covariates

ANXIETY	Column 6.1.1D, *Complete sample* n=34874				Column 6.1.2D, *Females* n=24640				Column 6.1.3D, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Infrequent e-cigarette use	1.09	1.00	1.18	.059	1.22	1.09	1.37	**<.001**	1.19	1.04	1.36	**.011**
Current e-cigarette use	1.16	1.07	1.26	**<.001**	1.51	1.34	1.71	**<.001**	1.30	1.15	1.46	**<.001**
COVARIATES												
Stress (high)	6.61	6.27	6.97	**<.001**	6.45	6.03	6.89	**<.001**	6.02	5.51	6.58	**<.001**
Sexual violence (yes)	1.94	1.78	2.12	**<.001**	1.68	1.52	1.86	**<.001**	1.47	1.22	1.77	**<.001**
Sexual orientation (other)	2.13	1.96	2.31	**<.001**	1.93	1.75	2.14	**<.001**	2.18	1.87	2.53	**<.001**
Ethnic minority	0.99	0.93	1.04	.603	0.99	0.93	1.07	.831	1.08	0.99	1.19	.095
International student	0.77	0.71	0.83	**<.001**	0.76	0.69	0.85	**<.001**	0.89	0.78	1.01	.071

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 6.1E Anxiety and marijuana use and all covariates

ANXIETY	Column 6.1.1E, *Complete sample* n=34874				Column 6.1.2E, *Females* n=24640				Column 6.1.3E, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Infrequent marijuana use	1.28	1.19	1.38	**<.001**	1.37	1.25	1.50	**<.001**	1.24	1.10	1.41	**<.001**
Current marijuana use	1.42	1.33	1.52	**<.001**	1.66	1.52	1.81	**<.001**	1.45	1.31	1.61	**<.001**
COVARIATES												

Stress (high)	6.53	6.20	6.89	**<.001**	6.36	5.95	6.80	**<.001**	5.97	5.47	6.52	**<.001**
Sexual violence (yes)	1.85	1.69	2.01	**<.001**	1.59	1.44	1.76	**<.001**	1.44	1.19	1.73	**<.001**
Sexual orientation (other)	2.08	1.92	2.26	**<.001**	1.87	1.69	2.06	**<.001**	2.14	1.84	2.48	**<.001**
Ethnic minority	1.03	0.97	1.09	.346	1.04	0.97	1.11	.326	1.12	1.02	1.23	**.022**
International student	0.80	0.74	0.87	**<.001**	0.80	0.72	0.89	**<.001**	0.92	0.81	1.04	.180

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 6.1F Anxiety and binge drinking and all covariates

ANXIETY												
	Column 6.1.1F, *Complete sample* n=34874				Column 6.1.2F, *Females* n=24640				Column 6.1.3F, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Non-binge drinker	1.22	1.14	1.30	**<.001**	1.18	1.08	1.28	**<.001**	1.17	1.05	1.31	**.006**
Binge drinker	1.14	1.06	1.22	**<.001**	1.21	1.10	1.34	**<.001**	1.15	1.03	1.30	**.017**
COVARIATES												
Stress (high)	6.58	6.24	6.93	**<.001**	6.46	6.04	6.90	**<.001**	6.03	5.52	6.59	**<.001**
Sexual violence (yes)	1.96	1.80	2.14	**<.001**	1.73	1.56	1.91	**<.001**	1.52	1.26	1.83	**<.001**
Sexual orientation (other)	2.12	1.95	2.30	**<.001**	1.94	1.76	2.15	**<.001**	2.14	1.84	2.49	**<.001**
Ethnic minority	1.00	0.95	1.06	.894	1.01	0.94	1.08	.854	1.08	0.98	1.19	.109
International student	0.78	0.72	0.85	**<.001**	0.77	0.69	0.86	**<.001**	0.89	0.79	1.01	.078

Bolded *p* values are statistically significant at *p* less than .05.

LOGISTIC REGRESSION FULL MODELS

TABLE 7.1 Logistic Regression for DEPRESSION (Full model)

Column 7.1.1 Complete sample

Column 7.1.2 Females

Column 7.1.3 Males

DEPRESSION												
	Column 7.1.1, *Complete sample* n=34874				Column 7.1.2, *Females* n=24640				Column 7.1.3, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Insufficient sleep	1.78	1.70	1.87	**<.001**	1.80	1.69	1.91	**<.001**	1.67	1.53	1.83	**<.001**
Insufficient physical activity	1.20	1.12	1.29	**<.001**	1.18	1.07	1.29	**<.001**	1.11	0.99	1.24	.073
Infrequent cigarette use	1.29	1.19	1.40	**<.001**	1.32	1.20	1.45	**<.001**	1.23	1.06	1.42	**.007**
Current cigarette use	1.61	1.46	1.77	**<.001**	1.80	1.59	2.05	**<.001**	1.44	1.22	1.69	**<.001**
Infrequent e-cigarette use	0.98	0.90	1.07	.625	1.06	0.95	1.18	.276	0.90	0.77	1.05	.168
Current e-cigarette use	0.97	0.89	1.06	.464	1.08	0.96	1.20	.190	0.91	0.79	1.06	.236
Infrequent marijuana use	1.16	1.09	1.25	**<.001**	1.16	1.07	1.26	**<.001**	1.15	1.01	1.32	**.037**
Current marijuana use	1.49	1.39	1.60	**<.001**	1.48	1.36	1.60	**<.001**	1.57	1.38	1.79	**<.001**
Non-binge drinker	0.94	0.88	1.00	.066	0.89	0.82	0.96	**.002**	1.03	0.92	1.16	.643

Binge drinker	0.82	0.76	0.89	**<.001**	0.80	0.73	0.88	**<.001**	0.85	0.74	0.97	**.018**
COVARIATES												
Stress (high)	4.78	4.54	5.03	**<.001**	4.62	4.34	4.90	**.000**	4.74	4.33	5.19	**<.001**
Sexual violence (yes)	2.01	1.87	2.16	**<.001**	1.96	1.80	2.12	**<.001**	1.60	1.34	1.91	**<.001**
Sexual orientation (other)	2.17	2.02	2.32	**<.001**	2.24	2.07	2.42	**<.001**	1.77	1.54	2.03	**<.001**
Ethnic minority	1.42	1.35	1.50	**<.001**	1.47	1.38	1.57	**<.001**	1.38	1.26	1.53	**<.001**
International student	1.42	1.31	1.53	**<.001**	1.53	1.38	1.69	**<.001**	1.35	1.18	1.53	**<.001**

Bolded *p* values are statistically significant at *p* less than .05.

TABLE 8.1 Logistic Regression for ANXIETY (Full model)

Column 8.1.1 Complete sample

Column 8.1.2 Females

Column 8.1.3 Males

ANXIETY												
	Column 8.1.1, *Complete sample* n=34874				Column 8.1.2, *Females* n=24640				Column 8.1.3, *Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Insufficient sleep	1.66	1.57	1.75	**<.001**	1.60	1.50	1.72	**<.001**	1.61	1.47	1.76	**<.001**
Insufficient physical activity	1.32	1.23	1.43	**<.001**	1.21	1.09	1.34	**<.001**	1.15	1.03	1.29	**.017**
Infrequent cigarette use	1.21	1.10	1.33	**<.001**	1.26	1.12	1.43	**<.001**	1.17	1.00	1.36	**.045**
Current cigarette use	1.22	1.09	1.37	**<.001**	1.36	1.16	1.60	**<.001**	1.22	1.03	1.45	**.020**
Infrequent e-cigarette use	0.87	0.79	0.96	**.004**	0.94	0.82	1.07	.321	0.97	0.83	1.13	.688
Current e-cigarette use	0.92	0.83	1.02	.101	1.12	0.97	1.29	.125	1.02	0.87	1.18	.854
Infrequent marijuana use	1.27	1.17	1.37	**<.001**	1.30	1.18	1.44	**<.001**	1.20	1.05	1.37	**.009**
Current marijuana use	1.44	1.33	1.56	**<.001**	1.56	1.41	1.73	**<.001**	1.40	1.23	1.59	**<.001**
Non-binge drinker	1.12	1.05	1.20	**.001**	1.05	0.97	1.15	.247	1.07	0.95	1.20	.278
Binge drinker	0.93	0.86	1.01	.088	0.90	0.81	1.00	.060	0.92	0.80	1.05	.222
COVARIATES												
Stress (high)	5.86	5.56	6.19	**<.001**	5.76	5.38	6.17	**.000**	5.41	4.94	5.92	**<.001**
Sexual violence (yes)	1.82	1.67	1.99	**<.001**	1.55	1.40	1.72	**<.001**	1.43	1.19	1.73	**<.001**
Sexual orientation (other)	2.00	1.84	2.18	**<.001**	1.81	1.63	2.00	**<.001**	2.11	1.81	2.46	**<.001**
Ethnic minority	0.97	0.92	1.03	.369	0.99	0.92	1.06	.699	1.07	0.97	1.18	.157
International student	0.81	0.74	0.88	**<.001**	0.80	0.72	0.89	**<.001**	0.92	0.81	1.05	.197

Bolded *p* values are statistically significant at *p* less than .05.

PROGRESSION COMPARISON FOR LOGISTIC REGRESSION MODELS

Progression comparison through the logistic regression models. 1) Univariate models with each independent variable for depression and separately for anxiety, 2) adjusted models with each independent variable while accounting for covariates including demographic characteristics for depression and separately for anxiety, and 3) final full logistic regression models with all independent variables and covariate (including controlling for various demographic characteristics) for depression and separately for anxiety. U=UNIVARIATE, A=ADJUSTED, FM=FULL MODEL

TABLE 9.1A Progression comparison for Logistic Regression Models for DEPRESSION

DEPRESSION												
Tables 3.1, 5.1 & 7.1	*Complete sample* n=34874				*Females* n=24640				*Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Insufficient sleep Univariate	2.47	2.36	2.58	**.000**	2.44	2.31	2.57	**<.001**	2.26	2.08	2.45	**<.001**
Insufficient sleep Adjusted	1.79	1.70	1.88	**<.001**	1.81	1.70	1.917	**<.001**	1.67	1.53	1.83	**<.001**
Insufficient sleep Full Model	1.78	1.70	1.87	**<.001**	1.80	1.69	1.91	**<.001**	1.67	1.53	1.83	**<.001**
Insufficient physical activity U	1.35	1.27	1.44	**<.001**	1.30	1.20	1.41	**<.001**	1.19	1.07	1.31	**.001**
Insufficient physical activity A	1.24	1.16	1.33	**<.001**	1.24	1.13	1.36	**<.001**	1.13	1.01	1.26	**.034**
Insufficient physical activity FM	1.20	1.12	1.29	**<.001**	1.18	1.07	1.29	**<.001**	1.11	0.99	1.24	.073
Infrequent cigarette use U	1.53	1.44	1.63	**<.001**	1.69	1.57	1.82	**<.001**	1.35	1.21	1.51	**<.001**
Infrequent cigarette use A	1.40	1.31	1.50	**<.001**	1.51	1.39	1.64	**<.001**	1.30	1.15	1.46	**<.001**
Infrequent cigarette use FM	1.29	1.19	1.40	**<.001**	1.32	1.20	1.45	**<.001**	1.23	1.06	1.42	**.007**
Current cigarette use U	2.10	1.95	2.27	**<.001**	2.69	2.42	2.98	**<.001**	1.74	1.54	1.96	**<.001**
Current cigarette use A	1.80	1.65	1.96	**<.001**	2.13	1.90	2.38	**<.001**	1.61	1.40	1.84	**<.001**
Current cigarette use FM	1.61	1.46	1.77	**<.001**	1.80	1.59	2.05	**<.001**	1.44	1.22	1.69	**<.001**
Infrequent e-cigarette use U	1.35	1.26	1.45	**<.001**	1.55	1.42	1.68	**<.001**	1.19	1.05	1.34	**.005**
Infrequent e-cigarette use A	1.25	1.16	1.35	**<.001**	1.37	1.24	1.50	**<.001**	1.15	1.01	1.31	**.033**
Infrequent e-cigarette use FM	0.98	0.90	1.07	.625	1.06	0.95	1.18	.276	0.90	0.77	1.05	.168
Current e-cigarette use U	1.44	1.35	1.54	**<.001**	1.76	1.61	1.91	**<.001**	1.34	1.21	1.49	**<.001**
Current e-cigarette use A	1.35	1.26	1.45	**<.001**	1.53	1.39	1.69	**<.001**	1.29	1.15	1.45	**<.001**
Current e-cigarette use FM	0.97	0.89	1.06	.464	1.08	0.96	1.20	.190	0.91	0.79	1.06	.236
Infrequent marijuana use U	1.36	1.29	1.44	**<.001**	1.41	1.32	1.50	**<.001**	1.21	1.09	1.35	**<.001**
Infrequent marijuana use A	1.21	1.14	1.29	**<.001**	1.24	1.15	1.34	**<.001**	1.17	1.04	1.32	**.010**
Infrequent marijuana use FM	1.16	1.09	1.25	**<.001**	1.16	1.07	1.26	**<.001**	1.15	1.01	1.32	**.037**
Current marijuana use U	1.84	1.75	1.94	**<.001**	2.00	1.87	2.13	**<.001**	1.66	1.52	1.82	**<.001**
Current marijuana use A	1.57	1.48	1.66	**<.001**	1.63	1.51	1.75	**<.001**	1.59	1.43	1.76	**<.001**
Current marijuana use FM	1.49	1.39	1.60	**<.001**	1.48	1.36	1.60	**<.001**	1.57	1.38	1.79	**<.001**
Non-binge drinker U	1.19	1.13	1.26	**<.001**	1.10	1.03	1.17	**.005**	1.23	1.11	1.35	**<.001**
Non-binge drinker A	1.05	0.99	1.12	.106	1.00	0.93	1.07	.940	1.15	1.03	1.28	**.017**
Non-binge drinker FM	0.94	0.88	1.00	.066	0.89	0.82	0.96	**.002**	1.03	0.92	1.16	.643
Binge drinker U	1.22	1.15	1.29	**<.001**	1.23	1.15	1.32	**<.001**	1.14	1.03	1.26	**.012**
Binge drinker A	1.10	1.03	1.18	**.005**	1.11	1.02	1.21	**.013**	1.12	1.00	1.26	.051
Binge drinker FM	0.82	0.76	0.89	**<.001**	0.80	0.73	0.88	**<.001**	0.85	0.74	0.97	**.018**
COVARIATES UNIVARIATE												
Stress (high)	5.53	5.28	5.80	**<.001**	5.32	5.03	5.64	**<.001**	5.20	4.77	5.66	**<.001**

Sexual violence (yes)	2.69	2.52	2.87	**<.001**	2.55	2.38	2.74	**<.001**	1.99	1.70	2.33	**<.001**
Sexual orientation (other)	2.78	2.62	2.96	**<.001**	2.78	2.59	2.99	**<.001**	2.24	1.98	2.54	**<.001**
Ethnic minority	1.16	1.11	1.21	**<.001**	1.22	1.16	1.29	**<.001**	1.16	1.07	1.25	**<.001**
International student	1.02	0.96	1.09	.552	1.11	1.02	1.20	**.021**	1.08	0.97	1.20	.153
COVARIATES FULL MODEL												
Stress (high)	4.78	4.54	5.03	**<.001**	4.62	4.34	4.90	**.000**	4.74	4.33	5.19	**<.001**
Sexual violence (yes)	2.01	1.87	2.16	**<.001**	1.96	1.80	2.12	**<.001**	1.60	1.34	1.91	**<.001**
Sexual orientation (other)	2.17	2.02	2.32	**<.001**	2.24	2.07	2.42	**<.001**	1.77	1.54	2.03	**<.001**
Ethnic minority	1.42	1.35	1.50	**<.001**	1.47	1.38	1.57	**<.001**	1.38	1.26	1.53	**<.001**
International student	1.42	1.31	1.53	**<.001**	1.53	1.38	1.69	**<.001**	1.35	1.18	1.53	**<.001**

Bolded *p* values are statistically significant at *p* less than .05.

All covariates were statistically significant for adjusted models and followed the same pattern.

TABLE 9.1B Progression comparison for Logistic Regression Models for ANXIETY

ANXIETY												
Tables 4.1, 6.1 & 8.1	*Complete sample* n=34874				*Females* n=24640				*Males* n=10234			
	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*	Exp(B) Odds Ratio	95% CI Lower	95% CI Upper	*Signif p*
INDEPENDENT VARIABLES												
Insufficient sleep Univariate	2.44	2.33	2.56	**<.001**	2.35	2.21	2.50	**<.001**	2.24	2.07	2.43	**<.001**
Insufficient sleep Adjusted	1.67	1.58	1.76	**<.001**	1.61	1.51	1.73	**<.001**	1.62	1.48	1.77	**<.001**
Insufficient sleep Full Model	1.66	1.57	1.75	**<.001**	1.60	1.50	1.72	**<.001**	1.61	1.47	1.76	**<.001**
Insufficient physical activity U	1.36	1.27	1.45	**<.001**	1.22	1.12	1.34	**<.001**	1.15	1.04	1.27	**.005**
Insufficient physical activity A	1.35	1.25	1.45	**<.001**	1.25	1.13	1.39	**<.001**	1.16	1.03	1.29	**.012**
Insufficient physical activity FM	1.32	1.23	1.43	**<.001**	1.21	1.09	1.34	**<.001**	1.15	1.03	1.29	**.017**
Infrequent cigarette use U	1.56	1.45	1.67	**<.001**	1.81	1.64	1.99	**<.001**	1.44	1.29	1.61	**<.001**
Infrequent cigarette use A	1.29	1.19	1.39	**<.001**	1.47	1.33	1.64	**<.001**	1.29	1.14	1.46	**<.001**
Infrequent cigarette use FM	1.21	1.10	1.33	**<.001**	1.26	1.12	1.43	**<.001**	1.17	1.00	1.36	**.045**
Current cigarette use U	1.69	1.55	1.85	**<.001**	2.33	2.04	2.66	**<.001**	1.59	1.40	1.80	**<.001**
Current cigarette use A	1.34	1.21	1.47	**<.001**	1.68	1.46	1.94	**<.001**	1.42	1.23	1.63	**<.001**
Current cigarette use FM	1.22	1.09	1.37	**<.001**	1.36	1.16	1.60	**<.001**	1.22	1.03	1.45	**.020**
Infrequent e-cigarette use U	1.31	1.21	1.41	**<.001**	1.53	1.38	1.70	**<.001**	1.30	1.15	1.46	**<.001**
Infrequent e-cigarette use A	1.09	1.00	1.18	.059	1.22	1.09	1.37	**<.001**	1.19	1.04	1.36	**.011**
Infrequent e-cigarette use FM	0.87	0.79	0.96	**.004**	0.94	0.82	1.07	.321	0.97	0.83	1.13	.688
Current e-cigarette use U	1.41	1.31	1.52	**<.001**	1.95	1.74	2.18	**<.001**	1.45	1.30	1.61	**<.001**
Current e-cigarette use A	1.16	1.07	1.26	**<.001**	1.51	1.34	1.71	**<.001**	1.30	1.15	1.46	**<.001**
Current e-cigarette use FM	0.92	0.83	1.02	.101	1.12	0.97	1.29	.125	1.02	0.87	1.18	.854
Infrequent marijuana use U	1.60	1.51	1.71	**<.001**	1.72	1.58	1.86	**<.001**	1.40	1.26	1.56	**<.001**
Infrequent marijuana use A	1.28	1.19	1.38	**<.001**	1.37	1.25	1.50	**<.001**	1.24	1.10	1.41	**<.001**
Infrequent marijuana use FM	1.27	1.17	1.37	**<.001**	1.30	1.18	1.44	**<.001**	1.20	1.05	1.37	**.009**
Current marijuana use U	1.93	1.82	2.04	**<.001**	2.31	2.13	2.50	**<.001**	1.71	1.56	1.88	**<.001**
Current marijuana use A	1.42	1.33	1.52	**<.001**	1.66	1.52	1.81	**<.001**	1.45	1.31	1.61	**<.001**
Current marijuana use FM	1.44	1.33	1.56	**<.001**	1.56	1.41	1.73	**<.001**	1.40	1.23	1.59	**<.001**
Non-binge drinker U	1.57	1.49	1.67	**<.001**	1.50	1.39	1.61	**<.001**	1.38	1.25	1.52	**<.001**
Non-binge drinker A	1.22	1.14	1.30	**<.001**	1.18	1.08	1.28	**<.001**	1.17	1.05	1.31	**.006**

Non-binge drinker FM	1.12	1.05	1.20	**.001**	1.05	0.97	1.15	.247	1.07	0.95	1.20	.278
Binge drinker U	1.52	1.43	1.62	**<.001**	1.64	1.52	1.78	**<.001**	1.34	1.21	1.47	**<.001**
Binge drinker A	1.14	1.06	1.22	**<.001**	1.21	1.10	1.34	**<.001**	1.15	1.03	1.30	**.017**
Binge drinker FM	0.93	0.86	1.01	.088	0.90	0.81	1.00	.060	0.92	0.80	1.05	.222
COVARIATES UNIVARIATE												
Stress (high)	7.36	6.99	7.75	**<.001**	7.20	6.74	7.69	**<.001**	6.32	5.79	6.89	**<.001**
Sexual violence (yes)	2.70	2.50	2.92	**<.001**	2.38	2.17	2.61	**<.001**	1.82	1.54	2.15	**<.001**
Sexual orientation (other)	2.78	2.58	3.00	**<.001**	2.49	2.27	2.73	**<.001**	2.63	2.29	3.03	**<.001**
Ethnic minority	0.77	0.73	0.81	**<.001**	0.78	0.74	0.83	**<.001**	0.86	0.79	0.93	**<.001**
International student	0.55	0.51	0.58	**<.001**	0.53	0.49	0.58	**<.001**	0.70	0.63	0.78	**<.001**
COVARIATES FULL MODEL												
Stress (high)	5.86	5.56	6.19	**<.001**	5.76	5.38	6.17	**.000**	5.41	4.94	5.92	**<.001**
Sexual violence (yes)	1.82	1.67	1.99	**<.001**	1.55	1.40	1.72	**<.001**	1.43	1.19	1.73	**<.001**
Sexual orientation (other)	2.00	1.84	2.18	**<.001**	1.81	1.63	2.00	**<.001**	2.11	1.81	2.46	**<.001**
Ethnic minority	0.97	0.92	1.03	.369	0.99	0.92	1.06	.699	1.07	0.97	1.18	.157
International student	0.81	0.74	0.88	**<.001**	0.80	0.72	0.89	**<.001**	0.92	0.81	1.05	.197

Bolded *p* values are statistically significant at *p* less than .05.

Stress, sexual violence, and sexual orientation covariates were statistically significant for adjusted models and followed the same pattern.

Ethnic minority covariate had an inverse relationship with independent variables; only sleep with both sexes combined and female sex at birth continued to be significant in adjusted model.

International student covariate had an inverse relationship with independent variables; international student covariate was significant for both sexes combines and female sex at birth and only significant for physical activity and cigarette use for male sex at birth.