SUBSTANCE USE DISORDERS AMONG YOUNG PEOPLE
SUBSTANCE USE DISORDERS AMONG EMERGING AND YOUNG ADULTS: AN EPIDEMIOLOGICAL STUDY

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Abstract

Objectives:

We investigated the prevalence of substance use disorders among emerging adults and quantified the extent to which emerging adults, compared to young adults, are at increased odds for substance use disorders.

Methods:

Data come from the 2012 Canadian Community Health Survey – Mental Health (CCHS-MH). Respondents were 15–39 years of age (n=9228) and were categorized as: early emerging adults (15-22 years); late emerging adults (23-29 years); and, young adults (30-39 years). Substance use disorders (alcohol or drug abuse/dependence) were measured using the Composite International Diagnostic Interview 3.0. The prevalence of substance use disorders was compared across age groups using design-based $\chi^2$ analyses. Odds ratios (OR) and 95% confidence intervals (CI) were computed from logistic regression models adjusting for sociodemographic and health covariates. All analyses were weighted to maintain representativeness of the study sample to the Canadian population.

Results:
The prevalence of alcohol use disorder was 8.0%, 6.6%, and 2.7% for early emerging adults, late emerging adults, and young adults respectively. For drug use disorder, the prevalence was 6.4%, 3.6%, and 1.3%. Compared to young adults, early and late emerging adults were more likely to report substance use disorders (p<0.01). The prevalence of drug use disorder was higher among early versus late emerging adults ($\chi^2=119.8, p=0.01$). Among all age groups, males were more likely to report alcohol or drug use disorders (p≤0.01 for all). After covariate adjustment, early and late emerging adults had greater odds of reporting alcohol (OR=3.2, 95% CI=2.2-4.9 and OR=2.4, 95% CI=1.6-3.4, respectively) or drug (OR=4.2, 95% CI=2.5-7.0 and OR=2.5, 95% CI=1.6-4.1, respectively) use disorders compared to young adults.

**Conclusion:**

Emerging adulthood represents an important developmental period in which individuals are at increased odds of reporting substance use disorders. This finding has implications for the provision of screening and treatment of substance use disorders as these individuals transition from the pediatric to adult healthcare system.
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LIST OF ABBREVIATIONS

CCHS-MH   Canadian Community Health Survey - Mental Health
CI        Confidence Interval
CTADS     Canadian Tobacco, Alcohol, and Drugs Survey
GAD       Generalized Anxiety Disorder
HiREB     Hamilton Integrated Research Ethics Board
NSDUH     National Survey on Drug Use and Health
OR        Odds Ratios
RDC       Research Data Centre
SE        Standard Error
WHO       World Health Organization
CHAPTER ONE: INTRODUCTION

1.1. EMERGING ADULTHOOD

In the past fifty years, a gradual demographic shift has taken place for young people in post-industrial societies. Today, young people face an increasingly prolonged transition to adulthood as compared to their counterparts from fifty years ago (Arnett, 2014). The young people of today marry later, have their first child later, and extend their formal education (Schwartz, Côté, & Arnett, 2005). For example, as recently as the 1960s, a typical 21-year-old was married, was expecting a child, and held a long-term employment position or, in the case of most married women, was settling into the role of a stay-at-home parent. However, today, a typical 21-year-old is not married, is not expecting a child, and does not hold a long-term employment position. In fact, marriage, parenthood, and a long-term employment position are not likely for at least another six to nine years (Arnett, 2014). Due to such demographic shifts, a novel and distinct period of development, emerging adulthood, has been identified for today’s young people in industrialized societies (Arnett, 2007).

Typically, emerging adulthood has referred to the developmental period between the ages of 15 and 25. However, recently, researchers have suggested that emerging adulthood can last until the late twenties and encompasses those individuals up to 29 years of age (Arnett, Žukauskienė, & Sugimura, 2014). Although some research has attempted to incorporate
this entire range, most estimates associated with various emerging adulthood behaviours (e.g., substance misuse) end at age 25 (Arnett, 2015). In some cases, this developmental period, characterized by change, exploration, development, and growth, is divided into two categories: 1) early emerging adulthood and 2) late emerging adulthood. However, the age demarcations associated with these categories are not clearly defined in the literature (Menard, 2009).

For emerging adults, as transitions such as marriage and parenthood are postponed until later years, the late teens and early twenties are available for exploring various life directions (Arnett, 2000). Emerging adulthood has five defining features that separate this developmental period from the preceding adolescence and the following young adulthood. These features include identity exploration, instability, a focus on self, a feeling of in-betweenness, and optimism (Arnett, 2007).

During this developmental period, emerging adults are not beholden to either traditional adult roles or their parents. Therefore, emerging adults are free to explore various life options in a variety of areas such as romance, work, travel, and education (Arnett, 2014). This exploration allows emerging adults to develop an identity and find an answer to the following crucial question: “Who am I and what do I want out of life?” The independence from parents and long-term commitments makes this interval of years an ideal time for exploration of different ways of living (Arnett, 2007). However, such explorations and subsequent shifting choices are a cause of exceptional instability. Although most emerging
adults do have a life course plan (an idea of the route they will be taking to transition into adulthood), explorations during this time period may provide reasons to alter their plan (Arnett, 2014). Each modification or revision to the life course plan brings instability and gives emerging adults an opportunity to learn about themselves, their preferences, and about the future they desire (Arnett, 2007, 2014; Arnett et al., 2014).

The independence and freedom from responsibilities of adulthood (e.g., marriage, parenthood) and supervisory bodies (e.g., parents at home and teachers at school) also allow emerging adults to be self-focused. Perhaps, this is the first developmental period where individuals are responsible for making most of their personal decisions (Arnett, 2014). By being self-focused, emerging adults can understand their preferences and values to make independent decisions and develop skills that are essential for establishing a foundation for adult life (Arnett, 2014). Across various ethnic groups and social classes, making independent decisions is often seen as a hallmark of adulthood along with financial independence and accepting responsibility for one’s behaviours and actions. Since these criteria for adulthood are incremental and gradual, emerging adults often feel in-between adolescence and full adulthood (Arnett, 2000, 2007, 2014). While in this state of in-betweenness, emerging adults feel optimistic and positive about the future. Due to a lack of commitments and obligations, there is a marvelous opportunity to transform lives and become independent. Emerging adulthood, the possibility of change, and a wide range of choices in many different areas of life go hand in hand (Arnett, 2014).
Brought on by sweeping demographic shifts in industrialized societies, emerging adulthood has emerged as a distinct period of the life course and is an important time for development and growth. During this time, individuals obtain education and training that will determine their careers and incomes (Arnett, 2007). Various opportunities in the realm of work, love, and world-views are explored. The most important events in life are often taking place during this period. Decisions, experiences, and actions taken during this period have lasting and enduring ramifications (Arnett, 2007).

1.2. EMERGING ADULTHOOD AND RISK-TAKING BEHAVIOUR

The unique and distinct characteristics of emerging adulthood can be the impetus for various opportunities (e.g., exploring possibilities related to various realms of life, becoming independent, creative expression, finding one-self) and vulnerabilities (Arnett, 2014). In fact, the prevalence of many different types of risk-taking behaviour including unprotected sexual intercourse, substance misuse, and unsafe driving practices (e.g., driving over the speed limit) peak during emerging adulthood (Arnett, 2000; Bachman, Johnston, O’Malley, & Schulenberg, 1996). For instance, Bradley and Wildman (2002) reported that over 25% of the emerging adults (18 – 25 year olds) drive 20 miles per hour (mph) over the speed limit at least once a week. Administrative data reports that emerging adults (18 – 25 year olds) hold the highest injury and fatality rates due to automobile and motorcycle accidents as compared to other age groups. Furthermore, the highest proportion of drivers and motorcyclists that are under the influence of alcohol during fatal
Crashes are emerging adults (National Highway Traffic Safety Administration, 2016). Unsafe sexual practices are also common among emerging adults (18 – 25 year olds); 2% to 5% report that they had sex at least five times with someone they had not known well in the past year (Arnett, 1996; Bradley & Wildman, 2002). Moreover, emerging adults (18 – 25 year olds) have the highest rates of unintended pregnancies and unintended pregnancies ending in birth among all age groups (Finer & Zolna, 2011).

Researchers hypothesize that risk-taking behaviours during emerging adulthood are a part of identity exploration. Emerging adults may want to seek many different sensations and feelings before settling into adult life (Arnett, 2005). Sensation seeking has been consistently linked with numerous risk-taking behaviours including driving under the influence of alcohol, drug and alcohol use, reckless sexual behaviour, theft, and vandalism among young adults (Duangpatra, Bradley, & Glendon, 2009; Ham & Hope, 2003; Rolison & Scherman, 2003; Rosenbloom, 2003; Wagner, 2001). Furthermore, due to a lack of parental monitoring and long-term commitments (e.g., marriage, children), emerging adults have the opportunity to pursue these novel and sometimes risky experiences more freely than adolescents or adults (Arnett, 2000, 2007, 2014).

1.3. EMERGING ADULTHOOD AND SUBSTANCE MISUSE

This thesis focuses on one particular risk-taking behaviour among emerging adults; substance misuse. For this thesis, substance misuse includes the usage of alcohol, cannabis,
and other drugs in a manner, situation, amount, or frequency that could cause harm to
the user or to those around the user. Substance misuse affects many Canadian emerging
adults and imposes enormous accumulated costs to the individual (e.g., compromised
physical and mental health), the family (e.g., abuse or neglect of children), and the
community (e.g., loss of productivity) (Mental Health Services Administration US &

Substance misuse among young adults has captured the attention of many different
segments (e.g., public health, parents of young adults) in our society. Although substance
misuse among any individual is detrimental, ravages of substance misuse among young
adults raises additional concerns such as wasted potential, negatively altered life
trajectories, brain development issues, and possibly lifelong substance abuse and
dependence (Bachman, Wadsworth, O'Malley, Johnston, & Schulenberg, 2013).

1.4. Epidemiology of Substance Use and Misuse During Emerging
Adulthood

Typically, substance use has a systemic relationship with age. Specifically, substance use
begins during adolescence, peaks during emerging adulthood, and declines thereafter.
National survey data from the United States suggests that alcohol use and first
intoxication occur between grades 7 and 10 (Tucker, Ellickson, Orlando, Martino, &
Klein, 2005). Likewise, data from the Monitoring the Future (MTF) study, which assessed
the values, attitudes, and behaviours of adolescents, suggests a high rate of alcohol use and misuse in this population. Approximately 18% of the 8th graders, 38% of 10th graders, and 56% of 12th graders had consumed alcohol in the year prior to the survey (Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2017). Data from the 2012 – 2013 Canadian Youth Smoking Survey also reported that 22% of students in grades 7 – 9 and 60% of those in grades 10 – 12 had used alcohol in the year prior to the survey (Health Canada, 2014).

Similar to alcohol, illicit drug use begins during adolescence. Approximately 50% of secondary school seniors who use marijuana and 25% of secondary school seniors who use cocaine reported that they had first used before the age of 15 (Johnston et al., 2017). According to the United States’ National Survey on Drug Use and Health (NSDUH), 8% of 14 – 15 year olds and 16% of 16 – 17 year olds reported that they had used an illicit drug (e.g., marijuana, cocaine, ecstasy, heroin) in the past month (Substance Abuse and Mental Health Services Administration, 2015). Furthermore, data from the MTF study state that 12% of 8th graders, 27% of 10th graders, and 38% of 12th graders had used an illicit drug in the year prior to the survey (Johnston et al., 2017). Canadian studies have reported similar results. According to the 2012 – 2013 Youth Smoking Survey, 10% of those in grades 7 – 9 and 32% of those in grades 10 – 12 had used an illicit drug in the past year (Health Canada, 2014).
Following adolescence, substance use and misuse peak during emerging adulthood. Evidence from the MTF study addressing alcohol and illicit drug use among adolescents was presented above. It is important to note the MTF follow-up surveys were also conducted. These follow-up surveys selected the sample from those secondary school students who had completed the MTF during their senior year (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2016). As compared to other age groups, a higher percentage of emerging adults (19 – 24 year olds) had consumed alcohol in the past month (64%) and the past year (79%). Binge drinking during the two-week period prior to the survey was also the highest among emerging adults (37% among 21 – 22 year olds). Similarly, as compared to other age groups, a higher percentage of emerging adults had used illicit drugs in the past month (23%) and the past year (40%) (Johnston et al., 2016). Other national surveys from the United States have reported similar results (Grant et al., 2015; Grant et al., 2016; Substance Abuse and Mental Health Services Administration, 2015).

According to the NSDUH, the past year and past month prevalence of alcohol consumption was the highest among emerging adults (18 – 25 years old) as compared to all other age groups. In 2015, nearly 76% and 58% of emerging adults reported using alcohol in the past year and past month respectively. Along with alcohol use, alcohol misuse was also the highest among emerging adults. In the same survey, 39% of emerging adults reported binge drinking in the month preceding the survey (Substance Abuse and Mental Health Services Administration, 2015). Furthermore, 11% of emerging adults
reported heavy alcohol use (i.e., five or more drinks on the same occasion on five or more days) in the past month. Likewise, the highest rates of illicit drug use in the past month (22%) and the past year (38%) were among emerging adults (Substance Abuse and Mental Health Services Administration, 2015).

Although scarce, recent Canadian studies have provided similar results. During the year 2013, a national biennial population survey assessing the prevalence, incidence, and patterns of tobacco, alcohol, and illicit drug use in the Canadian population was conducted. This survey, the Canadian Tobacco, Alcohol, and Drugs Survey (CTADS), reported that emerging adults (20 – 24 years old) had the highest percentage (83%) of respondents that had consumed alcohol in the past year as compared to other age groups (Health Canada, 2013). This survey further revealed that 20 – 24 year olds reported exceeding the Low-Risk Drinking Guidelines and put themselves at risk for acute (e.g., injuries, overdose) and chronic (e.g., liver disease, certain cancers) harms related to intoxication more frequently than any other age group at rates of 24% and 19% respectively. Similarly, the rates of illicit drug use during the year prior to the survey were the highest (28%) among emerging adults. As compared to other age groups, emerging adults were also four times more likely to report harm to one of the eight measured domains (e.g., physical health, friendships and social life, home life or marriage) due to their illicit drug use in the year preceding the survey (Health Canada, 2013).

1.4.1. COMPARISON OF THE RESULTS ACROSS STUDIES
Although it is clear that substance use and misuse peak during emerging adulthood, inconsistencies in substance use measurement and distinctive conceptualizations of emerging adulthood hinder the comparison of the research findings across studies. First, based on the frequency of use, quantity of use, and the assessment period, substance use can be operationalized in many different ways. For example, the MTF study and the NSDUH measured the past month and the past year prevalence of substance use. However, the CTADS only measured the past year prevalence. Furthermore, the MTF study measured binge drinking in the two-week period preceding the survey and the NSDUH measured binge drinking in the past month (Health Canada, 2013; Johnston et al., 2016; Substance Abuse and Mental Health Services Administration, 2015). Second, each of these studies used distinctive conceptualizations for emerging adulthood. For instance, according to the MTF study, emerging adulthood encompasses those individuals that are between the ages of 19 – 24. In contrast, emerging adulthood is defined as encompassing those individuals that are between the ages of 18 – 25 and 20 – 24 in the NSDUH and the CTADS respectively (Health Canada, 2013; Johnston et al., 2016; Substance Abuse and Mental Health Services Administration, 2015). Although nonequivalent substance use measures, variation in assessment periods, and the discrepancy in the conceptualization of emerging adulthood across studies can create difficulties in interpretation and generalization of knowledge, some equivalent measures across studies are discussed below.
The past month prevalence of substance use was assessed in two different surveys (i.e., the MTF and the NSDUH). According to the MTF study, the past month prevalence of alcohol use and illicit drug use among emerging adults was 64% and 23% respectively. According to the NSDUH, 58% and 22% of emerging adults reported using alcohol and illicit drugs in the past month respectively (Figure 1). Although the past month prevalence of alcohol and illicit drug use across both studies were similar (i.e., differences of 6% and 1% for alcohol use and illicit drug use respectively), the estimates obtained from the MTF study were higher, especially for alcohol use (Johnston et al., 2016; Substance Abuse and Mental Health Services Administration, 2015). These small differences may be attributable to differences in sampling. The MTF follow-up study was limited to those respondents that graduated high school and excluded those individuals that dropped out of secondary school before graduation, whereas, the NSDUH included all non-institutionalized civilians of the United States. Thus, as compared to the NSDUH, the MTF included a greater number of individuals attending post-secondary educational institutions (Johnston et al., 2016; Substance Abuse and Mental Health Services Administration, 2015). Research suggests that university or college students have a higher prevalence of substance use, especially alcohol use. For instance, a review of studies that compared alcohol consumption among college students and their age-matched non-student peers determined that college students consumed a greater amount of alcohol and
consumed alcohol more frequently than their non-college peers (Carter, Brandon, & Goldman, 2010).

Past Year Prevalence of Substance Use

The past year prevalence of substance use was assessed in each of the studies presented above. The estimates for alcohol use in the year prior to the survey were similar across studies and ranged from 76% (NSDUH) to 83% (CTADS). However, the estimates for illicit drug use in the year prior to the survey were not similar across these studies. According to the MTF study and the NSDUH, the past year prevalence of illicit drug use was 40% and 38% among emerging adults. Yet, according to the CTADS, the past year prevalence of illicit drug use was 28% (Health Canada, 2013; Johnston et al., 2016; Substance Abuse and Mental Health Services Administration, 2015) (Figure 2). It is possible that these differences were attributable to the data collection methodologies used in these studies. The NSDUH involved in-person interviews and the MTF study employed mailed questionnaires to collect data. However, the CTADS was conducted using telephone interviews based on a sample of telephone numbers (Health Canada, 2013; Johnston et al., 2016; Substance Abuse and Mental Health Services Administration, 2015). Research suggests that such a sampling strategy can result in underrepresentation of young people (18 – 29 year olds) who are at a higher risk for substance use leading to underestimated substance use estimates in this population (Johnson, 2014). Furthermore, as compared to telephone surveys, mailed questionnaires and in-person interviews lead to
greater and possibly more accurate reporting of substance use, especially for the
prevalence of past month illicit drug use (Beebe, McRae, Harrison, Davern, & Quinlan,

1.5. **Epidemiology of Substance Use Disorders During Emerging Adulthood**

Clearly, emerging adulthood is associated with high levels of substance use and misuse
(e.g., binge drinking). In fact, during this developmental period, substance use is accepted
as a social norm and is even encouraged by older adults and peers (Arnett, 2005; Bradley
& Wildman, 2002). Although substance use is considered normative, it does not mean that
it is without detrimental consequences. Among young adults, substance use can result in
injuries (Taylor, Rehm, Room, Patra, & Bondy, 2008), emotional dysfunction
(Schulenberg, O'Malley, Bachman, Wadsworth, & Johnston, 1996), risk-taking behaviours
such as driving while under the influence of alcohol, aggression, and risky sexual
behaviors (Beck et al., 2010; Mustonen, 2000; Neal & Fromme, 2007), a higher likelihood
of not completing school, and even death (Krohn, Lizotte, & Perez, 1997; Tucker et al.,
2005).

Accompanying the high substance use rates and the detrimental consequences of
substance use are the peaks in the prevalence of substance use disorders. According to
recent estimates based on the 5th edition of the Diagnostic and Statistical Manual of
Mental Disorders (DSM-5), the prevalence of past year and lifetime alcohol use disorder were 27% and 37% among emerging adults (18 – 29 year olds), percentages higher than all other age groups (Grant et al., 2015). Similarly, the prevalence of past year (8%) and lifetime (14%) drug use disorder were the highest among emerging adults (Grant et al., 2016). Other older population-based studies from the United States have provided similar estimates. For instance, according to Compton et al. (2007), the prevalence of past year and lifetime drug use disorder were 5% and 14% among emerging adults. Unfortunately, recent Canadian studies assessing substance use disorders among emerging adults are not readily available. However, one Canadian study reported that emerging adults (15 – 24 year olds) had the highest prevalence (12%) of any past year substance use disorder as compared to all other age groups during the year 2013 (Pearson, Janz, & Ali, 2013).

1.5.1. Age Sub-Group Differences for Substance Use Disorders Between Emerging Adults

Within emerging adulthood, significant variability in mental health outcomes between early emerging adults, late emerging adults, and slightly older young adults has been identified. For instance, Tanner et al. (2007) demonstrated that 12-month prevalence of phobia declines from early emerging adulthood (age 21) to young adulthood (age 30). Research has also shown that the prevalence of suicidal thoughts varies within emerging adulthood and young adulthood (highest among 16 – 20 year olds, followed by 21 – 25 year olds, and then 26 – 35 year olds) (Sumnall et al., 2010). Moreover, age sub-group
differences in treatment seeking rates for mental health problems have been found.

Research has suggested that older emerging adults and young adults (26 – 34 year olds) are more likely to seek treatment as compared to early emerging adults (18 – 25 year olds) (Adams, Knopf, & Park, 2014). This variation in mental health and treatment outcomes between early emerging adults, late emerging adults, and slightly older young adults suggests that detailed study of age sub-group differences in these populations is warranted.

Despite the growing amounts of literature analyzing the sub-group differences between early and late emerging adults (Menard, 2009; Peer & McAuslan, 2016), research analyzing such sub-group differences for substance use disorders is non-existent. Furthermore, comparisons assessing substance use disorders between emerging adults and young adults are few. Only one study has directly compared the prevalence of substance use disorders between emerging adults (18 – 25 years old) and young adults (26 – 34 years old). Based on the 2010 NSDUH, this study reported that emerging adults were significantly more likely to report past year alcohol (OR = 1.5, 95% CI = 1.3 – 1.7) or drug (OR = 1.8, 95% CI = 1.5 – 2.2) disorder as compared to the older young adults. Although based on a large nationally representative sample, this study did not include the full spectrum of emerging adulthood and failed to uniquely target late emerging adults (i.e., those aged 26 – 29 were categorized as young adults) (Adams et al., 2014).

1.6. **Thesis Overview**
Emerging adults are a unique and vulnerable demographic that is at great risk for mental disorders. The vulnerability of emerging adults is attributable to the considerable physical, emotional, and social change that occurs during this developmental period. Moreover, as compared to previous decades, demographic changes (e.g., later marriage and childbirth) in industrialized nations have rendered this period a longer state than ever before (Arnett, 1996, 2000, 2007, 2014, 2015; Arnett et al., 2014). Emerging adulthood is also a critical period for substance use disorders. Research has suggested that the prevalence of substance use disorders peaks during this developmental period and has further identified the higher rates of alcohol and drug problems for emerging adults as compared to adolescents and older adults. Additionally, the onset of the majority of lifetime substance use disorders occurs by the end of early emerging and beginning of late emerging adulthood years (approximately age 22 to 24) (Arnett, 2005).

Despite the large prevalence of substance use disorders and substance use related problems in emerging adulthood, there is a paucity of research examining these disorders in this developmental period thoroughly. Existing studies have been limited methodologically. First, there have been remarkably few recent Canadian studies analyzing the prevalence of substance use disorders among emerging adults. With rapidly changing societal factors (e.g., legalization, increase in prescriptions for medications such as opioid analgesics with addiction potential), recent prevalence estimates for emerging adults are required for informing economic and social costs, generating policies aimed at the prevention and treatment of substance use disorders, and delivering healthcare
services (Grant et al., 2015; Grant et al., 2016). Second, most estimates of substance use disorders have failed to include the full spectrum of emerging adulthood. As mentioned earlier, emerging adulthood has recently been conceptualized to encompass those individuals between the ages of 15 – 29. However, estimates associated with substance use and substance use disorders typically end at age 25 (Arnett, 2015). Third, given the variability in mental health outcomes (e.g., mental disorders, rates of treatment seeking) between early emerging adults, late emerging adults, and young adults, a more comprehensive understanding of substance use disorders, including sub-group differences, is required. Since most estimates associated with substance use disorders end at age 25, such sub-group differences between early and late emerging adults are also necessary to provide additional evidence for the extension of emerging adulthood into the late twenties.

Given the limitations and the paucity of previous research, this thesis used current national population-based data to provide prevalence estimates for substance use disorders among emerging adults, quantify the age sub-group differences between early emerging adults, late emerging adults, and young adults for substance use disorders, and potentially provide contemporary Canadian evidence for the extension of emerging adulthood to the late twenties. The objectives of this thesis along with the hypotheses were as follows:
1. Estimate the overall, age-specific, and sex-specific past year prevalence of substance use disorders for early emerging adults (15 – 22 years old), late emerging adults (23 – 29 years old), and slightly older young adults (30 – 39 years old). *We hypothesize that the prevalence of substance use disorders will be equivalent among early and late emerging adults; prevalence will be higher among younger participants (i.e., emerging adults) as compared to those older; prevalence will also be higher among males as compared to females across all age groups.*

2. Quantify the extent to which early and late emerging adults, compared to young adults, are at increased odds for substance use disorders. *We hypothesize that in sociodemographic-adjusted models, younger age will be positively associated with substance use disorders.*

3. Examine the potential moderating effects of sex, the number of chronic health conditions, major depressive episode, generalized anxiety disorder, and pain on the association between age and substance use disorders. *We hypothesize that sex, pain, the number of chronic health conditions, major depressive episode, and generalized anxiety disorder will moderate the association; that is, odds for substance use disorder will be greatest among early emerging adults who are males, have a greater number of chronic health conditions, have higher levels of pain, have generalized anxiety disorder, and have major depressive episode.*
In the recent decades, perhaps no issue has garnered more interest from policy makers, public health initiatives, and the general public than substance abuse in emerging adults. For example, since 2010, World Health Organization’s (WHO) global strategy has been placing significant and growing emphasis on addressing alcohol and drug problems in young people (Degenhardt, Stockings, Patton, Hall, & Lynskey, 2016; Hall et al., 2016). This is partly due to the high costs associated with these individuals but also due to the substantial changes that occur in the brain and in one’s life (e.g., completing education, gaining meaningful employment, transitioning into marriage and eventually, parenthood) during this key developmental period. Substance use disorders can negatively impact brain development and have short-term and long-term impacts on young people’s physical, mental, and social well-being (Degenhardt et al., 2016; Hall et al., 2016).

However, in Canada, there have been few thorough recent studies assessing substance use disorders in emerging adults. Much of the available evidence is historical and is based on cohorts of young people interviewed a decade ago (Tjepkema, 2004). Since then, types and levels of substance abuse, age of onset, and social features of young people have changed massively (Degenhardt et al., 2016). Globally and in Canada, studies have not addressed sub-group differences for substance use disorders among emerging and young adults specifically.

Given that emerging adulthood is a crucial time of susceptibility for the development of substance use disorders, addressing this gap would produce evidence-based findings that will have implications for the provision of screening and treatment of substance use
disorders among young people. The prevalence rates from this study will provide an estimate of the burden of substance use disorders among young people and will also act as a baseline for assessing substance abuse trends in Canada over time, especially in the light of impending legislative changes. Furthermore, demographic changes such as extension of formal education have ensured that emerging adulthood is no longer a brief transition but a longer state than ever before. Comparisons between emerging and young adults in sociodemographic-adjusted models will uniquely target early emerging, late emerging, and young adults to elucidate the unique context of substance use disorders among today’s young people. Given that early emerging, late emerging, and young adults are likely to be at different stages of life, this study will have broad implications for alcohol and drug treatment services, especially the applicability of such treatment approaches to different age groups (Stockings et al., 2016). Moreover, there is very limited research on the interaction between age and common risk factors (e.g., generalized anxiety disorder) for substance use disorders (Alegria et al., 2010). The results from such analyses will contribute to the growing literature assessing the risk and protective factors for substance use disorders in young people.
1.7. REFERENCES


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CHAPTER TWO: METHODS

2.1. DATA & SAMPLE

The data were obtained from the 2012 Canadian Community Health Survey-Mental Health (CCHS-MH). The CCHS-MH is a national epidemiological study conducted by Statistics Canada that provides a comprehensive assessment of the mental health of Canadians. It focused on various aspects of mental health such as prevalence of mental disorders, access and utilization of formal and informal mental health care services, and the links between functioning, disability, and socioeconomic variables and mental health (Statistics Canada, 2013).

The CCHS-MH employed a multi-stage stratified cluster sampling design to interview a nationally representative sample of Canadians (15 years of age or older) residing in the ten Canadian provinces. Following a two-step strategy to allocate the sample to the ten provinces while accommodating for the distinct demographics of the various provinces, a three-stage sampling design was used to select the sample of respondents (Statistics Canada, 2013). First, clusters or geographical areas within the ten provinces were selected. Second, households (i.e., an individual or a group of related or unrelated individuals residing in the same collective or private dwelling) within the sampled clusters were selected. Third, one respondent per selected household was randomly selected (Statistics Canada, 2013). Canadians residing in the territories, persons living on reserves
and other Aboriginal settlements, full-time members of the Canadian Forces, and the institutionalized population were excluded. Overall, the excluded population comprised of 3% of the target population (Statistics Canada, 2013). Out of 36,443 households that were in-scope for the CCHS-MH, 29,088 agreed to participate. Responses were obtained from 25,113 individuals. Thus, for the CCHS-MH, the household-level response rate was 79.8%, the person-level response rate was 86.3%, and the combined (household and person) response rate was 68.9% (Statistics Canada, 2013).

Data were collected directly from the selected survey respondents by decentralized field interviewers from January 2, 2012 to December 31, 2012 using computer-assisted personal interviewing. The majority of the interviews (87%) were conducted face-to-face. The remainder were conducted by telephone. Respondents were made aware that participation in the CCHS-MH is voluntary. The respondent confidentiality and privacy was guaranteed by Statistics Canada (Statistics Canada, 2013).

2.2. MEASURES

2.2.1. ALCOHOL AND DRUG USE DISORDER

Alcohol use disorder and drug use disorder were the primary outcomes for this analysis. Although there is little agreement regarding the conventions for the time frame to use in reporting data from epidemiological surveys, a 12-month time period was preferred over
a lifetime perspective to avoid biases associated with selective recall and to ensure a more rigorous methodological approach (Jenkins et al., 1997; Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012; Statistics Canada, 2013).

Assessment of these disorders was based on the CCHS-MH and the World Health Organization-Composite International Diagnostic Interview 3.0 (WHO-CIDI). The WHO-CIDI is a standardized, valid, and reliable instrument that is widely used in population surveys to assess mental and substance use disorders, including those examined in this analysis (Kessler & Üstün, 2004; Pearson, Janz, & Ali, 2013; Robins et al., 1988; Wittchen, 1994). The WHO-CIDI 3.0 has undergone extensive methodological development and testing. Therefore, it has been used to assess mental disorders including substance use disorders in surveys around the world in a variety of settings. For example, the WHO-CIDI has been used to assess mental disorders in low-income (e.g., India, Nigeria, Iraq), middle-income (e.g., Brazil, South Africa), and high-income (e.g., Unites States, Spain, Germany) countries (Alonso et al., 2011).

The WHO-CIDI 3.0 consists of a comprehensive, fully-structured, diagnostic interview and employs computerized algorithms to provide lifetime and 12-month diagnoses for mental and substance use disorders based on the 4th edition of the DSM (DSM-IV) and the International Classification of Diseases version 10 (ICD-10) (Kessler & Üstün, 2004; Pearson et al., 2013; Robins et al., 1988; Wittchen, 1994). The DSM is the universally recognized and authoritative guide for the diagnosis of mental disorders and the ICD is
the international guide for reporting of diseases and health conditions. Beginning with a
screening and lifetime review module, the WHO-CIDI determines the number of
diagnostic sections to be completed based on predetermined skip patterns. Out of 40
sections, 22 are diagnostic in nature. In these diagnostic sections, all participants are asked
questions about selective symptoms of selected mental and substance use disorders
(Robins et al., 1988). Positive responses to such items lead to more detailed questioning to
ensure that the cause of the symptom is psychiatric and not medication, physical illness, or
injury. If symptoms are endorsed and suggest a diagnosis of a mental disorder, additional
questions are asked to establish the onset and regency of the symptoms (Robins et al.,
1988).

Alcohol Use Disorder

This measure identified individuals that met the criteria for alcohol abuse or dependence
within the 12-months prior to the interview. The criteria to assess past year alcohol abuse
or dependence employed in this thesis (established by the WHO-CIDI) has previously
been used in various studies (Bernal et al., 2007; Demyttenaere et al., 2007; Kalaydjian et
al., 2009; Teesson et al., 2010; Wells et al., 2006). According to the CCHS-MH, alcohol
dependence was defined as having at least three of seven grouped dependence symptoms
(i.e., tolerance, withdrawal, increased consumption, attempts to quit, time lost, reduced
activities, continued consumption) and reporting a maladaptive pattern of alcohol use.
Alcohol abuse was defined as experiencing at least one of the four abuse symptoms (i.e.,
failure in fulfilling obligations, alcohol use in physically hazardous situations, recurrent alcohol-related problems, continued use despite problems caused or exacerbated by alcohol) (Statistics Canada, 2013).

Based on the WHO-CIDI and a CCHS-MH pilot study, the CCHS-MH used alcohol consumption as a tool to screen respondents into questioning for alcohol abuse or dependence. Respondents whose alcohol consumption did not meet the specific thresholds were classified as not meeting the criteria for alcohol use disorder. The required criteria for the diagnostic algorithms and the specific screening thresholds for 12-month alcohol use disorder are described in detail in Appendix 1. In summary, this measure identifies respondents that report the following: 1) meeting the criteria for lifetime alcohol abuse or dependence; and 2) having at least one symptom of alcohol abuse or dependence in the 12-months prior to the interview (Statistics Canada, 2013).

**Drug Use Disorder**

This measure identified individuals that met the criteria for drug abuse or dependence within the 12-months prior to the interview. Similar to alcohol use disorder, the criteria established by the WHO-CIDI to assess past year drug abuse or dependence has been used previously (Codony et al., 2007; Swendsen et al., 2009; Wells et al., 2006). Likewise, drug dependence was defined as having at least three of seven grouped dependence symptoms (e.g., tolerance) and reporting a maladaptive pattern of drug use. Drug abuse
was defined as experiencing at least one of the four abuse symptoms (e.g., recurrent drug-related problems) (Statistics Canada, 2013).

Cannabis abuse and dependence were assessed independently from any other drug (e.g., sedatives, tranquilizers, nonmedical stimulants, nonmedical analgesics) abuse and dependence. However, due to sparse data, drug-specific analyses could not be conducted. Similar to alcohol use disorder, the CCHS-MH used drug usage as a screening tool. If respondents did not meet these thresholds, they were classified as not meeting the criteria for drug use disorder (Statistics Canada, 2013). The required criteria for the diagnostic algorithms, the specific screening thresholds, and the complete list of drugs assessed in the CCHS-MH for 12-month drug use disorder are described in detail in Appendix 2. In summary, this measure identifies respondents that report the following: 1) meeting the criteria for lifetime drug abuse or dependence; and 2) having at least one symptom of drug abuse or dependence in the 12-months prior to the interview (Statistics Canada, 2013).

2.2.2. PSYCHIATRIC DISORDERS

The CCHS-MH also utilized the WHO-CIDI to measure other psychiatric disorders based on the criteria established by the DSM-IV. As for substance use disorders, a 12-month time period was preferred over a lifetime perspective. Other 12-month psychiatric disorders that were derived from the CCHS-MH and included in the analysis were major
depressive episode and generalized anxiety disorder (Statistics Canada, 2013). Previous research has frequently used the WHO-CIDI to measure the prevalence of these two psychiatric disorders (Bernal et al., 2007; Bromet et al., 2011; Demyttenaere et al., 2007; Kessler et al., 2010; Kessler et al., 2005; Teesson et al., 2010; Wells et al., 2006).

*Major Depressive Episode*

According to the CCHS-MH, major depressive episode is a period of at least two weeks with persistent depressed mood and loss of interest in normal activities that is not more appropriately accounted for by bereavement. The CCHS-MH also identified seven other symptoms that may be associated with such a period; significant changes in weight or in appetite, insomnia or hypersomnia, psychomotor agitation or retardation, decreased energy or fatigue, feelings of worthlessness, impaired concentration, and feelings of guilt, hopelessness, or suicidal thoughts (Statistics Canada, 2013).

Respondents that experienced depressed mood for at least two weeks or a loss of interest in normal activities, at least five additional symptoms, and clinically significant distress or social or occupational impairment not caused by bereavement were characterized as meeting the criteria for lifetime major depressive episode. Additionally, those that met the criteria for lifetime major depressive episode and reported an episode in the past 12-months with impairment in social or occupational functioning met the criteria for 12-month major depressive episode (Statistics Canada, 2013).
Generalized Anxiety Disorder

Generalized anxiety disorder was defined as a pattern of frequent and persistent anxiety about several events or activities during at least a 6-month period. The CCHS-MH also identified other symptoms that could be associated with generalized anxiety disorder; restlessness, being easily fatigued, impaired concentration, irritability, muscle tension, shakiness, headaches, sleep disturbance, excessive sweating, palpitations, shortness of breath, and gastrointestinal symptoms (Statistics Canada, 2013).

Respondents who experienced excessive anxiety about at least one event during at least a six-month period, at least three symptoms associated with anxiety, and clinically significant distress or social or occupational impairment met the criteria for lifetime generalized anxiety disorder. Respondents that met the criteria for 12-month generalized anxiety disorder reported the following: 1) meeting the criteria for lifetime generalized anxiety disorder; 2) having an episode of excessive anxiety in the 12 months prior to the interview; and, 3) clinically significant distress or social or occupational impairment (Statistics Canada, 2013).

2.2.3. Chronic Health Conditions
Chronic health conditions were assessed by presenting a list of long-term health conditions (had lasted or were expected to last for at least six months) to the respondents and asking if they had been diagnosed with such long-term health conditions by a health professional. The chronic health conditions included in the CCHS-MH were: asthma, arthritis, back problems (not including fibromyalgia or arthritis), high blood pressure, migraine headache, chronic bronchitis/emphysema/chronic obstructive pulmonary disease, diabetes, epilepsy, heart disease, cancer, effects of a stroke, bowel disease (inflammatory bowel disease, Crohn’s disease or ulcerative colitis), Alzheimer’s disease/other dementia, chronic fatigue syndrome, and multiple chemical sensitivities. As compared to open-ended questions, such lists have been shown to yield more complete and accurate reports. In addition, reports based on lists have moderate to good concordance with administrative medical records (Baker, Stabile, & Deri, 2004; Knight, Stewart-Brown, & Fletcher, 2001; Schoenborn, Adams, & Schiller, 2003). Due to sparse data, chronic health condition-specific analyses could not be conducted (Statistics Canada, 2013).

The chronic health conditions were then summed and the population was identified as having none, one, two, or three or more chronic health conditions. This categorization captured the escalating public health and medical problem of multiple chronic health conditions and has been used previously to estimates rates of chronic health conditions in large epidemiological studies (Parekh, Goodman, Gordon, Koh, & Conditions, 2011; Vogeli et al., 2007; Ward, 2014). Based on this categorization, 57.1% of the population
had none, 23.2% had one, 10.7% had two, and 9.0% had three or more chronic health conditions.

2.2.4. PAIN

Pain was assessed using responses from the following two items that captured the presence (question 1) and intensity (question 2) of the pain: 1) are you usually free of pain or discomfort? and 2) how would you describe the usual intensity of your pain or discomfort? The participants who responded “yes” to the first question were coded as having no pain. The participants who responded “no” were then classified according to the intensity of their pain or discomfort into three separate categories: 1) mild; 2) moderate; and 3) severe. A higher score on this measure represented more intense pain or discomfort. Due to a small number of participants endorsing “moderate” or “severe” pain, these two categories were aggregated in the analyses. This pain attribute of the CCHS-MH has been used in other studies (Ferro, 2015; Fuller-Thomson & Hollister, 2016; Gilmour, 2015).

2.2.5. SOCIODEMOGRAPHIC COVARIATES

Sociodemographic covariates were included in the analyses to provide unbiased estimates of the association between substance use disorders and age. These were: participant sex, education, income (in increments of $10,000), working status (not employed, employed part-time, or employed full-time), and immigrant status (born or not born in Canada).
2.3. **ANALYSIS**

Data was accessed and analyzed at the McMaster Research Data Centre (RDC) – a university based extension of Statistics Canada. All analyses were approved by Hamilton Integrated Research Ethics Board (HiREB). These analyses were performed using STATA MP13. An exhaustive list of measures used in the analyses by measure type and the coding for the statistical analyses is presented in Appendix 3.

The CCHS-MH is a complex survey that involved a multi-stage stratified cluster sampling design to select respondents. As such, the analysis associated with this dataset had to be modified in two important ways to obtain unbiased and accurate results (Statistics Canada, 2013). First, sample weights provided by Statistics Canada had to be applied. These sample weights were developed based on the probabilities of selection and participation. Sample weights were necessary to derive meaningful estimates and to ensure comparability between the CCHS-MH sample and the Canadian population (Statistics Canada, 2013). Sample weights also helped address the issues of household- and person-level non-response. The strategy used to create sample weights is discussed in Appendix 4. Second, due to the complex sampling design, variance estimates could not be calculated using standard formula. Therefore, bootstrap methods were used to calculate variance estimates (Appendix 4) (Statistics Canada, 2013).
To address the objectives of this analysis, emerging adulthood was divided into two categories: 1) early emerging adulthood; and 2) late emerging adulthood. While the age demarcations for early and late emerging adults are not clearly defined, we defined early emerging adulthood as encompassing those individuals that are between the ages of 15 – 22 years to ensure adequate group sizes and capture those who are likely to be attending secondary or post-secondary educational institutions. Late emerging adulthood consisted of individuals that comprised the remainder of the emerging adulthood years (23 – 29 years). Substance use disorders within these two age groups were then compared to substance disorders among those who are 30 to 39 years old (young adults). Based on this classification, there were n = 3,160 early emerging adults, n = 2,470 late emerging adults, and n = 3,598 young adults in the sample.

**Objective 1**

The overall, age-specific, and sex-specific prevalence of substance use disorders was estimated as the proportion of the sample found to have substance use disorders during the 12-months prior to the interview. The overall prevalence of substance use disorders was then compared across age groups and sex using $\chi^2$ tests. The Pearson $\chi^2$ statistic was corrected for survey design based on the second-order Rao and Scott correction and was converted into an F statistic (Rao & Scott, 1984).

**Objective 2**
Given the categorical nature of the primary outcomes, a logistic regression model was built and pursued to quantify the association between age and substance use disorders. Two models were built; one for alcohol use disorder and one for drug use disorder. The logistic regression models were created through a series of hierarchical steps and started with an intercept-only model or the null model. The logistic regression equation for this model was as follows:

\[
\ln \left( \frac{\hat{p}}{1 - \hat{p}} \right) = \beta_0
\]

Subsequently, each model included a group of related variables. The first model included the age groups: 1) early emerging adulthood; 2) late emerging adulthood; and, 3) young adults (control group). The second model included the psychiatric disorders identified above (i.e., major depressive episode and generalized anxiety disorder). The third model included pain and sociodemographic covariates (i.e., participant age, sex, education, income, employment status, and immigrant status).

The logistic regression equation for the final model was as follows:

\[
\ln \left( \frac{\hat{p}}{1 - \hat{p}} \right) = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 \ldots \beta_n * X_n
\]
where the $\beta$ coefficients represent the independent effect of variable X (e.g., participant sex) after adjusting for other covariates in the model. Using the $\beta$ coefficients and the logistic regression models, odds ratios (OR), bootstrapped variance estimates (e.g., standard error), and the associated 95% confidence intervals (CI) were calculated.

**Objective 3**

This objective investigated the potential moderating effects of participant sex, the number of chronic health conditions, major depressive episode, generalized anxiety disorder, and pain on the association between substance use disorders and age. As such, the fourth model of the logistic regression analysis explained above included product-term interactions between age and participant sex, the number of chronic health conditions, major depressive episode, generalized anxiety disorder, and pain. Interactions were tested in separate models due to sparse data. The hierarchical logistic regression models are outlined in Table 1.

2.4. **MISSING DATA**

A total of $n = 269$ (2.9%) participants had missing data for any measure included in this analysis. Four measures (i.e., age, sex, household income, and chronic health conditions) had no missing data. However, the household income measure was imputed by Statistics Canada (Statistics Canada, 2013). The percentage of missing data ranged from 0.04%
(pain) to 1.17% (alcohol use disorder) for all measures included in this analysis. The percentages of missing responses for each measure are presented in Table 2.

A missing data analysis was also conducted using a logistic regression model. Because the outcome variables had the greatest percentages of missing data, a dummy variable was created: 0 = respondent with no missing data for the outcome variables and 1 = respondent with missing data for the outcome variables. A logistic regression analysis was then conducted to specify the variables that predicted a missing outcome. The results of the logistic regression analysis suggested that none of the variables included in this study predicted missingness of the outcome variables (Table 3).

Missing data are a ubiquitous problem in all types of surveys. Therefore, there is a large body of literature addressing missing data (Allison, 2001). Although many different methods have been proposed for dealing with missing data, the most conventional method is to exclude cases with missing data – commonly known as listwise deletion or complete case analysis. Listwise deletion has many attractive properties including its simplicity, superiority over many widespread methods (e.g., pairwise deletion), and its usability for any kind of statistical analysis (Allison, 2001). For this thesis, we used listwise deletion due to two reasons; 1) minimal missing data; and 2) covariates did not predict missingness of the outcome variables. First, in this thesis, missing data was minimal (ranged from 0.00 – 1.17% for the variables included in this study). As such, the usage of listwise deletion was valid; listwise deletion is problematic if the proportion of missing data
is large (≥5%) (Allison, 2001; Dong & Peng, 2013). Second, the majority of the overall minimal missingness for this thesis was nested in the outcome variables (i.e., the outcome variables had the greatest percentages of missing data). When the missingness of the outcome variables was assessed in a logistic regression model, the missingness was independent of all other covariates. This implies that the obtained estimates, test statistics, and standard errors will be unbiased and appropriate (Allison, 2001). Furthermore, listwise deletion for logistic regression models like the ones built in this thesis are known to be robust; probability of missing data has to depend on both the dependent and the independent variables for problematic inferences (Allison, 2001; Vach, 2012). Although we are aware of other superior methods such as multiple imputations, we are assured that the results and conclusions from this thesis are unlikely to have been seriously affected by bias due to missing data.
2.5. REFERENCES


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epidemiologic instrument suitable for use in conjunction with different diagnostic systems and in different cultures. *Archives of general psychiatry, 45*(12), 1069-1077.


CHAPTER THREE: RESULTS

3.1. SAMPLE CHARACTERISTICS

There were 3,160 early emerging adults (15-22 years old), 2,470 late emerging adults (23-29 years old), and 3,598 young adults (30-39 years old) included in the analyses. The analyses were weighted to maintain representativeness of the study sample to the Canadian population. The mean age was 27.0 (SD 7.7) years and 50.7% of the population was male. Nearly half (52.9%) were working full-time, 82.2% had at least completed high school, 84.5% had household incomes equal to or above the Canadian low-income cut-off ($30,000), 22.9% were immigrants, and 88.0% were usually free from pain and discomfort. A small percentage of the population met the criteria for past year (i.e., 12-month) major depressive episode (6.2%) and generalized anxiety disorder (2.7%). Based on the ICD-10, 57.1% had no chronic health conditions, 23.2% had one, 10.7% had two, and 9.0% had three or more.

As compared to young adults, the group of emerging adults included significantly more males, fewer immigrants, and had lower educational attainment. Furthermore, early emerging adults were significantly less likely to be working part- or full-time or to be experiencing pain as compared to late emerging adults or young adults. There were no significant differences in household income, number of chronic health conditions, or prevalence of past year mental disorders (i.e., major depressive episode or generalized
anxiety disorder) between the groups. Detailed sample characteristics and pairwise contrasts by age groups are shown in Table 4.

3.2. **Past Year Prevalence of Substance Use Disorders**

Overall, the prevalence of alcohol use disorder was 5.5% and drug use disorder was 3.6%. Specifically, the prevalence of alcohol use disorder was 8.0% for early emerging adults, 6.6% for late emerging adults, and 2.7% for young adults (Table 5). As compared to alcohol use disorder, the prevalence of drug use disorder was lower across all age groups. The prevalence was 6.4% for early emerging adults, 3.6% for late emerging adults, and 1.3% for young adults (Table 6; Figure 3).

3.2.1. **Age-Specific Prevalence of Substance Use Disorders**

As compared to young adults, the prevalence of both 12-month substance use disorders was significantly higher among emerging adults. Pairwise contrasts further revealed that the prevalence of substance use disorders was inversely related with age. For instance, the prevalence of alcohol use disorder was significantly higher among early or late emerging adults as compared to young adults ($F = 23.0, p<0.001$). However, no significant differences were found between early and late emerging adults for alcohol use disorder (Table 5). The prevalence of drug use disorder was also significantly higher among early or late emerging adults as compared to young adults. However, in contrast to alcohol use
disorder, the prevalence of drug use disorder was also significantly higher among early emerging adults as compared to late emerging adults ($F = 30.5, p<0.001$) (Table 6).

### 3.2.2. Sex-Specific Prevalence of Substance Use Disorders

The prevalence of both substance use disorders was significantly higher among males as compared to females across all age groups (Figures 4 and 5). Among males, the prevalence of alcohol use disorder was 10.4% among early emerging adults, 8.6% among late emerging adults, and 3.7% among young adults (Table 5). The prevalence of drug use disorder among males followed a similar pattern; the prevalence decreased with increasing age. The prevalence was 8.1% among early emerging adults, 5.3% among late emerging adults, and 2.1% among young adults (Table 6). Among females, the prevalence of alcohol use disorder was 5.5% among early emerging adults, 4.2% among late emerging adults, and 1.7% among young adults (Table 5). The prevalence of drug use disorder was 4.6% among early emerging adults, 1.5% among late emerging adults, and 0.6% among young adults (Table 6).

### 3.3. Risk for Substance Use Disorders Among Emerging Adults

Hierarchical logistic regression models, adjusting for a number of sociodemographic (i.e., participant sex, educational levels, household income, working status, immigration status) and health characteristics (i.e., the number of chronic health conditions, levels of
experienced pain, 12-month major depressive disorder, and 12-month generalized anxiety disorder), were computed to examine and quantify the extent to which emerging adults, compared to young adults, are at increased odds for substance use disorders.

3.3.1. Alcohol Use Disorder

The logistic regression models for alcohol use disorder are shown in Table 7.

Model 1

As compared to young adults, early emerging adults (OR = 3.2, 95% CI = 2.3 – 4.3) and late emerging adults (OR = 2.6, 95% CI = 1.8 – 3.7) had greater odds for alcohol use disorder.

Model 2: Effects of sociodemographic characteristics

Adjusting for sociodemographic characteristics did not change the results from the previous unadjusted model; early (OR = 3.0, 95% CI = 2.0 – 4.6) and late (OR = 2.3, 95% CI = 1.1 – 3.4) emerging adults were more likely to report alcohol use disorder as compared to young adults. Moreover, males (OR = 2.1, 95% CI = 1.6 – 2.7) were more likely, whereas, those that were not working full-time (OR = 0.8, 95% CI = 0.7 – 0.9) and immigrants (OR = 0.4, 95% CI = 0.2 – 0.7) were less likely to report alcohol use disorder.
Model 3: Effects of health characteristics

In this model, health characteristics were added. As seen in previous models, early (OR = 3.2, 95% CI = 2.2 – 4.9) and late (OR = 2.4, 95% CI = 1.6 – 3.4) emerging adults had greater odds for alcohol use disorder as compared to young adults. Moreover, males (OR = 2.3, 95% CI = 1.7 – 2.9), those with major depressive episode (OR = 2.2, 95% CI = 1.4 – 3.5), and those with generalized anxiety disorder (OR = 2.5, 95% CI = 1.3 – 4.8) were more likely, whereas, those that were not working full-time (OR = 0.8, 95% CI = 0.6 – 0.9) and immigrants (OR = 0.4, 95% CI = 0.2 – 0.7) were less likely to report alcohol use disorder.

3.3.2. Drug Use Disorder

The logistic regression models for drug use disorder are shown in Table 8.

Model 1

As compared to young adults, early emerging adults (OR = 5.1, 95% CI = 3.3 – 7.8) and late emerging adults (OR = 2.8, 95% CI = 1.7 – 4.5) had greater odds for drug use disorder.
Model 2: Effects of sociodemographic characteristics

Similar to alcohol use disorder, adjusting for sociodemographic characteristics did not change the results from the previous model of drug use disorder; early (OR = 3.3, 95% CI = 2.0 – 5.4) and late (OR = 2.4, 95% CI = 1.4 – 3.9) emerging adults were more likely to report drug use disorder as compared to young adults. Moreover, males (OR = 2.3, 95% CI = 1.6 – 3.3) and those with lower educational levels (OR = 1.2, 95% CI = 1.1 – 1.4) had greater odds, whereas, immigrants (OR = 0.3, 95% CI = 0.2 – 0.6) had lower odds for drug use disorder.

Model 3: Effects of health characteristics

Health characteristics were added in this model. As above, early (OR = 4.2, 95% CI = 2.5 – 7.0) and late (OR = 2.5, 95% CI = 1.6 – 4.1) emerging adults were more likely to report drug use disorder as compared to young adults. Moreover, males (OR = 2.9, 95% CI = 2.0 – 4.2), those with lower educational levels (OR = 1.2, 95% CI = 1.1 – 1.4), those with three or more chronic health conditions (OR = 1.9, 95% CI = 1.1 – 3.3), those with higher levels of pain (OR = 1.5, 95% CI = 1.1 – 1.9), and those with major depressive episode (OR = 4.4, 95% CI = 2.6 – 7.5) had greater odds for drug use disorder. Similar to alcohol use disorder, immigrants (OR = 0.4, 95% CI = 0.2 – 0.8) were at less likely to report drug use disorder.
3.3.3. **Moderating Effects**

Moderating effects of sex, the number of chronic health conditions, major depressive episode, generalized anxiety disorder, and pain were tested in separate models and are presented in Table 9. One moderating effect was found; generalized anxiety disorder (OR = 0.3, 95% CI = 0.1 – 0.9) was found to moderate the association between early emerging adulthood and alcohol use disorder.
CHAPTER FOUR: DISCUSSION

4.1. SUMMARY OF FINDINGS

In this thesis, data from a large nationally-representative Canadian survey was used to estimate the overall, age-specific, and sex-specific past year prevalence of substance use disorders among early emerging (15 – 22 years old), late emerging (23 – 29 years old), and young (30 – 39 years old) adults, and quantify the extent to which emerging adults, compared to young adults, are at increased odds for substance use disorders. Potential moderating effects of certain sociodemographic (i.e., participant sex, educational levels, household income, working status, immigration status) and health variables (i.e., the number of chronic health conditions, levels of experienced pain, 12-month major depressive disorder, and 12-month generalized anxiety disorder) on the association between age and substance use disorders were also examined. This study encompassed the full spectrum of emerging adulthood (15 – 29 years old) and to our knowledge, this was the first study assessing age sub-group differences among emerging adults (i.e., early versus late emerging adults) for substance use disorders.

The prevalence of both 12-month substance use disorders was the highest among early emerging adults and the lowest in young adults. As compared to females, the prevalence of both substance use disorders was higher among males. Furthermore, younger age and male gender were positively associated with substance use disorders in sociodemographic-
adjusted models. These findings were consistent with our hypotheses. Although the prevalence of alcohol use disorder was statistically equivalent between early and late emerging adults, the prevalence of drug use disorder was significantly higher among early emerging adults as compared to late emerging adults. This finding was not consistent with our hypothesis. The study hypothesis expected to find equivalent prevalence among early and late emerging adults for both substance use disorders.

In sociodemographic-adjusted models, participants that reported working full- or part-time, major depressive episode, and generalized anxiety disorder were more likely to report alcohol use disorder. Participants with lower educational levels, major depressive episode, greater levels of pain, and three or more chronic health conditions were more likely to report drug use disorder. As compared to those born in Canada, immigrants were less likely to report both substance use disorders. Hypotheses surrounding the moderating effects of sex, the number of chronic health conditions, major depressive episode, and pain were not supported by the findings. However, one moderating effect was found but not in the exact direction initially predicted; generalized anxiety disorder was found to moderate the association between early emerging adulthood and alcohol use disorder.

4.2. INTERPRETATION OF FINDINGS AND COMPARISONS WITH PREVIOUS LITERATURE

4.2.1. PREVALENCE OF PAST YEAR SUBSTANCE USE DISORDERS
Below, we compare the prevalence estimates from our study to two recent nationally-representative surveys assessing substance use disorders in the United States; the 2015 NSDUH and the 2012–2013 NESARC-III. Recent Canadian studies assessing both substance use disorders (i.e., alcohol and drug use disorder) independently among emerging or young adults are not available. Consistent with previous research, the prevalence of substance use disorders was greater among emerging adults as compared to older age groups (Grant et al., 2015; Grant et al., 2016; Substance Abuse and Mental Health Services Administration, 2015).

**NSDUH**

The NSDUH measured past year alcohol use disorder among three age sub-groups; adolescence (12–17 years old), emerging adulthood (18–25 years old), and adulthood (those aged 26 and older) (Substance Abuse and Mental Health Services Administration, 2015). Since these age sub-groups were meaningfully different from the age sub-groups included in our study, direct comparisons were not made. The most comparable age sub-groups between the two studies were adolescence and emerging adulthood in the NSDUH and early emerging adulthood in this thesis. According to the NSDUH, the prevalence of past year alcohol use disorder was 3% and 11% among adolescents and emerging adults respectively. In our study, the prevalence of alcohol use disorder was 8% among early emerging adults. Comparably, according to the NSDUH, the prevalence of
drug use disorder was 3% among adolescents and 7% among emerging adults. In our study, the prevalence of drug use disorder was 6% among early emerging adults (Substance Abuse and Mental Health Services Administration, 2015). Thus, as compared to the NSDUH’s prevalence estimates for adolescents, the estimates from our study were higher. As compared to the NSDUH’s prevalence estimates for emerging adults, the estimates from our study were lower. Such findings are attributable to the distinct conceptualizations of the age sub-groups assessed in each study. For example, in our study, early emerging adulthood encapsulated those participants aged 15 – 17 that were categorized as adolescents in the NSDUH study. Furthermore, those that were 12 – 14 years old were not included and those that were 23 – 25 years old were categorized as late emerging adults. Given that the prevalence of substance use disorders is likely to be lower during adolescence (12 – 14 years) and peaks during the mid-twenties (23 – 25 years old) (Adams, Knopf, & Park, 2014; Merikangas & McClair, 2012), these findings were expected.

**NESARC-III**

According to the NESARC-III, the prevalence of past year alcohol use disorder was 27% among 18 – 29 year olds and 16% among 30 – 44 year olds. The prevalence of past year drug use disorder was 8% among 18 – 29 year olds and 4% among 30 – 44 year olds (Grant et al., 2015; Grant et al., 2016). Because the NESARC-III used the diagnostic criteria established by the DSM-5, these prevalence estimates were further broken down
into three categories based on the number of criteria endorsed; mild (2 \textendash 3 criteria), moderate (4 \textendash 5 criteria), or severe (6 or more criteria). Among 18 \textendash 29 year olds, 13\% had mild, 7\% had moderate, and 7\% had severe alcohol use disorder. Furthermore, 4\% had mild and 4\% had moderate to severe drug use disorder. Among 30 \textendash 44 year olds, 9\% had mild, 4\% had moderate, and 4\% had severe alcohol use disorder. Approximately 2\% had mild and 2\% had moderate to severe drug use disorder (Grant et al., 2015; Grant et al., 2016). As compared to the results from the NESARC-III, the prevalence estimates in our study were lower.

A number of methodological factors might have contributed to such discrepancies, including the distinct conceptualizations of the age sub-groups and the varying diagnostic criteria used for assessing substance use disorders. As for the NSDUH, the age sub-groups measured in our study and the NESARC-III were distinct. In addition, this thesis used the diagnostic criteria established by the DSM-IV while the NESARC-III used the diagnostic criteria from the DSM-5 (Grant et al., 2015; Grant et al., 2016). From the DSM-IV to the DSM-5, two key changes have been made to the diagnostic criteria for substance use disorders. One, substance abuse and dependence have been combined into one category. Two, the thresholds for the diagnostic criteria for substance use disorders have been altered. In the DSM-5, the presence of two or more from a possible eleven criteria indicates a substance use disorder. In contrast, the presence of three or more from a possible seven criteria indicated substance dependence and the presence of one or more from a possible four criteria indicated substance abuse in the DSM-IV (American
Psychiatric Association, 2013). Such changes have ensured that the prevalence estimates obtained using the DSM-5 criteria are greater than those obtained using the DSM-IV, especially for population-based non-clinical samples. According to a systematic review consisting of twelve studies, the DSM-5 diagnostic criteria can inflate the prevalence rates of alcohol use disorders by as much as 61% as compared to the DSM-IV (Bartoli, Carrà, Crocamo, & Clerici, 2015).

However, research that has compared the prevalence estimates for substance use disorders obtained using the DSM-IV to the DSM-5 moderate or severe prevalence estimates has shown similarities. One study found that 81% of individuals that met the criteria for DSM-IV alcohol dependence met the criteria for DSM-5 severe alcohol use disorder while 58% of those that met the criteria for DSM-IV alcohol abuse met the criteria for DSM-5 moderate alcohol use disorder (Dawson, Goldstein, & Grant, 2013). It is probable that the mild category in the DSM-5 captures those individuals that were categorized as “diagnostic orphans” (those that met two or more dependence criteria but no abuse criteria) according to the DSM-IV (Bartoli et al., 2015; Compton, Dawson, Goldstein, & Grant, 2013; Dawson et al., 2013). If the prevalence estimates for substance use disorders from our study are compared to the DSM-5 moderate or severe estimates, the results are largely similar. For instance, according to the NESARC-III, the past year prevalence of moderate or severe alcohol use disorder among 18 – 29 year olds was 7%. Likewise, in this thesis, the prevalence of alcohol use disorder among 15 – 29 year olds was 7%. Similar trends were seen for drug use disorder (4% among 18 – 29 year olds
according to the NESARC-III and 5% among 15 – 29 year olds in our study). In addition, the prevalence estimates for the DSM-5 moderate or severe substance use disorders among 30 – 44 year olds and DSM-IV substance use disorders among 30 – 39 years old were similar; 4% versus 3% for alcohol use disorder and 2% versus 1% for drug use disorder.

4.2.2. COMPARISON BETWEEN EMERGING ADULTS AND YOUNG ADULTS

To date, very little has been published on comparisons between emerging adults and young adults for substance use disorders. Only one study has directly compared the prevalence of substance use disorders between emerging adults (18 – 25 years old) and young adults (26 – 34 years old). Using the 2010 NSDUH data, this study found that emerging adults were twice as likely to report either past year alcohol or drug use disorder as compared to the older young adults (Adams et al., 2014). Data from our study show similar results with medium to large odds ratios (Sullivan & Feinn, 2012). As such, in sociodemographic-adjusted models, early emerging adults were three times and late emerging adults were two times more likely to report alcohol use disorder as compared to young adults. Similarly, early emerging adults were four times and late emerging adults were three times more likely to report drug use disorder as compared to young adults. Distinct conceptualizations of the age sub-groups and differences in covariates included in analyses are the probable causes for discrepancies in odds ratios. As compared to this thesis, the study by Adams et al. (2014) did not include the full spectrum of emerging
adulthood and failed to uniquely target late emerging adults. Furthermore, Adams et al. did not control for major depressive episode and generalized anxiety disorder — both variables were significantly associated with substance use disorders in this thesis. Although other studies have not compared the prevalence of substance use disorders between emerging and young adults directly, they have compared such estimates with older age groups. For instance, using the 2012–2013 NESARC-III, Grant et al. (2015) found that those aged 18–29 were fourteen times and those aged 30–44 were nine times more likely to report past year alcohol use disorder as compared to those aged 65 and older. Similarly, those aged 18–29 were ten times and those aged 30–44 were seven times more likely to report past year drug use disorder as compared to those aged 65 and older (Grant et al., 2016).

As mentioned earlier, this was also the first study assessing age sub-group differences among emerging adults (i.e., early versus late emerging adults) for substance use disorders. This comparison suggested that the prevalence of alcohol use disorder was statistically equivalent between early and late emerging adults. However, the prevalence of drug use disorder was significantly higher among early emerging adults as compared to late emerging adults. There are a few possible reasons for such findings. In industrialized nations, the consumption of alcohol is socially accepted throughout emerging adulthood and is deemed to serve many positive functions such as friendship formation. As such, alcohol use and subsequent abuse is common among early and late emerging adults (White & Jackson, 2004). In contrast, it is possible that the societal acceptability of drug
usage is constrained to early emerging adulthood years. Older adults that use drugs are often considered social deviants (i.e., individuals that do not adhere to societal norms) (Arnett, 2005; Golub, Johnson, & Dunlap, 2005; Isralowitz, 2002; Senate of Canada, 2002). Research has shown that perceived social norms can influence substance use among emerging adults (Ecker & Buckner, 2014). Because of this, it is possible that alcohol use disorder is likely to persist at greater rates as compared to drug use disorder. For example, one longitudinal study suggested that the relative contribution of persistence to the prevalence of diagnosed alcohol dependence increases with age (Vergés et al., 2012). Comparatively, results from a different study suggested that the relative contribution of persistence to the prevalence of drug use disorder does not increase with age (Vergés et al., 2013). It is also possible that the new onset of drug use disorder among late emerging adults decreases at a greater rate than the rates of alcohol use disorder (Vergés et al., 2013; Vergés et al., 2012). However, given the varying levels of stigma associated with different drugs (Ahern, Stuber, & Galea, 2007), we suspect that this trend will vary based on the drug of interest. Studies that directly compare drug-specific and alcohol use disorders among early and late emerging adults in a longitudinal manner are required to confirm such notions.

Based on the findings presented above, it is evident that the prevalence of substance use disorders is higher among early and late emerging adults as compared to young adults. These findings raise two important questions; 1) why is the prevalence of substance use disorders so high among emerging adults?; and 2) given the recent research suggesting the
extension of emerging adulthood until the late twenties, are the findings from this thesis further evidence for such an extension?

Why is the prevalence of substance use disorders so high among emerging adults?

As explained in an earlier chapter, emerging adulthood is composed of five unique main features (i.e., identity exploration, instability, a focus on self, a feeling of in-betweenness, and optimism). Accordingly, these features can be used to explain the high rates of substance use during this developmental period (Arnett, 2005). First, substance use is a part of identity exploration for emerging adults. Emerging adults may want to experience many different sensations and feelings before settling into adult life. As such, emerging adults may be tempted to explore and try various substances such as alcohol and cannabis (Arnett, 2005; Gates, Corbin, & Fromme, 2016). In addition, because emerging adulthood is a confusing and complex period of time, many emerging adults may seek out substances to relieve their confusions regarding their identities. For emerging adults, this association between identity exploration and substance use is well-supported (Bishop, Weisgram, Holleque, Lund, & Wheeler-Anderson, 2005; Schwartz et al., 2011). Second, emerging adulthood is associated with increased self-focus due to a greater amount of leisure time and a freedom from responsibilities of adulthood and supervisory bodies (e.g., separation from parents). Therefore, emerging adults, not only have the time, but also the freedom to explore their identities and personalities. Research studies posit that this increase in self-focus resulting due to a lack of supervisory bodies, increased leisure time,
and minimal social commitments is positively associated with substance use. For example, research studies have found that transition out of college/university dormitories (i.e., decline in monitoring by dormitory officials) is associated with an increase in substance use (Arnett, 2005; Gotham, Sher, & Wood, 1997).

Third, substance use during emerging adulthood may be a response to the tremendous instability (e.g., multiple transitions in housing) during this interval of time. Some researchers hypothesize that the instabilities in professional and personal life of an emerging adult may be a cause of great anxiety and sadness. Therefore, to alleviate such negative feelings, an emerging adult may turn to substance use as a method of self-medication (Arnett, 2005; White & Jackson, 2004; White et al., 2006). Fourth, it is known that emerging adults feel in-between adolescence and adulthood. As such, they may believe that they can make their decisions but are not committed to adult standards of behaviour and responsibility. In industrialized societies, young people are often given a “license” to be daring and exuberant. Indeed, a 21-year-old who binge drinks every weekend and uses cannabis occasionally is not unusual and is informally tolerated. However, a 45-year-old who binge drinks every weekend and uses cannabis occasionally is considered unusual and viewed much more negatively (Arnett, 2005; Nelson & Barry, 2005; Smith, Bahar, Cleeland, & Davis, 2014). Fifth, emerging adulthood is a time of optimism and hope. Because of this, emerging adults engaging with substances may not understand the negative consequences of substance use or may view substance use as holding little consequences. These young people may choose to live life “to the fullest”;
such an ideology may promote a whole range of risky behaviours including substance use and abuse. However, the relationship between optimism and substance use is hypothesized to be curvilinear; substance use is higher at both high and low levels of optimism (Arnett, 2005; Lapsley & Hill, 2010; Wray, Dvorak, Hsia, Arens, & Schweinle, 2013).

Given the recent research suggesting the extension of emerging adulthood until the late twenties, are the findings from this thesis further evidence for such an extension?

While emerging adulthood has typically referred to the developmental period between the ages of 15 and 25, researchers have suggested that emerging adulthood can last until the late twenties and encompasses individuals up to 29 years of age. The findings from this thesis provide additional evidence for the extension of emerging adulthood into the late twenties. First, prevalence of substance use disorders was greater among emerging adults as compared to young adults indicating that substance use behaviours during these two developmental periods are distinct and unique. It is important to note that not only early emerging adults (more aligned with the typical definition of emerging adulthood) but late emerging adults had a prevalence of substance use disorders that was significantly greater than that of young adults. Second, the phenomenon used to explain the decrease in the prevalence of substance use disorders from emerging adulthood to later developmental periods is termed “maturing out” – processes involved in maturation (e.g., parenting children, career establishment) that are incompatible with substance use explain the
decrease in the prevalence of substance use disorders (Dawson, Grant, Stinson, & Chou, 2006; Jochman & Fromme, 2010; Labouvie, 1996). Given that young people today view maturation processes such as parenting children as perils to be avoided, instead of achievements to be pursued, until they reach at least age 30, it is viable that emerging adulthood along with one of its hallmarks (i.e., substance abuse) has extended to the late twenties (Arnett, 2005). Third, the prevalence of alcohol use disorder among early and late emerging adults was equivalent suggesting similar alcohol use behaviours during these two age sub-groups. However, the prevalence of drug use disorder decreases significantly from early to late emerging adulthood. In post-hoc analysis, we compared the odds ratios from socio-demographic adjusted logistic regression models for early and late emerging adults (i.e., difference between these effect measures was measured and a confidence interval was constructed). Such a comparison of effect estimates and confidence intervals is often deemed as being more informative than significance testing (Zou & Donner, 2008). As compared to young adults, the magnitude of the difference for the association between early and late emerging adults and drug use disorder was not significantly different (difference between ORs = -1.6, 95% CI = -4.6 – 0.7). Likewise, there was no statistical difference in the magnitude of the difference for the association between early and late emerging adults and drug use disorder (difference between ORs = -0.9, 95% CI = -2.6 – 0.65). Thus, it is probable that both alcohol and drug abuse behaviours are similar among early and late emerging adults. Further research is warranted to study and compare the prevalence of substance use disorders, especially drug use disorder, among
early and late emerging adults to provide additional evidence and ensure that these results were not sample-dependent.

4.2.3. **Moderating Effects**

As mentioned above, sex, the number of chronic health conditions, major depressive episode, and pain did not moderate the association between substance use disorders and age. However, generalized anxiety disorder was found to moderate the association between early emerging adulthood and alcohol use disorder. Specifically, among early emerging adults, the odds of reporting alcohol use disorder were higher for those without generalized anxiety disorder; however, among late emerging and young adults, odds were higher for respondents with generalized anxiety disorder. This finding supports previous research that suggests that risk processes for substance use disorders can differ due to age and developmental periods. For example, researchers have suggested that anxiety increases the risk of substance use disorders at age 16, but is unrelated to substance use disorders before this age (Sung, Erkanli, Angold, & Costello, 2004). Therefore, it is possible that generalized anxiety disorder has an important influence on the likelihood of developing alcohol use disorder in late emerging and young adulthood relative to early emerging adulthood.

Overall, our findings indicate that the nature of alcohol use disorder’s relationship with age may change depending on the presence or absence of generalized anxiety disorder.
Other potential mechanisms may also contribute to this finding. Research suggests that adolescents and early emerging adults with anxiety disorders portray interpersonal deficits and often abstain from social activities (Markowitz, Lipsitz, & Milrod, 2014; McKay & Storch, 2011). Since the onset of alcohol use and experimentation with alcohol commonly occurs in social settings during early emerging adulthood (Merikangas & McClair, 2012), early emerging adults with generalized anxiety disorder may have fewer opportunities to access alcohol and subsequently develop alcohol use disorder. However, our study was the first to demonstrate this moderating effect of generalized anxiety disorder on early emerging adulthood and alcohol use disorder. Future studies are warranted to ensure that this finding is evidence of true effect-modification and is not sample-dependent.

4.2.4. Sociodemographic and Health Correlates

Some notable associations between certain sociodemographic and health characteristics and substance use disorders identified in this study warrant discussion. First, the strong association between male gender and substance use disorders confirms findings from previous epidemiological population-based studies. Results from many studies have shown that males have higher rates of both substance use disorders as compared to females (Merikangas & McClair, 2012). For instance, similar to our study, Grant et al. (2015; 2016) found that males were twice as likely to report alcohol or drug use disorder as compared to females. Second, the negative association between immigrant status and substance use disorders supports the immigrant paradox – the concept that immigrants
have better developmental and educational outcomes including lower levels of substance use disorders as compared to their native-born counterparts (Coll & Marks, 2012; Hamilton, Noh, & Adlaf, 2009).

Third, there was a positive association between major depressive episode and substance use disorders, a finding that is highly consistent across studies. For example, a strong association between alcohol use disorder and major depressive episode has been observed; approximately 30 – 40% of alcoholics experience major depressive episode (Anthenelli, 2010). Furthermore, research has suggested that depressive disorders are the most common diagnosis among those in treatment for opioid disorders (Swendsen & Merikangas, 2000). Fourth, in our study, a positive association between generalized anxiety disorder and alcohol use disorder was noted. This finding was expected; anxiety disorders are frequently comorbid with alcohol use disorders (Alegría et al., 2010; Kushner, Abrams, & Borchardt, 2000; Yu et al., 2017). It is hypothesized that individuals with generalized anxiety disorder seek alcohol to cope with or escape from their anxiety (i.e., avoid negative affect). Although such usage can bring relief, the behaviour is negatively reinforced increasing the likelihood of continued use and alcohol abuse (Gorka et al., 2014; Thomas, Randall, & Carrigan, 2003). However, an association between generalized anxiety disorder and drug use disorder was not found. Given the widespread usage of drugs such as cannabis and opioids in managing anxiety among young people, this finding was unexpected. Moreover, generalized anxiety disorder has been shown to be associated with specific drug use disorders (i.e., opioid and cannabis disorder) in
previous research (Barry et al., 2016; Dorard et al., 2016; Welsh et al., 2017). However, large population-based surveys that did not assess drug-specific disorders have supported the finding from this thesis. For example, using the NESARC-III, Grant et al. (2016) found that generalized anxiety disorder was not associated with past year drug use disorder (OR = 1.2, 95% CI = 0.9 – 1.6). It is probable that aggregating all illicit drug use disorders (e.g., cannabis disorder, opioid disorder, etc.) into one category (i.e., drug use disorder) rendered this association statistically insignificant highlighting the need for drug-specific analyses.

Fifth, this thesis found that participants with three or more chronic health conditions were more likely to report drug use disorder as compared to those without such health conditions. Although participants with one or two chronic health conditions were more likely to report drug use disorder as compared to healthy controls – the association was not significant. There is a growing body of research that indicates that young adults with chronic conditions are more likely or at least similarly likely to engage in risky behaviors including substance use and eventual substance abuse as compared to their healthy peers. For example, using age-adjusted models, Wells, Golding, and Burnam (1989) found an increased prevalence of lifetime substance use disorders among persons with high blood pressure as compared to the general population with no chronic health conditions. Similarly, for persons with chronic lung disease, heart disease, and arthritis, there was an increased prevalence of lifetime substance use disorders. In another study, researchers from Switzerland compared the frequency of risky behaviours (including substance use)
among young people (16 – 20 years) with and without chronic health conditions. After controlling for academic track, gender, age, and even parental education, these researchers concluded that young people with chronic health conditions reported higher rates of illicit drug use (Suris, Michaud, Akre, & Sawyer, 2008). However, the association between the number of chronic health conditions and substance use disorders has not been studied. Based on the results from this thesis, we hypothesize that an increase in the number of chronic health conditions increases the odds of past year drug use disorder. This finding is similar to previous models that have suggested an increase in negative outcomes (e.g., elevated levels of pain, hospitalizations) with the increasing number of chronic health conditions (US Department of Health Human Services, 2010). Such negative outcomes have also been linked with substance use disorders, especially drug use disorder. In fact, similar to previous research, higher levels of pain were also positively associated with drug use disorder in this thesis (Fishbain, Rosomoff, & Rosomoff, 1992; Maruta, Swanson, & Finlayson, 1979).

Sixth, education and working status had complicated relationships with substance use disorders. Lower educational levels were positively associated with drug use disorder, but there was no association between educational levels and alcohol use disorder. Nonetheless, these findings were consistent with previous research among young people (Adams et al., 2014). In contrast, those working part- or full-time were more likely to report alcohol use disorder. However, a significant association between working status and drug use disorder was not found. Although working part- or full-time can have many
benefits for young people such as increased self-esteem, autonomy, and personal responsibility, it can also be a cause for psychological distress, especially for those young people still attending school (i.e., work-school conflict) (Arkes, 2007; Catalano et al., 2011; Wu, Schlenger, & Galvin, 2003). Consequently, alcohol use may be a response to such distress. Furthermore, alcohol abuse, especially among early emerging adults, might be attributable to increased income. The financial gain from working part- or full-time could fuel risky behaviours such as alcohol abuse (Wu et al., 2003). However, it is possible that the null finding between working status and drug use disorder was sample-dependent. Previous research has shown that working part- or full-time is associated with increased rates of alcohol and drug (especially cannabis) use (Wu et al., 2003). It is also probable that aggregating all illicit drug use disorders into one category rendered this association statistically insignificant. Furthermore, different study objectives, criteria for assessing substance use disorders, and study designs (e.g., distinctive conceptualizations of age sub-groups) can make comparisons across studies difficult. As such, research suggests that studies, especially those assessing substance use, often produce inconsistent results reflecting the vast differences in study methodologies (Substance Abuse and Mental Health Services Administration, 2015).

4.3. **Sources of Error**

For several decades, epidemiological surveys assessing substance use among adolescents and adults have been employed. However, as with any epidemiological survey, it is
important to assess the methodological quality and rigor of these surveys to ensure the
accuracy of estimates. The total survey error model is a useful theoretical framework for
epidemiological substance use surveys and research studies based on such surveys that
focuses on two classes of errors; representation and measurement (Groves, 2004; Johnson,
2014). A brief discussion of each class of error with regards to the CCHS-MH and this
thesis is presented below.

4.3.1. ERRORS OF REPRESENTATION

Errors of representation include those errors that impede a survey’s ability to mirror the
population being studied. These errors include; 1) coverage errors; 2) sampling errors; 3)
non-response errors; and 4) adjustment errors (Johnson, 2014).

Coverage Errors

As the name suggests, coverage errors occur if a sampling frame does not cover the
population being studied through employing sample frames that do not provide adequate
coverage or through sampling probability methods that inhibit some members of the
population from being sampled (Johnson, 2014). Although the CCHS-MH ensured that
all members of the population could be sampled, persons living on reserves and other
Aboriginal settlements, full-time members of the Canadian Forces, and the
institutionalized population were excluded from the sampling frame (Statistics Canada,
Some of these social groups that were systematically excluded from the CCHS-MH are associated with particularly high rates of substance use. For example, research comparing household settings with institutionalized settings has demonstrated that prevalence estimates for problem drinking and weekly drug use among institutionalized populations are significantly greater (Morehouse & Tobler, 2000; Weisner, Schmidt, & Tam, 1995). In light of these findings, although it is plausible that the results from the CCHS-MH and this study underestimated the prevalence of substance use disorders in the Canadian population, the excluded population only comprised of 3% of the target population.

**Sampling Errors**

Substance use surveys often apply probability and non-probability sampling methods. If sampling probability methods are applied, all elements within the sampling frames (e.g., households, respondents) have a known probability of selection. If the survey is focused on a special at-risk population, non-probability sampling methods are frequently used (Johnson, 2014). Because the CCHS-MH was a population-based survey, it employed the probability sampling methods. Therefore, the estimates produced from the CCHS-MH were subject to sampling errors. Strong methodological practices suggest that the magnitude of such sampling errors (e.g., standard errors) should be examined. For this thesis, the standard errors were small. However, as per Statistics Canada’s guidelines, the coefficient of variation estimates were also obtained for each estimate in this thesis. These
Coefficient of variation estimates were deemed “acceptable” by expert statisticians at the RDC and were without significant sampling error (Statistics Canada, 2013).

Non-response Errors

In general, population survey response rates have been declining over time (Groves, 2006; Groves, Dillman, Eltinge, & Little, 2002). While survey response rate can be an indicator for survey quality, recent research has suggested that nonresponse errors are not necessarily associated with the response rate. In fact, the differences between respondents and non-respondents should be the main concern for researchers, statisticians, and policymakers (Groves & Peytcheva, 2008; Merkle & Edelman, 2002). Unfortunately, data regarding non-respondents was not available. Thus, analyses examining the differences between respondents and non-respondents could not be conducted. This raised an important concern; given that heavy drinkers and illicit drug users are difficult to contact, less likely to cooperate, require more in-person contact attempts, and have higher attrition rates, it is possible that non-response errors had an effect on the estimates produced by the CCHS-MH (Beard, Lane, O'Fallon, Riggs, & Melton, 1994; Caetano, Ramisetty-Mikler, & McGrath, 2003; Cottler, Zipp, Robins, & Spitznagel, 1987; De Lint, 1981; Johnson, 2014; Permanen, 1974; Tibblin, 1965).

In the absence of the comparison between respondents and non-respondents, one useful strategy for assessing non-response errors is to compare the non-response rates across
large population-based surveys. For the CCHS-MH, the combined household- and person-level non-response rate was 31% (Statistics Canada, 2013). As compared to the NSDUH (non-response rate of 42%) and the NESARC-III (non-response rate of 40%), the non-response rate for the CCHS-MH was lower (Grant et al., 2016; Substance Abuse and Mental Health Services Administration, 2015). In addition, the CCHS-MH devoted considerable time, effort, and monetary resources to minimize such errors. For example, quality assurance measures (e.g., use of highly-qualified interviewers) were implemented at each step of data collection and processing. Because of such measures, the item non-response, even for sensitive topics such as substance use, was minimal. The CCHS-MH also made statistical adjustments to the weights of persons who responded to compensate for those individuals who did not respond (Statistics Canada, 2013). However, we recognize that these measures are unlikely to eliminate non-response errors completely.

*Adjustment Errors*

If the substance use survey fails to account for the complexity of the sampling design and data collection methodologies, adjustment errors can arise (Johnson, 2014). For the CCHS-MH, sample weights created by Statistics Canada were available. These weights were adjusted and calibrated for the sampling design, the household- and the person-level non-response, and the population estimates (Statistics Canada, 2013). These weights were applied to our analyses to avoid adjustment errors.
4.3.2. Errors of Measurement

Errors of measurement involve failures in correctly conceptualizing the measured constructs (specification errors), the possibility of external factors influencing measurement quality (measurement errors), defects in construction of data sets (processing errors), and difficulties in understanding and inferring results from survey data (inferential errors) (Johnson, 2014).

*Specification Errors*

In substance use surveys, specification errors occur when questionnaires do not conceptualize or operationalize the constructs of substance use correctly (Johnson, 2014). For example, illicit drug names used in the survey questionnaires should be consistent with the names employed by users in the community (Ouellet, Cagle, & Fisher, 1997). Furthermore, for accuracy and correctness, instead of global questions, specific questions regarding all types of substances (e.g., alcohol, cannabis, cocaine) should be asked. Often times, global questions can fail to detect experiences with less common illicit drugs (Johnson, 2014). The CCHS-MH avoided specification errors by assessing abuse of alcohol and ten separate categories of illicit drugs independently, using common drug names (e.g., crack), and employing validated instruments to measure substance use and other psychiatric disorders (Statistics Canada, 2013).
**Measurement Errors**

Sometimes, survey questionnaires can fail to measure what they were designed to measure. Such failures lead to measurement errors. When analyzing survey data, measurement errors can have several potential sources such as design-related errors, respondent errors, and interviewer errors (Johnson, 2014).

Design-related Errors: Respondents can often receive cues regarding the information that is being sought by substance use surveys from the interviewer or the questionnaire itself. Such cues can influence self-reports of substance use and can lead to design-related errors. Because every element of a survey that is exposed to a respondent can provide cues, design-related errors arise from a variety of different sources (Greenfield & Kerr, 2008). First, the methods used for asking respondents about substance use (e.g., wording of questionnaires) can have a large impact on the answers obtained. For example, open-ended questions lead to underestimated substance use prevalence rates (Kroutil, Vorburger, Aldworth, & Colliver, 2010). In the CCHS-MH, the graduated-frequency question response format was used. This format produces higher estimates of substance use and can measure irregularly high and variable levels of alcohol or illicit drug consumption. As such, this method of information collection is considered more precise and superior as compared to the commonly-used quantity-frequency, recent recall, and open ended question response formats (Dawson, 1998; Hilton, 1989; Midanik, 1994; Poikolainen, Podkletnova, & Alho, 2002; Sobell & Sobell, 1995; Stockwell et al., 2004).
Second, substance use reference periods can also impact the quality of a substance use survey. The past month and the past year reference periods (used in the CCHS-MH) are the most commonly used. While the past month reference period is less likely to be associated with recall accuracy delays, it can be affected by seasonal variations in substance use and often fails to capture binge drinking episodes (Bachman & O'Malley, 1981; Cho, Johnson, & Fendrich, 2001). Third, different modes of survey data collection can lead to different prevalence estimates (Johnson, 2014). For example, survey modes such as the CCHS-MH that rely on interviewers to ask about substance use obtain estimates that are lower than survey modes that rely on self-administration (Aquilino, 1994; Aquilino & Sciuto, 1990).

Respondent and Interviewer Errors: If a respondent provides untrue and inaccurate information, respondent errors can occur. The ability and willingness of survey respondents to provide true and accurate information regarding their substance use behaviours varies considerably and can be influenced by several factors such as the respondent’s interpretation of the question being asked, memory retrieval, and response editing (Johnson, 2014). First, although methodologists and researchers attempt to employ appropriate and easily understandable terminology, miscommunications may occur. For example, in alcohol research, respondents can misinterpret the size of a standard drink. However, the CCHS-MH attempted to minimize such miscommunications by utilizing trained interviewers that were encouraged to clarify the respondents’ concerns, employing detailed and easily understandable questionnaires, and providing definitions of
measurement units (e.g., a drink) to the respondents (Statistics Canada, 2013). Second, similar to most epidemiological surveys, the CCHS-MH examined self-reports of substance use and therefore, was heavily reliant on respondent memory retrieval. It is well-understood that the accuracy of respondent recall can have large impacts on the obtained substance use estimates (Johnson, 2014; Sudman, Bradburn, & Schwarz, 1996). Furthermore, research suggests that respondent recall varies between respondents; respondents that are heavy users of alcohol and illicit drugs can have memory deficiencies (Ardila, Rosselli, & Strumwasser, 1991; Bolla, McCann, & Ricaurte, 1998; Ryback, 1971; van Gorp et al., 1999; Zakzanis & Young, 2001). Thus, the respondents that are more likely to be afflicted with substance use disorders are likely to underreport substance use and abuse. Third, if the respondent understands the question adequately, retrieves the answer from his/her memory, the respondent still has to decide if they want to share that answer with the researcher. Often times, respondents will make decisions to underreport or deny substance use behaviours due to the societal stigma associated with such behaviours (Johnson, 2014). This desire of the respondent to present themselves in a favorable manner is referred to as the social desirability bias. Research in the methodology literature has shown that respondents are likely to overreport desirable behaviours (e.g., exercise) and underreport undesirable behaviours (e.g., substance use) to avoid feelings of shame and possible legal sanctions (Grimm, 2010; Krumpal, 2013; Tourangeau & Yan, 2007). However, given the strict confidentiality provisions of the CCHS-MH, incentives for inaccurate reporting were minimized (Statistics Canada, 2013).
Not only respondents, but interviewers can also lead to potential errors. For instance, interviewers could intentionally misread questions, ignore methodological protocols, and falsify results (Johnson, 2014; Johnson, Parker, & Clements, 2001). Interviewers can also affect the results of a survey unknowingly. For example, interviewers associated with a government body (e.g., Statistics Canada) obtain lower substance use prevalence estimates (Grucza, Abbacchi, Przybeck, & Gfroerer, 2007). Likewise, experienced interviewers obtain fewer reports of substance use behaviours (Chromy, Eyerman, Odom, McNeeley, & Hughes, 2005). Furthermore, similarities and differences between the interviewers and respondents can have effects on substance use reporting (Johnson, Fendrich, Shaligram, Garcy, & Gillespie, 2000). For example, male respondents are more likely to report greater levels of alcohol consumption to female interviewers and female respondents are more likely to report greater levels of alcohol consumption to male interviewers (Mulford & Miller, 1959). For the CCHS-MH, data regarding the sociodemographic characteristics of the interviewers was not available. As such, it is possible that the estimates obtained from the CCHS-MH were influenced by interviewer errors.

*Processing and Inferential Errors*

Post data-collection, a final survey dataset must be constructed. Problems with coding, editing, and data-entry can compromise the integrity of this dataset (Johnson, 2014). The CCHS-MH dataset was constructed by expert statisticians, methodologists, and
researchers. Moreover, the CCHS-MH provided detailed and careful documentation indicating the veracity of the post data-collection processes (Statistics Canada, 2013). Therefore, the CCHS-MH is unlikely to have processing errors. In the absence of processing errors, inferential errors were avoided by employing sound methodological designs and appropriate analytical procedures as per the Statistics Canada guidelines. For example, standard errors were bootstrapped and weights provided by Statistics Canada were applied to all analyses to ensure representativeness of the obtained estimates to the Canadian population (Statistics Canada, 2013).

4.4. LIMITATIONS, STRENGTHS, AND SUGGESTIONS FOR FUTURE RESEARCH

4.4.1. LIMITATIONS

In accordance with the interpretations described above, there are some limitations to our study. First, although strategies to mitigate inaccuracies were implemented, the CCHS-MH was associated with some sources of error, mainly nonresponse errors and measurement errors (e.g., social desirability errors, recall errors). Based on these errors, the prevalence estimates from this thesis are likely to be conservative. Second, the CCHS-MH was a cross-sectional survey. Thus, temporal associations between age and substance use disorders could not be assessed. Third, although we statistically controlled for certain sociodemographic and health correlates of substance use in our logistic regression models, we were unable to control for one potentially important variable; current student status
(e.g., currently attending college or university). While questions regarding current student status are asked in the CCHS-MH, all types of educational institutions (e.g., secondary school, college, university) are aggregated into one category. Research has suggested that the risk for substance use disorders varies according to the type (e.g., secondary school, university) and level (e.g., graduate, undergraduate) of educational institution; university or college students are likely to report higher levels of substance abuse as compared to their non-college peers but secondary school students are likely to report lower levels of substance abuse as compared to their non-secondary school age-peers (Carter, Brandon, & Goldman, 2010; Townsend, Flisher, & King, 2007). Fourth, mental disorders including substance use disorders were identified based on the WHO-CIDI and the DSM-IV screening measures. Although these measures have good psychometric properties, prevalence estimates based on clinical diagnoses may differ. Therefore, prevalence rates reported in this thesis should be interpreted as estimates rather than definitive diagnoses. Fifth, due to sparse data, we only controlled for certain mental disorders (i.e., major depressive episode and generalized anxiety disorder). However, research has also pinpointed the strong association between substance use disorders and other mental disorders such as bipolar disorder (Grant et al., 2015; Grant et al., 2016; Grant et al., 2004). Sixth, we aggregated drug-specific disorders (e.g., cannabis disorder, cocaine disorder) into one category (i.e., drug use disorder). However, the prevalence rates and associations between age, sociodemographic measures, and health variables and drug-specific disorders may differ among early emerging, late emerging, and young adults based on the drug use disorder of interest.
4.4.2. **Strengths and Future Research**

The limitations of this study were offset by the various strengths that include a large sample size, minimal missing data, reliable and valid measures of substance use disorders and other psychopathologies, and rigorous methodological methods (e.g., use of weights to adjust for non-response errors). This study was also novel as it included the full-spectrum of emerging adulthood, provided current and comprehensive Canadian information on alcohol and drug use disorder for emerging and young adults, and was the first study that assessed age sub-group differences among early and late emerging for substance use disorders.

Results from this study lay important groundwork for future studies. First, a deeper understanding of the role of comorbidity between alcohol and drug use disorders among young people is required. As compared to healthy individuals, persons with alcohol use disorder are at a greater risk for drug use disorder – and vice versa (Grant et al., 2015; Grant et al., 2016). Such individuals may require specialized pharmacological and psychosocial treatments that address both conditions. Second, there has been limited research studying drug-specific disorders among emerging and young adults. Since young people and governmental bodies are more likely to approve of specific drug types (e.g., cannabis) as compared to others (e.g., cocaine) (Senate of Canada, 2002), drug-specific analyses are required. Third, longitudinal studies assessing the temporal association between age and substance use disorders are needed to assess the trends in substance
abuse over time and address the following questions; 1) do early emerging adults maintain their substance abuse levels from early to late emerging adulthood?; 2) do late emerging adults maintain their substance abuse levels from late emerging adulthood to young adulthood?; and 3) what factors (e.g., environmental conditions, genetics) play a role in the persistence or decline in substance abuse from early emerging adulthood to late emerging adulthood? Fourth, studies need to examine age sub-group differences between early emerging, late emerging, and young adults for treatment-seeking rates for substance use disorders. Limited research has suggested that emerging adults are doubly disadvantaged – engage in risky behaviours such as substance use and abuse at a higher rate than young adults but are less likely to seek treatment (Adams et al., 2014). Fifth, additional studies are required to validate the findings from this study. Because this thesis was one of the few Canadian studies assessing substance use disorders among young people and the first study assessing age sub-group differences between early and late emerging adults for substance use disorders, the models presented in this thesis should be replicated using other, preferably Canadian, datasets. Although this study provides baseline estimates, we encourage other researchers to advance these findings by analyzing trends of substance abuse over time, especially given the rapidly changing political climates and legislative policies (e.g., legalization of cannabis).

4.5. IMPLICATIONS
The findings presented above suggest the need for tailored programs and a greater systematic focus on preventing and treating substance use disorders among young people, especially emerging adults. Thus, integration and coordination of services within and across public sectors for young people with substance use disorders is required. Previous literatures states that the assessment and treatment of substance abuse is cost-effective and holds significant benefits for the afflicted individual and the society (Ettner et al., 2006). Within the health system, brief screening, early interventions, and empirically validated treatment approaches such as cognitive-behavioural therapies and motivational enhancement in primary and tertiary care settings have been deemed to be effective for individuals with substance use problems (Grant et al., 2015; Grant et al., 2016). Special attention should be given to early emerging adults – substance abuse rates during this period are the highest and can have lifelong consequences (Arnett, 2005). Early interventions aimed at early emerging adults, especially males, could also reduce the persistence of substance use disorders to later developmental periods and prevent loss of functional impairment (Carney & Myers, 2012; Substance Abuse and Mental Health Services Administration, 2016). Furthermore, the education system is uniquely positioned to deliver broad risk-reduction strategies that have sustained effectiveness and reduce stigma associated with seeking addiction and mental services (Kratochwill & Shernoff, 2004; Weare & Nind, 2011). Finally, social services can integrate their services with the education system to support participation, social and employment opportunities, and community engagement for young people thereby facilitating the prevention or reduction of substance use (Baggio et al., 2015). However, programs and policies should recognize
the unique aspects of this developmental period that have contributed to decreased usage of services (e.g., transition out of pediatric healthcare system, less family involvement) to aid this vulnerable population more effectively (Singh et al., 2010). As such, services that uniquely target emerging adults may be required. For example, in the United Kingdom, Youthspace works with general practitioners to treat mental illnesses among 16 – 25 year olds (McGorry, Bates, & Birchwood, 2013). In the absence of recent epidemiological evidence for substance use disorders in young people, the results from this study can help inform the development and implementation of such programs in Canada.
4.6. REFERENCES


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CHAPTER FIVE: CONCLUSIONS

The purpose of this thesis was to provide a national profile of substance use disorders among emerging and young adults. An analysis of a large representative Canadian sample was completed. We documented a high prevalence burden of substance use disorders in young people (i.e., substance use disorders among young people are common). Results revealed that as compared to young adults, early and late emerging adults are at a greater risk for substance use disorders. Therefore, results from this thesis lend strong support to previous models that suggest a greater prevalence of substance use disorders among emerging adults. Such findings suggest that emerging adulthood is a critical developmental period that should be targeted to prevent substance use disorders from occurring and persisting to later developmental periods. There is an urgent need to educate health professionals, educators, and those in social services to battle the stigma surrounding substance use disorders, integrate and coordinate services within and across public sectors for emerging adults with substance use disorders, and develop focused prevention and intervention programs from an asset building perspective (i.e., promoting healthy development and enhancing resiliency), thereby reducing the personal suffering and adverse societal impacts of substance use disorders in Canada. Although additional research assessing the economic costs, treatment rates, chronicity, co-morbidity of substance use disorders, and potential moderating and mediating factors in this population is warranted, the future of substance use research among young people is bright.
Table 1. Measures included in hierarchical logistic regression models.

<table>
<thead>
<tr>
<th>Model</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age groups: early emerging adulthood, late emerging adulthood, young adults (control group)</td>
</tr>
<tr>
<td>2</td>
<td>Model 1 + Psychiatric disorders (major depressive episode, generalized anxiety disorder)</td>
</tr>
<tr>
<td>3</td>
<td>Model 2 + Pain + Sociodemographic covariates (participant sex, education, working status, immigration status, and household income)</td>
</tr>
<tr>
<td>4</td>
<td>Model 3 + Product-term interactions between participant sex, the number of chronic health conditions, major depressive episode, generalized anxiety disorder, pain, and age</td>
</tr>
</tbody>
</table>
Table 2. Percentage of missing data for each measure included in the analysis.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Missing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sociodemographic Characteristics</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.00</td>
</tr>
<tr>
<td>Sex</td>
<td>0.00</td>
</tr>
<tr>
<td>Education</td>
<td>0.34</td>
</tr>
<tr>
<td>Household income</td>
<td>0.00</td>
</tr>
<tr>
<td>Working status</td>
<td>0.57</td>
</tr>
<tr>
<td>Immigrant</td>
<td>0.34</td>
</tr>
<tr>
<td>Health Characteristics</td>
<td></td>
</tr>
<tr>
<td>Major depressive episode</td>
<td>0.40</td>
</tr>
<tr>
<td>Generalized anxiety disorder (GAD)</td>
<td>0.47</td>
</tr>
<tr>
<td>Chronic health conditions</td>
<td>0.00</td>
</tr>
<tr>
<td>Pain</td>
<td>0.04</td>
</tr>
<tr>
<td>Substance Use Disorders</td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td>1.17</td>
</tr>
<tr>
<td>Drug</td>
<td>0.74</td>
</tr>
</tbody>
</table>
Table 3. Weighted logistic regression analysis for measures that predict missingness of the outcome variables.

<table>
<thead>
<tr>
<th>Measure</th>
<th>OR</th>
<th>SE</th>
<th>P-value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sociodemographic Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 – 22 years</td>
<td>0.77</td>
<td>0.23</td>
<td>0.39</td>
<td>0.42 - 1.40</td>
</tr>
<tr>
<td>23 – 29 years</td>
<td>1.10</td>
<td>0.33</td>
<td>0.75</td>
<td>0.61 - 1.99</td>
</tr>
<tr>
<td>Male</td>
<td>1.25</td>
<td>0.30</td>
<td>0.35</td>
<td>0.78 - 1.99</td>
</tr>
<tr>
<td>Education</td>
<td>1.02</td>
<td>0.09</td>
<td>0.78</td>
<td>0.87 - 1.21</td>
</tr>
<tr>
<td>Income</td>
<td>1.15</td>
<td>0.05</td>
<td>0.46</td>
<td>0.97 - 1.25</td>
</tr>
<tr>
<td>Working status</td>
<td>1.18</td>
<td>0.16</td>
<td>0.24</td>
<td>0.90 - 1.55</td>
</tr>
<tr>
<td>Immigrant</td>
<td>0.55</td>
<td>0.21</td>
<td>0.12</td>
<td>0.26 - 1.18</td>
</tr>
<tr>
<td><strong>Health Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major depressive episode</td>
<td>0.92</td>
<td>0.44</td>
<td>0.86</td>
<td>0.36 - 2.36</td>
</tr>
<tr>
<td>Generalized anxiety disorder</td>
<td>1.67</td>
<td>1.79</td>
<td>0.63</td>
<td>0.21 - 13.54</td>
</tr>
<tr>
<td>Chronic health conditions</td>
<td>1.00</td>
<td>0.18</td>
<td>0.99</td>
<td>0.70 - 1.42</td>
</tr>
<tr>
<td>Pain</td>
<td>1.24</td>
<td>0.25</td>
<td>0.30</td>
<td>0.83 - 1.84</td>
</tr>
</tbody>
</table>

Results are reported as odds ratios (OR), bootstrapped standard errors (SE), P-values, and 95% confidence intervals (CI). No significant findings were found.
Table 4. Weighted sample characteristics by age groups.

<table>
<thead>
<tr>
<th>Sociodemographic Characteristics</th>
<th>15 - 22</th>
<th>23 - 29</th>
<th>30 - 39</th>
<th>Design-Based F (P-Value)</th>
<th>Pairwise Comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>51.0</td>
<td>54.7</td>
<td>47.6</td>
<td>5.9 (0.003)</td>
<td>A,B&gt;C</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school diploma</td>
<td>39.1</td>
<td>8.3</td>
<td>7.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school diploma</td>
<td>42.0</td>
<td>22.9</td>
<td>18.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade certificate or diploma</td>
<td>3.1</td>
<td>11.2</td>
<td>10.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-university certificate or diploma</td>
<td>10.2</td>
<td>24.3</td>
<td>24.6</td>
<td>90.5 (&lt;0.001)</td>
<td>C&gt;B&gt;A</td>
</tr>
<tr>
<td>University certificate below bachelor’s level</td>
<td>3.0</td>
<td>5.0</td>
<td>4.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree or above</td>
<td>2.5</td>
<td>28.3</td>
<td>34.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤19,999</td>
<td>10.1</td>
<td>7.7</td>
<td>6.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$20,000 to $29,999</td>
<td>7.9</td>
<td>8.7</td>
<td>6.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$30,000 to $39,999</td>
<td>8.4</td>
<td>8.2</td>
<td>8.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$40,000 to $49,999</td>
<td>6.9</td>
<td>8.9</td>
<td>7.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$50,000 to $59,999</td>
<td>9.5</td>
<td>9.0</td>
<td>9.6</td>
<td>1.6 (0.054)</td>
<td></td>
</tr>
<tr>
<td>$60,000 to $69,999</td>
<td>8.0</td>
<td>8.8</td>
<td>7.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$70,000 to $79,999</td>
<td>7.1</td>
<td>8.3</td>
<td>8.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$80,000 to $89,999</td>
<td>6.9</td>
<td>6.7</td>
<td>8.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$90,000 to $99,999</td>
<td>5.2</td>
<td>5.5</td>
<td>5.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥$100,000</td>
<td>30.0</td>
<td>28.2</td>
<td>32.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A (15-22)</td>
<td>B (23-29)</td>
<td>C (30-39)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>25.6</td>
<td>64.9</td>
<td>66.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part-time</td>
<td>27.3</td>
<td>9.8</td>
<td>8.2</td>
<td>140.0 (&lt;0.001)</td>
<td>B,C&gt;A</td>
</tr>
<tr>
<td>Not working</td>
<td>47.1</td>
<td>25.3</td>
<td>25.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immigrant</td>
<td>14.3</td>
<td>23.6</td>
<td>29.3</td>
<td>36.0 (&lt;0.001)</td>
<td>C&gt;B&gt;A</td>
</tr>
</tbody>
</table>

**Health Characteristics**

<table>
<thead>
<tr>
<th>Condition</th>
<th>A (15-22)</th>
<th>B (23-29)</th>
<th>C (30-39)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major depressive episode</td>
<td>6.9</td>
<td>6.3</td>
<td>5.5</td>
</tr>
<tr>
<td>Generalized anxiety disorder</td>
<td>2.5</td>
<td>2.4</td>
<td>3.1</td>
</tr>
</tbody>
</table>

**Number of chronic health conditions**

<table>
<thead>
<tr>
<th>Number of Conditions</th>
<th>A (15-22)</th>
<th>B (23-29)</th>
<th>C (30-39)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>59.6</td>
<td>58.7</td>
<td>54.0</td>
</tr>
<tr>
<td>1</td>
<td>22.5</td>
<td>21.4</td>
<td>24.9</td>
</tr>
<tr>
<td>2</td>
<td>10.4</td>
<td>10.6</td>
<td>11.2</td>
</tr>
<tr>
<td>3 or more</td>
<td>7.5</td>
<td>9.3</td>
<td>10.0</td>
</tr>
</tbody>
</table>

**Pain**

<table>
<thead>
<tr>
<th>Pain Level</th>
<th>A (15-22)</th>
<th>B (23-29)</th>
<th>C (30-39)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>90.7</td>
<td>87.1</td>
<td>86.4</td>
</tr>
<tr>
<td>Mild</td>
<td>3.7</td>
<td>6.0</td>
<td>5.6</td>
</tr>
<tr>
<td>Moderate or severe</td>
<td>5.6</td>
<td>6.9</td>
<td>8.1</td>
</tr>
</tbody>
</table>

Data are percentages. The various age groups were compared using $\chi^2$ tests. If the comparison between age groups was significant, pairwise contrasts were made. Age groups: A, 15-22 year olds (early emerging adults); B, 23-29 year olds (late emerging adults); C, 30-39 year olds (young adults).
Table 5. Weighted age- and sex-specific prevalence of alcohol use disorder.

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>15 - 22 (95% CI)</th>
<th>23 - 29 (95% CI)</th>
<th>30 - 39 (95% CI)</th>
<th>Design-based F (P-Value)</th>
<th>Pairwise Contrasts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both sexes</td>
<td>8.0 (6.6 - 9.3)</td>
<td>6.6 (5.0 - 8.2)</td>
<td>2.7 (2.0 - 3.3)</td>
<td>23.0 (&lt;0.001)</td>
<td>A,B&gt;C</td>
</tr>
<tr>
<td>Male</td>
<td>10.4 (8.2 - 12.5)</td>
<td>8.6 (5.9 - 11.2)</td>
<td>3.7 (2.7 - 4.8)</td>
<td>12.8 (&lt;0.001)</td>
<td>A,B&gt;C</td>
</tr>
<tr>
<td>Female</td>
<td>5.5 (4.0 - 6.9)</td>
<td>4.2 (2.5 - 5.8)</td>
<td>1.7 (0.8 - 2.6)</td>
<td>9.4 (&lt;0.001)</td>
<td>A,B&gt;C</td>
</tr>
<tr>
<td>Design-based F (P-Value)</td>
<td>15.5 (&lt;0.001)</td>
<td>8.8 (0.003)</td>
<td>7.2 (0.007)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are percentages and 95% confidence intervals (CI). Alcohol use disorder across the various age groups was compared using χ² tests and pairwise contrasts were made. Age groups: A, 15-22 year olds (early emerging adults); B, 23-29 year olds (late emerging adults); C, 30-39 year olds (young adults).

Table 6. Weighted age- and sex-specific prevalence of drug use disorder.

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>15 - 22 (95% CI)</th>
<th>23 - 29 (95% CI)</th>
<th>30 - 39 (95% CI)</th>
<th>Design-based F (P-Value)</th>
<th>Pairwise Contrasts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both sexes</td>
<td>6.4 (5.1 - 7.6)</td>
<td>3.6 (2.5 - 4.7)</td>
<td>1.3 (0.8 - 1.8)</td>
<td>30.5 (&lt;0.001)</td>
<td>A&gt;B&gt;C</td>
</tr>
<tr>
<td>Male</td>
<td>8.1 (6.1 - 10.0)</td>
<td>5.3 (3.3 - 7.2)</td>
<td>2.1 (1.3 - 2.9)</td>
<td>15.9 (&lt;0.001)</td>
<td>A,B&gt;C</td>
</tr>
<tr>
<td>Female</td>
<td>4.6 (3.0 - 6.2)</td>
<td>1.5 (0.7 - 2.3)</td>
<td>0.6 (0.1 - 1.2)</td>
<td>16.4 (&lt;0.001)</td>
<td>A&gt;B,C</td>
</tr>
<tr>
<td>Design-based F (P-Value)</td>
<td>7.5 (0.006)</td>
<td>16.5 (&lt;0.001)</td>
<td>6.4 (0.011)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are percentages and 95% confidence intervals (CI). Drug use disorder across the various age groups was compared using χ² tests and pairwise contrasts were made. Age groups: A, 15-22 year olds (early emerging adults); B, 23-29 year olds (late emerging adults); C, 30-39 year olds (young adults).
Table 7. Weighted logistic regression models for alcohol use disorder.

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th></th>
<th></th>
<th>Model 2</th>
<th></th>
<th></th>
<th>Model 3</th>
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<tr>
<td></td>
<td>OR</td>
<td>SE</td>
<td>95% CI</td>
<td>OR</td>
<td>SE</td>
<td>95% CI</td>
<td>OR</td>
<td>SE</td>
<td>95% CI</td>
</tr>
<tr>
<td><strong>Sociodemographic Characteristics</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Age</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-22 years</td>
<td>3.17</td>
<td>0.51</td>
<td>2.31 - 4.34</td>
<td>3.04</td>
<td>0.62</td>
<td>2.04 - 4.55</td>
<td>3.23</td>
<td>0.67</td>
<td>2.15 - 4.85</td>
</tr>
<tr>
<td>23-29 years</td>
<td>2.57</td>
<td>0.48</td>
<td>1.79 - 3.70</td>
<td>2.33</td>
<td>0.44</td>
<td>1.61 - 3.37</td>
<td>2.37</td>
<td>0.45</td>
<td>1.64 - 3.43</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td>2.07</td>
<td>0.29</td>
<td>1.58 - 2.73</td>
<td>2.25</td>
<td>0.31</td>
<td>1.72 - 2.94</td>
</tr>
<tr>
<td>Education</td>
<td>1.04</td>
<td>0.06</td>
<td>0.93 - 1.16</td>
<td>1.03</td>
<td>0.06</td>
<td>0.92 - 1.16</td>
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</tr>
<tr>
<td>Income</td>
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<td>0.99 - 1.08</td>
<td>1.03</td>
<td>0.02</td>
<td>0.98 - 1.07</td>
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<tr>
<td>Working status</td>
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<td>0.77</td>
<td>0.06</td>
<td>0.65 - 0.90</td>
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<td>0.06</td>
<td>0.64 - 0.88</td>
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<td>Immigrant</td>
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<td>0.11</td>
<td>0.22 - 0.65</td>
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<td>0.12</td>
<td>0.24 - 0.72</td>
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<td><strong>Health Characteristics</strong></td>
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<td>Number of chronic health conditions</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1.02</td>
<td>0.16</td>
<td>0.75 - 1.39</td>
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<td>2</td>
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<td></td>
<td>0.97</td>
<td>0.24</td>
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<td>3 or more</td>
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<td></td>
<td>1.11</td>
<td>0.30</td>
<td>0.65 - 1.89</td>
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<tr>
<td>Pain</td>
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<td>1.10</td>
<td>0.13</td>
<td>0.88 - 1.38</td>
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<tr>
<td>Major depressive episode</td>
<td></td>
<td></td>
<td></td>
<td>2.19</td>
<td>0.53</td>
<td><strong>1.37 - 3.51</strong></td>
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<td></td>
</tr>
<tr>
<td>Generalized anxiety disorder</td>
<td></td>
<td></td>
<td></td>
<td>2.53</td>
<td>0.83</td>
<td><strong>1.34 - 4.80</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results are reported as odds ratios (OR), bootstrapped standard errors (SE), and 95% confidence intervals (CI). Significant findings are shown in bold.
Table 8. Weighted logistic regression models for drug use disorder.

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>SE</td>
<td>95% CI</td>
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<td><strong>Sociodemographic Characteristics</strong></td>
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<tr>
<td>Age</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>15-22 years</td>
<td>5.07</td>
<td>1.11</td>
<td>3.29 - 7.80</td>
</tr>
<tr>
<td>23-29 years</td>
<td>2.75</td>
<td>0.69</td>
<td>1.69 - 4.48</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.30</td>
<td>0.43</td>
<td>1.60 - 3.31</td>
</tr>
<tr>
<td>Education</td>
<td></td>
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</tr>
<tr>
<td>Education</td>
<td>1.23</td>
<td>0.08</td>
<td>1.09 - 1.39</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
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<tr>
<td>Income</td>
<td>1.03</td>
<td>0.03</td>
<td>0.97 - 1.08</td>
</tr>
<tr>
<td>Working Status</td>
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<tr>
<td>Working Status</td>
<td>0.94</td>
<td>0.10</td>
<td>0.76 - 1.16</td>
</tr>
<tr>
<td>Immigrant</td>
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<tr>
<td>Immigrant</td>
<td>0.30</td>
<td>0.11</td>
<td>0.15 - 0.64</td>
</tr>
<tr>
<td><strong>Health Characteristics</strong></td>
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<tr>
<td>Number of chronic health conditions</td>
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<td></td>
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<tr>
<td>3 or more</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major depressive episode</td>
<td>1.45</td>
<td>0.21</td>
<td>1.09 - 1.94</td>
</tr>
<tr>
<td>Generalized anxiety disorder</td>
<td>1.51</td>
<td>0.60</td>
<td>0.70 - 3.27</td>
</tr>
</tbody>
</table>

Results are reported as odds ratios (OR), bootstrapped standard errors (SE), and 95% confidence intervals (CI). Significant findings are shown in bold.
Table 9. Moderating effects of sex and health characteristics on the association between age and substance use disorders.

<table>
<thead>
<tr>
<th></th>
<th>Alcohol Use Disorder</th>
<th>Drug Use Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>SE</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-22 years</td>
<td>1.04</td>
<td>0.38</td>
</tr>
<tr>
<td>23-29 years</td>
<td>1.02</td>
<td>0.44</td>
</tr>
<tr>
<td>Number of chronic health conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-22 years</td>
<td>0.63</td>
<td>0.36</td>
</tr>
<tr>
<td>23-29 years</td>
<td>1.30</td>
<td>0.80</td>
</tr>
<tr>
<td>Major depressive episode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-22 years</td>
<td>0.78</td>
<td>0.43</td>
</tr>
<tr>
<td>23-29 years</td>
<td>1.19</td>
<td>0.73</td>
</tr>
<tr>
<td>Generalized anxiety disorder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-22 years</td>
<td><strong>0.27</strong></td>
<td><strong>0.17</strong></td>
</tr>
<tr>
<td>23-29 years</td>
<td>0.33</td>
<td>0.25</td>
</tr>
<tr>
<td>Pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-22 years</td>
<td>1.21</td>
<td>0.67</td>
</tr>
<tr>
<td>23-29 years</td>
<td>0.79</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Results are reported as odds ratios (OR), bootstrapped standard errors (SE), and 95% confidence intervals (CI) for the product-term interactions between the moderator (sex, number of chronic health conditions, major depressive episode, generalized anxiety disorder, and pain) and age [early emerging adults (15-22 years) and late emerging adults (23-29 years)] for each outcome. Significant findings are shown in bold.
Figure 1. Past month prevalence of alcohol and drug use among emerging adults from Monitoring the Future (MTF) study and the National Survey on Drug Use and Health (NSDUH). The conceptualization of emerging adulthood varied across studies: 19 – 24 years old (MTF) and 18 – 25 (NSDUH).
Figure 2. Past year prevalence of alcohol and illicit drug use among emerging adults from Monitoring the Future (MTF) study, the National Survey on Drug Use and Health (NSDUH), and the Canadian Tobacco, Alcohol, and Drugs Survey (CTADS). The conceptualization of emerging adulthood varied across studies: 19 – 24 years old (MTF), 18 – 25 (NSDUH), and 20 – 24 (CTADS).
Figure 3. Prevalence of substance use disorders among emerging and young adults. The error bars represent the standard errors associated with each prevalence estimate.
Figure 4. Sex-specific prevalence of alcohol use disorder among emerging and young adults. The error bars represent the standard errors associated with each prevalence estimate.
Figure 5. Sex-specific prevalence of drug use disorder among emerging and young adults. The error bars represent the standard errors associated with each prevalence estimate.
Appendix 1: Diagnostic algorithms and screening threshold for alcohol use disorder.

A1. Alcohol Use Disorder

This measure identified individuals that met the WHO-CIDI and the DSM-IV criteria, modified for the CCHS-MH, for alcohol abuse or dependence within the 12-months prior to the interview.

A1.1. Screening Threshold

For the CCHS-MH, an alcohol consumption threshold was used to screen individuals into the alcohol abuse or dependence questions. This threshold was based on the WHO-CIDI screening threshold. Although the CCHS-MH used the same screening threshold as the WHO-CIDI for the alcohol abuse questions, the consumption screening threshold for the dependence questions was increased (Statistics Canada, 2013). This increase in threshold was based on findings from the CCHS-MH pilot study that indicated that respondents with levels of alcohol consumption just above the WHO-CIDI threshold did not meet the criteria for alcohol dependence. The increase in threshold was approved by a group of academic experts and helped reduce respondent burden. Moreover, this threshold maintained 100% sensitivity of the measuring instrument and ensured comparability with the WHO-CIDI (Statistics Canada, 2013).
The threshold to screen individuals into the alcohol abuse questions was as follows:

1) Respondent drank at least 12 drinks in a year; and

2) Respondent drank at least once a week during the year that they drank the most or,

3) If the respondent drank less frequently than once a week, the respondent usually had three drinks or more on the days that they drank (Statistics Canada, 2013).

The threshold to screen individuals into the alcohol dependence questions was as follows:

1) Respondent drank at least 12 drinks in a year; and

2) Respondent drank at least four times a week during the year that they drank the most or,

3) If the respondent drank less frequently than four times a week, the respondent usually had five drinks or more on the days that they drank (Statistics Canada, 2013).

If the respondents met the criteria explained above, questions regarding lifetime alcohol dependence or abuse were asked. If the threshold above was not met, the respondents were characterized as not meeting the criteria for alcohol use disorder.

A1.2. **LIFETIME ALCOHOL ABUSE OR DEPENDENCE**
Following the screening threshold, questions regarding lifetime alcohol abuse or dependence were asked. For the CCHS-MH, respondents met the criteria for lifetime alcohol dependence if they experienced the following:

1) At least three of the seven symptoms of alcohol dependence:
   a) Tolerance (need for larger amounts of alcohol to achieve desired effect or diminished effect from continued use of same amount of alcohol);
   b) Withdrawal (alcohol withdrawal syndrome or usage of alcohol to avoid withdrawal symptoms);
   c) Increased consumption (larger amounts of alcohol being consumed or over a longer period than intended);
   d) Attempts to quit (desire or unsuccessful efforts to stop or lessen alcohol use);
   e) Time lost (significant amounts of time is spent consuming alcohol or recovering from effects);
   f) Reduced activities (reduced involvement in social, occupational, or recreational activities due to alcohol consumption);
   g) Continued use (alcohol consumption is continued despite physical or psychological problems that are caused by or exacerbated by alcohol); and

2) Maladaptive pattern of alcohol use as manifested by three or more symptoms occurring at any time in the same 12-month period (Statistics Canada, 2013).

Respondents met the criteria for lifetime alcohol abuse if they reported the following:

1) No lifetime alcohol dependence; and
2) At least one of the four symptoms of alcohol abuse from the following:
   a) Recurrent alcohol use resulting in a failure to fulfill major obligations at work, school, or home within a 12-month period (e.g., repeated absences, suspensions);
   b) Recurrent alcohol use in physically hazardous situations (e.g., driving an automobile while under the influence of alcohol) within a 12-month period;
   c) Recurrent alcohol-related problems (e.g., disorderly conduct caused by alcohol use) within a 12-month period;
   d) Continued use despite persistent social or interpersonal problems that are caused by or exacerbated by alcohol (e.g., physical fights) within a 12-month period (Statistics Canada, 2013).

A1.3. 12-MONTH ALCOHOL ABUSE OR DEPENDENCE

If the respondents met the criteria for lifetime alcohol abuse or dependence, 12-month alcohol abuse or dependence were assessed. Respondents that met the criteria for 12-month alcohol abuse or dependence reported the following:

1) Meeting the criteria for lifetime alcohol abuse or dependence; and
2) Having at least one symptom of alcohol abuse or dependence in the 12-months prior to the interview (Statistics Canada, 2013).
Respondents that met the criteria for 12-month alcohol abuse or dependence were categorized as having an alcohol use disorder. The diagnostic algorithms for 12-month alcohol use disorder are shown in Figure 1.
Figure 1. The diagnostic algorithms for 12-month alcohol use disorder.
Appendix 2: Diagnostic algorithms and screening threshold for drug use disorder.

A2. Drug Use Disorder

This measure identified individuals that met the WHO-CIDI and the DSM-IV criteria, modified for the CCHS-MH, for drug abuse or dependence within the 12-months prior to the interview. The drugs assessed in the CCHS-MH for abuse or dependence were as follows: sedatives, tranquilizers, nonmedical stimulants, nonmedical analgesics, cannabis, cocaine or crack, club drugs (e.g., MDMA, ecstasy, ketamine), hallucinogens (e.g., LSD, mescaline, PCP, angel dust, mushrooms, peyote), heroin or opium, inhalants or solvents (e.g., nitrous oxide, glue, paint, gasoline), and any other illegal drugs. Although the criteria for abuse or dependence were similar, cannabis abuse and dependence were assessed independently (Statistics Canada, 2013).

A2.1. Screening Threshold

Similar to alcohol use disorder, a consumption threshold based on the WHO-CIDI was used to screen individuals into the drug abuse or dependence questions. However, as compared to the WHO-CIDI, the consumption thresholds were increased. The CCHS-MH required that the respondent had used a drug a minimum of two times in their lifetime while the WHO-CIDI required a single use (Statistics Canada, 2013). Furthermore, the CCHS-MH increased the consumption screening threshold for
cannabis dependence questions to 50 lifetime uses to reduce respondent burden. This increase in threshold was based on findings from the CCHS-MH pilot study that indicated that respondents with low levels of cannabis consumption did not meet the criteria for cannabis dependence. Therefore, if cannabis had been used at least 50 times, questions pertaining to cannabis dependence were asked. If cannabis had been used a minimum of two times, questions pertaining to cannabis abuse were asked. If any other drug had been used a minimum of two times, questions pertaining to other drug abuse and dependence were asked. If respondents did not meet these thresholds, they were classified as not meeting the criteria for cannabis or other drug use disorder (Statistics Canada, 2013).

A2.2. LIFETIME DRUG ABUSE OR DEPENDENCE

Following the screening threshold, questions regarding lifetime drug abuse or dependence were asked. The criteria for cannabis abuse or dependence and other drug abuse or dependence were similar. For the CCHS-MH, respondents met the criteria for lifetime dependence if they experienced the following:

1) At least three symptoms of drug dependence from the following:
   a) Tolerance (need for larger amounts of drug to achieve desired effect or diminished effect from continued use of same amount of drug);
   b) Withdrawal (drug withdrawal syndrome or usage of drug to avoid withdrawal symptoms);
c) Increased consumption (larger amounts of drug being consumed or over a longer period than intended);

d) Attempts to quit (desire or unsuccessful efforts to stop or lessen drug use);

e) Time lost (significant amounts of time is spent consuming drug or recovering from effects);

f) Reduced activities (reduced involvement in social, occupational, or recreational activities due to drug consumption);

g) Continued use (drug consumption is continued despite physical or psychological problems that are caused by or exacerbated by drug); and

2) Maladaptive pattern of drug use as manifested by three or more symptoms occurring at any time in the same 12-month period (Statistics Canada, 2013).

Respondents met the criteria for lifetime drug abuse if they reported the following:

1) No lifetime drug dependence; and

2) At least one of the four symptoms of drug abuse from the following:

   a) Recurrent drug use resulting in a failure to fulfill major obligations at work, school, or home within a 12-month period (e.g., repeated absences, suspensions);

   b) Recurrent drug use in physically hazardous situations (e.g., driving an automobile while under the influence of drug) within a 12-month period;

   c) Recurrent drug-related problems (e.g., disorderly conduct caused by drug use) within a 12-month period;
d) Continued use despite persistent social or interpersonal problems that are caused by or exacerbated by drug use (e.g., physical fights) within a 12-month period (Statistics Canada, 2013).

A2.3. 12-MONTH DRUG ABUSE OR DEPENDENCE

If the respondents met the criteria for lifetime drug abuse or dependence, 12-month drug abuse or dependence were assessed. Respondents that met the criteria for 12-month drug abuse or dependence reported the following:

1) meeting the criteria for lifetime drug abuse or dependence; and

2) having at least one symptom of drug abuse or dependence in the 12-months prior to the interview (Statistics Canada, 2013).

Respondents that met the criteria for 12-month drug abuse or dependence were categorized as having a drug use disorder. The diagnostic algorithms for 12-month drug use disorder are shown in Figure 2.
Figure 2. The diagnostic algorithms for 12-month drug use disorder.
### Appendix 3: List of measures and the coding for the statistical analyses.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Coding</th>
</tr>
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<tbody>
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<td>Age (years)</td>
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</tr>
<tr>
<td></td>
<td>1 = 15 – 22</td>
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<tr>
<td></td>
<td>2 = 23 – 29</td>
</tr>
<tr>
<td>Sex</td>
<td>0 = Female</td>
</tr>
<tr>
<td></td>
<td>1 = Male</td>
</tr>
<tr>
<td>Education</td>
<td>0 = University degree above bachelor's</td>
</tr>
<tr>
<td></td>
<td>1 = Bachelor’s degree</td>
</tr>
<tr>
<td></td>
<td>2 = University certificate below bachelor’s</td>
</tr>
<tr>
<td></td>
<td>3 = Non-university certificate or diploma</td>
</tr>
<tr>
<td></td>
<td>4 = Trade Certificate or Diploma</td>
</tr>
<tr>
<td></td>
<td>5 = High school diploma</td>
</tr>
<tr>
<td></td>
<td>6 = Less than high school diploma</td>
</tr>
<tr>
<td>Income</td>
<td>0 = ≥$100,000</td>
</tr>
<tr>
<td></td>
<td>1 = $90,000 to $99,999</td>
</tr>
<tr>
<td></td>
<td>2 = $80,000 to $89,999</td>
</tr>
<tr>
<td></td>
<td>3 = $70,000 to $79,999</td>
</tr>
<tr>
<td></td>
<td>4 = $60,000 to $69,999</td>
</tr>
<tr>
<td></td>
<td>5 = $50,000 to $59,999</td>
</tr>
<tr>
<td></td>
<td>6 = $40,000 to $49,999</td>
</tr>
<tr>
<td></td>
<td>7 = $30,000 to $39,999</td>
</tr>
<tr>
<td></td>
<td>8 = $20,000 to $29,999</td>
</tr>
<tr>
<td></td>
<td>9 = ≤19,999</td>
</tr>
<tr>
<td>Working status</td>
<td>0 = Full-time</td>
</tr>
<tr>
<td></td>
<td>1 = Part-time</td>
</tr>
<tr>
<td></td>
<td>2 = Not working</td>
</tr>
<tr>
<td>Immigrant status</td>
<td>0 = Born in Canada</td>
</tr>
<tr>
<td></td>
<td>1 = Not born in Canada</td>
</tr>
<tr>
<td><strong>Health Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Chronic health conditions</td>
<td>0 = No chronic health conditions</td>
</tr>
<tr>
<td></td>
<td>1 = One chronic health condition</td>
</tr>
<tr>
<td></td>
<td>2 = Two chronic health conditions</td>
</tr>
<tr>
<td></td>
<td>3 = Three or more chronic health conditions</td>
</tr>
<tr>
<td>Condition</td>
<td>Scale</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Pain</td>
<td>0 = None</td>
</tr>
<tr>
<td></td>
<td>1 = Mild</td>
</tr>
<tr>
<td></td>
<td>2 = Moderate or severe</td>
</tr>
<tr>
<td>Major depressive episode</td>
<td>0 = Does not meet the criteria</td>
</tr>
<tr>
<td>Generalized anxiety disorder</td>
<td>1 = Meets the criteria</td>
</tr>
<tr>
<td>Substance Use Disorders</td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td>0 = Does not meet the criteria</td>
</tr>
<tr>
<td>Drug</td>
<td>1 = Meets the criteria</td>
</tr>
</tbody>
</table>
Appendix 4: Weighting strategy and the bootstrap methods for the CCHS-MH.

A4.1. Weighting Strategy and Non-Response

Initial Weight

Weights were created by Statistics Canada in numerous steps. Initially, weights were obtained from a major monthly survey conducted by Statistics Canada, the Labour Force Survey (LFS). These LFS weights are based on the LFS sampling design; dwellings within clusters from LFS strata were randomly selected. These weights were then modified for the CCHS-MH to account for the difference in the number of clusters selected by both surveys (Statistics Canada, 2013). Furthermore, an adjustment factor was calculated and applied to weights to account for stabilization (used in some clusters where larger than necessary samples have been selected) producing the initial CCHS-MH weights, called W1 (Statistics Canada, 2013).

Removal of Out-of-Scope Units

Following the initial creation of CCHS-MH weights (W1), all dwellings that were outside the target population along with their associated weights were removed from the sample. This left a set of weights that consisted of in-scope dwellings, now called W2 (Statistics Canada, 2013).
**Household-Level Non-Response**

Since some households refused to participate in the survey, provided unusable data, or could not be reached, weights had to be redistributed. Weights of the non-responding households were redistributed to responding households within response homogeneity groups (RHG) (Statistics Canada, 2013). RHGs grouped households with similar response properties and were created using propensity scoring and information such as collection period, geographic information, number of contact attempts, time of contact, and whether the household was contacted on a weekday or the weekend. Based on an adjustment factor, calculated within each RHG, new weights (W3) were produced for the responding households and the non-responding households were dropped (Statistics Canada, 2013).

**Person-Level Weights and Non-Response**

The household-level weights (W3) were then converted to person-level weights (W4) by multiplying the weights by the inverse of the probability of selection of the person selected within the household. Similar to households, some selected individuals refused to be interviewed or could not be reached (Statistics Canada, 2013). An adjustment factor was created to account for this person-level non-response using the same methodology that was applied within each RHG and using all available information (e.g., roster of
household members, geographic information, time of contact). This adjustment factor was then applied to person-level weights to calculate new weights (W5). Non-responding persons were then dropped from the weighting process (W6) (Statistics Canada, 2013).

**Final Weights**

Following the adjustments applied to accommodate for household- and person-level non-response, some respondents were associated with extreme weights [i.e., a respondent could represent a large portion of their domain of interest (province by age group by sex) or have a large impact on variance]. These outliers were adjusted using a winsorization trimming approach to create a new set of weights (W7). However, in most cases, the weights “W6” and “W7” were equivalent (Statistics Canada, 2013). The final phase of the weighting strategy involved calibration and was carried out in two steps. First, calibration was used to ensure that the sum of weights of respondents in a given province is same for each quarter (W8). Second, calibration was used to ensure that the sum of weights of respondents is the same as population estimates defined at the provincial level for eight age-sex groups of interest (i.e., males and females that are 15 – 24, 25 – 44, 45 – 64, and 65+ year old; W9) (Statistics Canada, 2013).

**A4.2. Bootstrap Methods**
For the CCHS-MH, the bootstrap re-sampling method was used to accommodate for the multi-stage survey design. This involved the selection of 500 sub-samples or replicates using simple random sampling. Within each stratum, a simple random sample of \( n - 1 \) clusters among the \( n \) clusters were selected with replacement (i.e., a cluster may be chosen more than once) to form the replicates (Statistics Canada, 2013). The weights were recalculated within each replicate for each record and were post-stratified according to demographic information to obtain the final bootstrap weights. The final bootstrap weights were provided by Statistics Canada. This entire process involving the selection of simple random samples, recalculation of weights, and the post-stratification of bootstrap weights was repeated 500 times. The variance estimates were then calculated using the 500 subsamples and the final bootstrap weights (Statistics Canada, 2013).