Mental disorders among emerging adults in Canada: A national study from the mental health and access to care survey

by

Lauren MacGowan

A Thesis submitted to the

Faculty of Graduate and Postdoctoral Studies

of the University of Manitoba

in partial fulfilment of the requirements of the degree of

Master of Science

College of Community and Global Health

University of Manitoba

Winnipeg

Acknowledgments

I would like to first and foremost thank my thesis supervisor, Dr. Tracie Afifi, for her steadfast support and mentorship. The opportunities she has provided me for leadership in research have challenged me giving me room to grow and flourish. I would also like to thank my committee members, Dr. Tamara Taillieu and Dr. Laurence Katz, for their guidance and counsel over the course of my thesis research. I would also like to thank Dr. Ian Clara at the Manitoba Research Data Centre for his assistance and advise with data access and analysis.

Additionally, I would like to acknowledge financial awards that supported me throughout the completion of my thesis including the 2024 Manitoba Research Data Centre Graduate Fellowship Award and the 2024 Research Manitoba Master's Studentship.

Personal achievements are never completed alone, so I would like to thank my fellow lab members for their support and comradery. To my family, thank you for your love, encouragement and support every step of the way. I wouldn't be where I am and who I am today without you. And to my new friends I have made here as I started this journey in graduate school, thank you for your love and friendship.

Table of Contents

List of Tables and Figures

List of Abbreviations

AOR	adjusted odds ratio
ARR	adjusted risk ratio
AUD	alcohol use disorder
CBD	cannabinoid
CBT	cognitive behavioural therapy
CCHS	Canadian Community Health Survey
CEVQ	Childhood Experiences of Violence Questionnaire
CI	confidence interval
CUD	cannabis use disorder
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders version IV
DSM-V	Diagnostic and Statistical Manual of Mental Disorders version V
EIPV	exposure to intimate partner violence
GAD	generalized anxiety disorder
ICD-10	International Classification of Diseases (version 10)
MDD	major depressive disorder
MDE	major depressive episode
MHACS	Mental Health and Access to Care Survey
OR	odds ratio
RR	risk ratio
SMH	self-medication hypothesis
SUD	substance use disorder
THC	tetrahydrocannabinol
WHO-CIDI	World Health Organization Composite International Diagnostic Interview

Abstract

Mental disorders including anxiety, depression, and substance use are some of the leading causes of disability worldwide. Emerging adults are at greater risk of developing mental disorders, like major depressive disorder (MDD) and generalized anxiety disorder (GAD), and substance use disorders (SUDs), indicating a need for age-specific interventions targeted to help treat emerging adults with mental disorders. Risk factors for developing anxiety and depressive disorders and SUDs are similar, with age and sex being two of the strongest factors. MDD and GAD are also individually associated with an increased likelihood of substance use, other mental disorders, relational issues at home and in the workplace, and suicidal thoughts, plans, and ideation. Child abuse is another important public health issue in Canada and is associated with poor outcomes in adulthood including mental disorders, suicide ideation, substance use, and physical illness. However, to date, no known study has examined child abuse as a moderator among any population worldwide, and this study aims to examine this in relation to mental disorders and substance use in Canadian emerging adults. Although substance use is a known risk factor for later mental disorders, evidence also supports the opposite direction of effects. A potential rationale for assessing how non-substance use disorders relate to SUDs are maladaptive coping mechanisms which result in individuals resorting to substance use to cope with mental disorders. Theories such as the self-medication hypothesis support this perspective. This theory in combination with Urie Bronfenbrenner's Ecological Theory on development are the conceptual frameworks guiding the current study.

The current study is a cross-sectional secondary data analysis with data drawn from Statistics Canada's nationally representative 2022 Mental Health and Access to Care Survey (MHACS). A subsample of emerging adults (i.e., 18 to 29 years old) was examined, with

additional analyses conducted among early emerging adults (i.e., 18 to 22 years old) and late emerging adults (i.e., 23 to 29 years old). Risk factors included MDD and GAD, a composite mental disorder variable combining both MDD and GAD, and varying degrees of substance use behaviours (i.e., any alcohol and cannabis use, at-risk alcohol and cannabis use, binge drinking, and alcohol use disorder [AUD] and cannabis use disorder [CUD]). Moderation analyses included an interaction term with main effects of the specific independent variable and moderator (i.e., child abuse or sex). Models with significant interaction terms were conducted stratified to examine the trends. Data analysis included logistic regressions and multinomial regressions adjusting for all sociodemographic characteristics.

Findings from this study provide updated descriptive and regression estimates on the association between mental disorders and substance use among Canadian emerging adults. Among early emerging adults, only MDD was associated with an increased likelihood of cannabis use, and among late emerging adults, MDD or GAD increased the odds of reporting cannabis and alcohol use at varying degrees. No significant associations were found with binge drinking or AUD. The current study did not find any significant child abuse moderation effects; however, models may have been underpowered to detect a significant effect. Significant sex moderation effects were found in the current study and findings indicate that having MDD increases the odds of varying levels of cannabis use more for females than for males.

These results have important implications for future interventions, treatment programs, prevention strategies, and policy. These include additional training among university and college educators and health care staff, harm reduction strategies, and public health interventions. Emerging adulthood is a formative stage of development and investments made to reduce and

prevent mental disorders and substance abuse during this developmental stage could have long-term benefits in young adulthood and later years in life.

Introduction

Mental disorders including anxiety, depression, and substance use are some of the leading causes of disability worldwide (Global Burden of Disease 2019 Mental Disorders Collaborators, 2022; Qadeer et al., 2019). In 2022, Statistics Canada reported that 18% of the national population, equating to over 5 million individuals aged 15 years and older, had diagnosed mental disorders or SUDs in the previous 12 months (Government of Canada, 2023b, 2023a). Statistics Canada investigated the change in the prevalence of various mental disorders among Canadians, including MDD, GAD, AUD and CUD, and they reported significant increases in the prevalence of MDD, GAD and AUD between 2012 and 2022; however, no significant change was detected for CUD (Government of Canada, 2023a). Although some forms of substance use seems to have remained consistent in recent years, substance use problems have cost the Canadian healthcare system billions of dollars in the last two decades with alcohol, tobacco, opioids, and cocaine being the most costly (Government of Canada, 2024). Many factors contribute to the prevalence and high costs associated with SUDs in Canada. Evidence indicates that the social determinants of health, and psychological, socio-cultural, biological, and environmental factors contribute to substance use behaviours (Alhammad et al., 2022; Lo et al., 2020). Specific factors such as anxiety and depression, and a history of child abuse can increase the likelihood of substance use in adolescence, early adulthood, and later into adulthood. In 2014, national estimates indicated that 32.1% of adult Canadians retrospectively reported experiencing child abuse (i.e., physical abuse, sexual abuse, and exposure to intimate partner violence [EIPV]) (Afifi et al., 2014). Since then, findings from retrospective reports on childhood experiences indicate that the prevalence has significantly increased to from 32.1% to 34.4% (Afifi et al., 2025). With mental disorder diagnoses and self-reports of child abuse increasing, it is paramount that we consider the

potential impact on substance use in Canada and develop and improve programs to help reduce burden and improve the health of Canadians.

In Canada, nearly 40,000 of people between 5 and 24 years old (27% of the population) were hospitalized in 2019 because of mental disorders, with females 15 to 17 years old being twice as likely as their male counterparts to be hospitalized due to mental disorders (Children and Youth Mental Health in Canada | CIHI, n.d.). Emerging adults between the ages of 15 years and 29 years are at risk of developing mental disorders, like anxiety and depression, and SUDs (Qadeer et al., 2019; Solmi et al., 2022; Vida et al., 2009). Public health policies and sex- and age-specific interventions can be targeted to help treat emerging adults with mental disorders.

The current study has two main purposes each with their own goals for future direction and practice. The first aim is to understand the problem, more specifically to determine the prevalence of mental disorders and substance use among emerging adults, and to examine if having mental disorders increases the odds that a person will have specific SUDs. This step is critical as issues cannot be addressed unless the magnitude of the problem is known. The second aim is to understand if certain environmental and biological factors moderate, or worsen, the relationship between mental disorders and SUDs. More specifically, assessing how child abuse and sex moderate this relationship is investigated. Child abuse has not been examined as a moderator among Canadian emerging adults and results will have implications for future best practices among physicians, clinicians, and community workers. Research also shows that males and females differ in mental disorder diagnoses, substance use, and child abuse experiences, however findings are inconsistent. Examining these differences among a young subpopulation of Canadian emerging adults can help provide insight to developing future targeted programs for helping treat mental disorders and reduce substance use.

Review of the Literature

Depression and Anxiety

Anxiety and depressive disorders are among two of the most common mental disorders worldwide (American Psychiatric Association, 2014; Pelletier et al., 2017; Watterson et al., 2017). GAD is often characterized by persistent feelings of worry and anxiety about life situations and circumstances in addition to physiological symptoms such as shortness of breath (American Psychiatric Association, 2014; Pelletier et al., 2017; Watterson et al., 2017). MDD is a mood disorder where the clinical diagnosis requires that an individual reports having at least five of a list of nine symptoms over a two-week time period and that these changes differ from the person's typical daily functioning (American Psychiatric Association, 2014). At least one of the five symptoms must be as loss of interest or pleasure in enjoyable activities or having a depressed mood (American Psychiatric Association, 2014; Scott et al., 2016). Global estimates of anxiety and depressive disorders in 1990 were 194.9 million cases and 170.8 million cases, respectively (Global Burden of Disease 2019 Mental Disorders Collaborators, 2022). Nearly 30 years later, cases multiplied over 1.5 times and anxiety disorders increased to 301.4 million cases and depressive disorders to 279.6 million cases (Global Burden of Disease 2019 Mental Disorders Collaborators, 2022). Population growth has changed over the past 30 years, however, these disorders made up nearly 60% of the global prevalence of mental disorders in 2019, revealing a massive burden on individuals health and well-being.

The most recent Canadian estimates of mental disorders were reported in 2022 by Statistics Canada's Mental Health and Access to Care Survey (18% of national population) (Government of Canada, 2023b, 2023a), however peer-reviewed evidence describing the current prevalence of mental disorders in Canada are limited. Much of the peer-reviewed national

evidence currently available are based on estimates from 2012 using the Canadian Community Health Survey (CCHS). At that time, the lifetime prevalence of MDD was 9.9% while past-year prevalence was 3.9% (Patten et al., 2015). The prevalence of GAD was 8.7% and past year prevalence 2.6% (Patten et al., 2015). The prevalence for MDD is also higher than GAD, similar to previously reported trends among a nationally representative Canadian sample (Knoll & MacLennan, 2017; Patten et al., 2015; Watterson et al., 2017). Some studies have assessed descriptive epidemiology of past year mental disorders within the ten Canadian provinces. After adjusting for sociodemographic characteristics, logistic regression analyses indicated that respondents living in Saskatchewan, Quebec, and Prince Edward Island were significantly less likely to report past year MDD compared to Manitoba (Palay et al., 2019). However, no significant provincial differences were observed for past year GAD (Palay et al., 2019).

Risk factors for developing anxiety and depressive disorders are many, and age is one of the strongest predictors (American Psychiatric Association, 2014; Galambos et al., 2004; Nawi et al., 2021; Solmi et al., 2022; Yeretzian et al., 2023). A meta-analysis of 192 epidemiological studies across the globe examined age of onset of various mental disorders and found that GAD most frequently began at age 15.5 years and depressive disorders at 19.5 years (Solmi et al., 2022). Evidence consistently indicates that compared to adults above approximately 30 years of age, younger individuals are more vulnerable to developing mental disorders (Arruda et al., 2023; Berger et al., 2022; Galambos et al., 2004; Qadeer et al., 2019; Sivayoganathan & Reid, 2023; Solmi et al., 2022; Vida et al., 2009). The vast majority of evidence compares younger youth samples to older youth samples, or emerging adults to older adults, however, comparisons between emerging adults of different ages are fewer. Age ranges for youth, young adults, and

emerging adults vary across studies, and this will be discussed later in this chapter (Berger et al., 2022; Hammond et al., 2021; Qadeer et al., 2019; Sivayoganathan & Reid, 2023).

Individuals with diagnosed depression face higher rates of mortality, particularly due to suicide, and those with GAD often report constant feelings of worry and anxiety (American Psychiatric Association, 2014; Knoll & MacLennan, 2017; Pelletier et al., 2017). Depression and anxiety are individually associated with an increased likelihood of substance use (Galambos et al., 2004; Nawi et al., 2021), other mental disorders (Galambos et al., 2004), relational issues at home and in the workplace (Mason et al., 2008), and suicidal ideation and plans (Patten et al., 2015; Scott et al., 2016; Watterson et al., 2017). Evidence also indicates that depressive and anxiety disorders are comorbid and can co-occur (Patten et al., 2015; Pelletier et al., 2017; Watterson et al., 2017). However, poor outcomes still exist among individuals with depressive disorders only and anxiety disorders only (Pelletier et al., 2017; Watterson et al., 2017). To address gaps in the literature, the current study assessed GAD and MDD individually among emerging adults and examined if sex differences exist.

Substance Use

SUDs are known to be chronic relapsing diseases making this a major public health issue that needs to be further addressed in Canada (Lo et al., 2020). They are associated with mental disorders (Lawrence et al., 2023; Marquette et al., 2024), suicidal ideation, plans, and attempts (Bragazzi et al., 2021), household food insecurity (Bragazzi et al., 2021), mortality (Deep et al., 2024; Shen et al., 2023), injury (Shen et al., 2023), communicable conditions such as sexually transmitted infections (STIs) (Shen et al., 2023), and other physical illnesses (Luther et al., 2020; Marquette et al., 2024). SUDs are classified by substance type, and whether a person meets certain criteria for substance dependence or abuse. Global age standardized rates from 2019

indicate that drug use disorders (713.5 per 100,000), CUDs (303.4 per 100,000), opioid use disorders (265.9 per 100,000), amphetamine use disorders (92.5 per 100,000), and cocaine use disorders (51.7 per 100,000) are prevalent (American Psychiatric Association, 2014; Shen et al., 2023). In 2018, the World Health Organization determined that the global alcohol consumption was equivalent to any one individual aged 15 years and older consuming 6.4 litres of pure alcohol per year, or an average of one litre of wine per week per person (Connery et al., 2020; GHO | World Health Statistics Data Visualizations Dashboard | Harmful Use of Alcohol, n.d.). Cannabis is used by 129 to 290 million people worldwide, and the most commonly used illicit substances following cannabis are amphetamines, stimulants, cocaine, and opioids (Connery et al., 2020).

Canadian prevalence estimates for past year substance use vary, however national estimates for all substance types are reportedly higher than other countries (Bragazzi et al., 2021; Hammond et al., 2021). In 2012, the prevalence of alcohol abuse/dependence in a Canadian sample of adults 15 years and older was 5.5%, while drug abuse/dependence was 3.6% (Qadeer et al., 2019). Later in 2015, the Canadian estimate of illicit drug use was 10.4% among Canadians 12 years and older (Bragazzi et al., 2021), and the national prevalence of past year cannabis use jumped from 4.2% in 1993 to 27% in 2021 based on pooled estimates of 29 Statistics Canada surveys conducted over 30 years (Bahji et al., 2022). AUD and SUDs are less likely among several provinces compared to Manitoba (Palay et al., 2019). However, evidence has also shown provincial differences in past year illicit drug use when comparing other provinces to Saskatchewan (Bragazzi et al., 2021). In this study, respondents living in all other provinces and territories were significantly more likely to report past year illicit drug use (Bragazzi et al., 2021). However, at the time these data were collected in 2015, non-medical or

recreational cannabis was classified as an illicit substance because it was illegal to consume in Canada. National evidence about illicit drug use therefore included cannabis among other illicit drugs, which may explain some of the significant findings observed in Canadian epidemiological data. Since these previously discussed data were collected in Canada, cannabis has been legalized for Canadians over the age of 18 years moving the classification of cannabis from an illicit substance to a licit substance. Updated national estimates of alcohol, cannabis, and illicit drug use disorders is necessary to inform targeted prevention and treatment approaches for Canadians with SUDs.

Substance use is frequent among youth and young adults and evidence suggests that substance use is greater in younger emerging adults compared to older emerging adults (Bragazzi et al., 2021; Deep et al., 2024; Qadeer et al., 2019; Wadsworth et al., 2022). However, different studies report these findings among various age categories (i.e., 12- to 19-year-olds vs 20 and 29 years, 16 to 24 years old vs 25+ years, 25 years old vs 34 years old) (Bragazzi et al., 2021; Poudel & Gautam, 2017; Wadsworth et al., 2022). Another study has also examined SUDs among early (15 to 22 years old) emerging adults and young adults (30 to 39 years old), and late (23 to 29 years old) emerging adults with young adults (30 to 39 years old) and found similar trends with both early and late emerging adults having higher odds of AUD and drug use disorder (DUD) (Qadeer et al., 2019). Sex differences also exist among those who use substances (Bragazzi et al., 2021; Mason et al., 2008). Evidence consistently reports that males are more likely than females to have SUDs (Bragazzi et al., 2021), but the strength of this relationship varies depending on the type of SUD that is being assessed. Although sex-differences among those with SUDs are found, examining sex as a moderator between non-substance use mental

disorders and specific SUDs in a representative Canadian sample would provide updated information for future interventions.

Associations Between Non-Substance Use and Substance Use Mental Disorders

A widespread debate in the literature is what came first – mental disorders or SUDs? Causality is often a goal in scientific research, however epidemiological evidence, especially cross-sectional studies, cannot infer causal relationships. Nonetheless, understanding how non-substance use and substance use mental disorders are related is still important to examine and understand to improve strategies for prevention, treatments and interventions. Literature supports the association between non-substance related mental disorders and substance related mental disorders in many forms, and various perspectives contribute to explaining this association including biological and genetic factors, social, cultural and cognitive perspectives, and environmental factors (Alhammad et al., 2022; Lo et al., 2020).

One viewpoint is that substance use can lead to the onset of mental disorders like depression (Bovasso, 2001; Degenhardt et al., 2003; Mason et al., 2008; Tapert et al., 2004; Wu & Anthony, 1999). Reasons for the direction of this association are often medical or neurobiological since there are physiological links between specific drug properties and neurotransmitters related to specific mental disorders (Degenhardt et al., 2003; Tapert et al., 2004). From a neurodevelopmental perspective, brain development continues into emerging adulthood and substance use can worsen brain development, impair neurocognitive functioning, alter the brains reward system, or impact how young adults come to making important life decisions for their future (Mason et al., 2008). These possible substance use-related impacts can influence the onset or progression of mental disorders across the lifespan, including emerging adulthood.

Although substance use is a known risk factor mental disorders, evidence also supports the opposite direction of effects (Hawes et al., 2019; Lawrence et al., 2023). A potential rationale for assessing how non-substance use disorders relate to substance use disorders are maladaptive coping mechanisms which result in individuals resorting to substance use to cope with mental disorders (Romano et al., 2021). Theories such as the self-medication hypothesis support this perspective (Khantzian, 1985, 1997), however evidence also indicates co-occurring non-substance use mental disorders with SUDs (Keen et al., 2022; Mason et al., 2008; Rush et al., 2008). Examining the relationship between mental disorders and substance use from a lens of maladaptive coping does not necessarily negate the neurobiological point of view but rather takes a closer examination of how environmental factors play a role in the relationship between non-substance use and substance use mental disorders. The current study examined how these disorders are related using the self-medication hypothesis and the assessment of how certain environmental and biological factors may impact this relationship.

Child Abuse

Child abuse is an important public health issue in Canada. In 2012, the Canadian prevalence of retrospective self-reports of child abuse among adults (i.e., physical abuse, sexual abuse, and EIPV) was 32.1% (Afifi et al., 2014), and in the last decade, that has significantly increased to 34.4% (Afifi et al., 2025). Child abuse is associated with poor outcomes in adulthood including mental disorders (Afifi et al., 2014, 2020; Cameranesi et al., 2019; England-Mason et al., 2018; Su et al., 2022), suicide ideation (Knoll & MacLennan, 2017), substance use (Alhammad et al., 2022), and physical illness (Afifi et al., 2016; Cameranesi et al., 2019; England-Mason et al., 2018; Hovdestad et al., 2020; Shields et al., 2016). National evidence from 2012 indicates that a history of child abuse increases the odds of having GAD, depression,

alcohol dependence/abuse, and drug dependence/abuse among adults (Afifi et al., 2014). However, these associations have not been updated in Canada since cannabis has been re-classified as a licit substance. Legalizing cannabis in Canada increases its accessibility and use which would consequently affect how cannabis use is associated with mental disorders, particularly among those with a history of child abuse. Additionally, child abuse has not yet been examined as a moderator between non-substance use mental disorders and substance use mental disorders among emerging adults. The current study assessed this relationship further using updated nationally representative data of emerging adults.

Sex

Biological sex is another factor that is strongly associated with anxiety and depressive disorders (American Psychiatric Association, 2014). Females are consistently more likely than males to have depressive and anxiety disorders (Galambos et al., 2004; Global Burden of Disease 2019 Mental Disorders Collaborators, 2022; Knoll & MacLennan, 2017; Patten et al., 2015; Watterson et al., 2017; Yeretzian et al., 2023). Studies have also examined whether a sex-age interaction exists, but findings are inconsistent. One cross-sectional Canadian study found significant sex differences among those reporting lifetime and past year MDD, and although trends indicated that MDD prevalence decreased with age, there was no significant sex-age interaction observed (Patten et al., 2015). Another cross-sectional study combined data from three sources and assessed both additive and multiplicative age-sex interactions among Canadians with major depressive episode (MDE) between 1996 and 2013 (Patten et al., 2016). Two key findings emerged from this study. First, age-sex interactions were found, more specifically that sex differences among those with MDE decreased with age (Patten et al., 2016). Secondly, an examination of sex differences in the two youngest age categories (15 to 24 years

and 25 to 34 years) showed different trends among males and females (Patten et al., 2016). The prevalence of MDE among males increased from the youngest age group (15 to 24 years) to the next age group (25 to 34 years), however the opposite trend was observed among females (Patten et al., 2016). These findings indicate that more females may report MDE at younger ages and males at slightly older ages, which aligns with other evidence (Patten et al., 2016; Solmi et al., 2022).

Emerging Adulthood

Emerging adulthood is a period of development marked as a transition period between adolescence and adulthood. Evidence supports differences in psychiatric diagnoses, help seeking behaviours, and mental health treatment utilization among emerging adults compared to other stages of development, and specific features describing this period could be related to these differences (Arnett et al., 2014; Goldstein et al., 2013; Qadeer et al., 2019; Sivayoganathan & Reid, 2023; Vida et al., 2009). Jeffrey Arnett proposed emerging adulthood as a developmental theory and identifies five key characteristics that describe emerging adulthood: identity exploration, instability, possibilities, self-focus, and "feeling in-between" (Moin Syed, 2016; Shek et al., 2020). This theory argues that individuals transitioning from adolescence into adulthood are distinguishable because their responsibilities and priorities are different (Arnett, 2000). Although this rationale remains true, societal traditions, values, and norms have shifted over generations and the age at which milestones describing adulthood are occurring have changed. College and post-secondary education has become more common, and the age at which individuals leave home, get married, and have children is later now in the 21st century (Shek et al., 2020). As a result of these social changes, theoretical and empirical evidence varies in defining the age range that constitutes emerging adulthood. Evidence has examined mental

health service use among 18- to 24-year-olds (Sivayoganathan & Reid, 2023), perceptions about cannabis use among 18- to 25-year-olds (Harris-Lane et al., 2023), and the epidemiology of SUDs among 15- to 29-year-olds (Qadeer et al., 2019) and all studies term these individuals as emerging adults. Recently, emerging adulthood has been expanding to include individuals up to 29 years of age, and one Canadian epidemiological study separated emerging adulthood into two age ranges and found differences in SUDs between emerging adults of different ages (Arnett et al., 2014; Qadeer et al., 2019). The current study assessed mental disorders and SUDs among emerging adults. However, the specific age ranges utilized in this study was determined empirically based on data and is described later in this chapter.

Theoretical Perspective

This work is inspired primarily by two theories, the first being Khantzian's self-medication hypothesis (SMH) which is rooted in psychodynamic theory. This theory has been established among studies seeking to explain the root behind addiction and substance use problems. There exists several perspectives relating to the development of substance use problems including sociocultural and genetic theories, however Khantzian developed this hypothesis to compliment established theories by providing an emotional perspective (Khantzian, 1997). His premise is that psychological distress, negative emotions, and psychiatric disorders are associated with maladaptive coping mechanisms, like substance use, which can contribute to substance use and addiction (Hall & Queener, 2007; Khantzian, 1985). In his first version of this theory, psychiatrist Edward Khantzian specified that psychiatric disorders in particular could explain self-medication using substance use (Khantzian, 1985), but in his revision of the SMH he modified the language based on clinical evidence to now suggest that psychological vulnerabilities can explain how individuals come to use substances (Khantzian,

1997). Of course everyone experiences stressful life events, and not everyone has a mental disorder or substance use problem. However, researchers have proposed that alexithymia, or the inability to verbalize emotions, is a possible reason why some individuals who experience adversity resort to acting on negative emotions, like using substances, rather than using healthy, adaptive coping mechanisms (Hall & Queener, 2007; Khantzian, 1997).

The second theory guiding this research is Urie Bronfenbrenner's ecological systems theory which provides an evolving perspective on human development across the lifespan (Bronfenbrenner, 1994). It is described as an ecological model because it mimics an individual's surroundings where various levels of their environment are nested within each other, beginning with the individual at the centre (Bronfenbrenner, 1994). The microsystem depicts a person's environment that they have direct contact with, such as family, school, and work (Bronfenbrenner, 1994). This space can be thought of as a critical level of the model because this is where development is established and sustained. Positive relationships and bonds must be formed with individuals in a person's immediate environment or else the next phases of development will be negatively impacted. Mesosystems are microsystems interacting with other microsystems (Bronfenbrenner, 1994). For example, an individual's parent's communicating with their child's co-workers. The next system is exosystems where two systems connect and one does not directly involve an individual, such as a child's parents work environment and the child's home (Bronfenbrenner, 1994). Exosystems are where community contexts intersect with an individual and poor community relationships can significantly affect children and youth's development. Macrosystems describe patterns among the micro-, meso-, and exosystems that are representative of specific cultures and lifestyles that in turn affect a person's microsystems (Bronfenbrenner, 1994). The last system in the model is chronosystems (Bronfenbrenner, 1994).

This system explains both a person's stage of development over time and the changes in their environment such as getting married or change of profession or socioeconomic status.

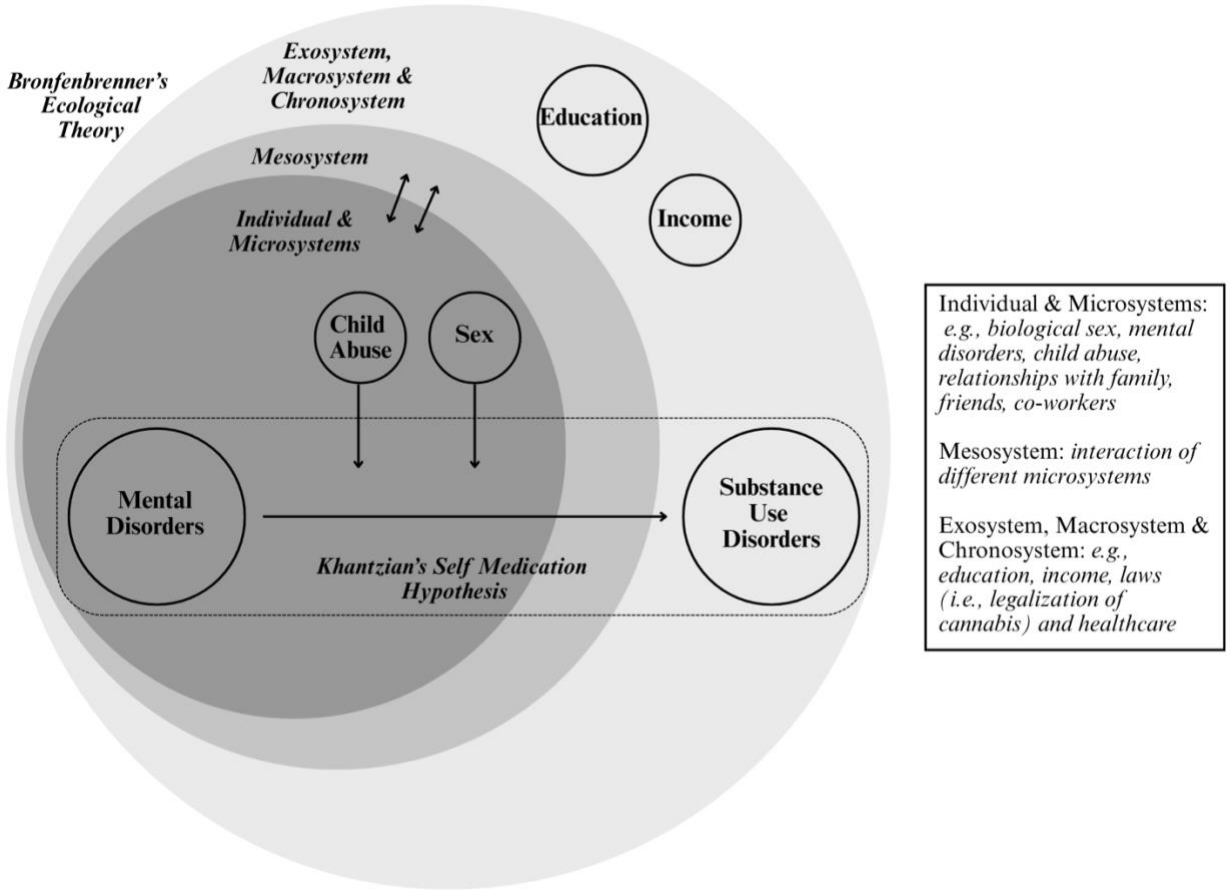
A conceptual framework combining Khantzian's self-medication hypothesis and Bronfenbrenner's ecological theory best supports the development of the current study. Figure 1 illustrates this conceptual framework. At the core of Bronfenbrenner's (1994) model is a person's innate traits (e.g., sex) and unique personal experiences (e.g., abuse, mental disorders). Relationships formed between a person and members in their immediate environment create the foundation for how they develop in other systems. Bronfenbrenner (1994) described these types of relationships and experiences within the microsystem, the only system that directly interacts with an individual, and all other systems are built from these microsystems making them pivotal for development. Child abuse experiences and/or poor mental health in childhood and adolescence negatively impacts current and future development. The mesosystem is defined by interacting microsystems, such as how a person's parent interacts with their adult child's friends and co-workers. If a child has experienced abuse, or if they have poor mental health resulting from relationships with people in their immediate environments, mesosystem dynamics may indirectly affect a person's interaction with immediate members of their microsystem. The exosystem and macrosystem are societal domains that indirectly interact with a person's development. An example of exosystem effects on a person's development is if their parent or another family member experiences stress, this could cause the home environment to also become stressed thereby affecting a person's environment. As Khantzian would note, if distress persists for a long period of time and is not addressed in a healthy way, maladaptive coping strategies like substance use may be utilized to deal with this distress. Macrosystems describe the society a person lives in, such as culture, religion, laws and governing agencies, and access to

public services like healthcare. Factors like education (i.e., attending college or university), access to licit and illicit substances, laws permitting use and distribution of substances, and more all contribute to an individual's pattern of substance use. For those who are disadvantaged due to poor mental health and/or child abuse, they may inappropriately deal with these types of distress by self-medicating using licit or illicit substances.

Emerging adults are uniquely vulnerable because of their critical stage of development, however biological and environmental circumstances and relationships prior to emerging adulthood contribute significantly to an emerging adult's life (Qadeer et al., 2019). Bronfenbrenner's ecological theory and Khantzian's self-medication hypothesis together conceptualize important factors that can contribute to the development of non-substance use related mental disorders and then later substance use related mental disorders. Additionally, biological sex and child abuse experiences play important roles as mental disorders and substance use behaviours may differ among males and females and those with child abuse experiences. Examining this association understanding development and coping mechanisms is important for advancing targeted strategies for prevention, treatment and intervention.

Figure 1

A conceptual framework for understanding mental disorders and substance use, and factors moderating this relationship among emerging adults



Note. Adapted from Edward Khantzian's Self Medication Hypothesis and Urie Bronfenbrenner's Ecological Theory

Study Objectives

The objectives of the current study are: 1) to compute the prevalence of mental disorders, substance use, and child abuse histories among emerging adults, and examine any differences by sex, education, household income, and any other mental disorder; 2) to determine if mental disorders are associated with an increased likelihood of substance use behaviours among

emerging adults after adjusting for sociodemographic covariates and any other mental disorder; 3) to examine if child abuse moderates (i.e., worsens) the relationship between mental disorders and substance use among emerging adults after adjusting for sociodemographic covariates and any other mental disorder; and 4) to examine if sex moderates the relationship between mental disorders and substance use among emerging adults after adjusting for all other sociodemographic covariates and any other mental disorder.

Research Questions and Hypotheses

Research Question 1

What is the percent of emerging adults with mental disorders (MDD and GAD), substance use (alcohol and cannabis), and histories of any child abuse (physical abuse, sexual abuse, and/or EIPV)? Are there differences by sex, education, household income, and any other mental disorder?

Hypothesis

Differences by sex, education, household income, and any other mental disorder will be significant among emerging adults with mental disorders, substance use, and child abuse histories.

Research Question 2

Are mental disorders (MDD and GAD) associated with a greater likelihood of substance use (alcohol and cannabis) in emerging adults after adjusting for age, sex, education, household income, and any other mental disorder?

Hypothesis

Mental disorders (MDD and GAD) will be associated with a greater likelihood of substance use (alcohol and cannabis) among emerging adults after adjusting for age, sex, education, household income, and any other mental disorder.

Research Question 3

Does a history of any child abuse (physical abuse, sexual abuse, and/or EIPV) moderate (i.e., worsen) the relationship between mental disorders (MDD and GAD) and substance use (alcohol and cannabis) among emerging adults after adjusting for age, sex, education, household income, and any other mental disorder?

Hypothesis

A history of child abuse among emerging adults will moderate (i.e., worsen) the relationship between mental disorders (MDD and GAD) and substance use (alcohol and cannabis) and that this moderation effect will remain significant after adjusting for age, sex, education, household income, and any other mental disorder. It is expected that the association between mental disorders and substance use will be stronger (i.e., worse) among individuals with a history of child abuse. It is expected that this moderation effect will be significant after adjusting for age, education, household income, and any other mental disorder.

Research Question 4

Does sex (male and female) moderate the relationship between mental disorders (MDD and GAD) and substance use (alcohol and cannabis) among emerging adults after adjusting for age, education, household income, and any other mental disorder?

Hypothesis

Sex will moderate the relationship between mental disorders (MDD and GAD) and substance use (alcohol and cannabis) among emerging adults. It is expected that the association

between mental disorders and substance use will be stronger among females than males. It is expected that this moderation effect will be significant after adjusting for age, education, household income, and any other mental disorder.

Methods

Data and Sample

The current study was a secondary data analysis with data drawn from Statistics Canada's nationally representative 2022 Mental Health and Access to Care Survey (MHACS). This survey uses a stratified random sampling survey design and includes approximately 9,000 respondents over the age of 15 years old residing in all Canadian provinces (Government of Canada, 2023a). For the purposes of this study, a subsample of respondents was examined. All analyses were assessed among emerging adults; however, the specific age categories were decided based on empirical evidence of these data. Details on how this decision was made are later discussed in the data analysis section. The 3 age groups were emerging adults 18 to 29 years old (n = 2,151), early emerging adults 18 to 22 years old (n = 1,166), and late emerging adults 23 to 29 years old (n = 985). All questions on child abuse were limited to those 18 years and older. Interviews were conducted between March 2022 and July 2022 via computer-assisted telephone interviews (CATI) and participation was voluntary. All respondents voluntarily agreed to participate and all provided informed consent.

Measures

Substance Use. The World Health Organization Composite International Diagnostic Interview (WHO-CIDI) is a standardized questionnaire based on criteria outlined in the International Classification of Diseases (ICD-10) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). The questionnaire was originally developed to diagnose mental disorders

in epidemiological studies and is now widely used in clinical and research settings (The Composite International Diagnostic Interview, 1988; Wittchen, 1994). A modified WHO-CIDI was used to assess whether a respondent met the criteria for alcohol abuse or dependence and cannabis abuse or dependence. All other substance use variables were created and conceptualized from questions asking about past year alcohol use and past year cannabis use.

Any Alcohol Use. Respondents were asked "during the past 12 months, that is from [date 365 days ago] to yesterday, have you had a drink of beer, wine, liquor or any other alcoholic beverage?" Response options included a) yes, b) no, c) don't know and d) refusal. This was dichotomized and respondents who said yes were coded as "yes" to any past year alcohol use and no as "no", while those who didn't know or did not answer were coded out of the final variable.

Any Cannabis Use. Respondents were asked "have you ever used or tried cannabis sometimes called marijuana, pot, weed, hash, budder, shatter or any other preparation of the cannabis plant such as edibles, concentrates or liquids or other products? This question addressed lifetime cannabis use, and those who answered with a) yes, just once, b) yes, more than once, c) don't know, d) refusal, or e) not stated proceeded to answer about past year cannabis use. Those who answered "no" to ever using cannabis skipped all proceeding questions about cannabis use. This lifetime cannabis use variable was not assessed in the current study; however, it provides the total population and number of observations for all other cannabis use variables used in the current study. Past year cannabis use asked if respondents had ever used cannabis in the past 12 months. Answer categories were a) yes, b) no, c) valid skip, d) don't know and e) not stated. This was dichotomized and those who answered 'no' or were a 'valid skip' (i.e., they answered in the previous question that they had never in their lifetime used cannabis) were recoded and included in the "no" while those who said yes were coded as "yes". Respondents who indicated they did

not know their past year cannabis use or did not state an answer were coded out of the final variable.

At-Risk Alcohol Use. Respondents who answered 'yes' to drinking one or more alcoholic beverages during the past year were asked about the frequency of alcohol consumption. Specifically, respondents were asked "during the past 12 months, how often did you drink alcoholic beverages?" Answer categories included a) less than once a month, b) once a month, c) 2 to 3 times a month, d) once a week, e) 2 to 3 times a week, f) 4 to 6 times a week, g) every day, h) valid skip, i) don't know, j) refusal, and k) not stated. This variable was recoded into three categories based on the Government of Canada's low-risk alcohol use guidelines (Government of Canada, 2021). No-risk included those in the valid skip option because they did not drink in the past year. Low-risk alcohol use was coded to include all respondents who said to drink 2 to 3 times a week or less (i.e., once a week, 2 to 3 times a month, or once a month). High-risk alcohol use was coded to include those who drink 4 to 6 times a week or more (i.e.,4 to 6 times a week or every day). Those who did not know the frequency of alcohol consumption or did not answer the question were excluded from the final variable.

At-Risk Cannabis Use. Respondents who said yes to past year cannabis use were asked "how often did you use cannabis in the past 12 months?" Answer categories included a) less than once a month, b) 1 to 3 times a month, c) once a week, d) more than once a week, e) every day, f) valid skip, g) don't know, h) refusal and i) not stated. This variable was recoded into three categories based on the Government of Canada's low-risk cannabis use guidelines (Government of Canada, 2020). No-risk cannabis use was coded to include those in the valid skip option as they did not use cannabis in the past year. Low-risk cannabis use included respondents who said yes to using cannabis in some form once a week or less (i.e., 1 to 3 times a month or less than

once a month). High-risk cannabis use included those who said yes to using cannabis more than once a week or more (i.e., once a week, more than once a week, or every day). Those who did not know the frequency of cannabis use or did not answer the question were excluded from the final variable.

Binge Drinking. Respondents who said yes to past year alcohol use were asked "how often in the past 12 months have you had 5 or more drinks on one occasion?" Response options included a) never, b) less than once a month, c) once a month, d) 2 to 3 times a month, e) once a week, f) more than once a week, g) valid skip, h) don't know, i) refusal, and j) not stated. Alcohol frequency was dichotomized and no past year binge drinking and included those who never consumed 5 or more drinks on one occasion and respondents who were skipped from this question because they had not consumed alcohol in the past year. Respondents who answered yes to consuming 5 or more drinks on at least one occasion in the past year were coded as yes to past year binge drinking (i.e., less than once a month, once a month, 2 to 3 times a month, once a week, and more than once a week). Those who did not know how frequently they consumed 5 or more drinks on one occasion or did not answer the question were excluded from the final variable.

AUD. Based on the WHO-CIDI, respondents either met the criteria for past-year alcohol abuse or dependence. Examples of alcoholic beverages include wine, wine cooler, beer, draft beer, or cocktails with at least 1.5oz of liquor (Government of Canada, 2022e). Alcohol dependence is described by specified recurring patterns within 12 months where at least three of these conditions must occur: increased tolerance, withdrawal, increased consumption, unsuccessful attempts to quit, time lost due to recovering or drinking alcohol, decreased activities, and continued drinking despite physical or psychological problems caused or

intensified by alcohol (Government of Canada, 2018). Respondents answered questions about alcohol such as, a) during the past 12 months, how often did you drink alcoholic beverages; and b) how often in the past 12 months have you had 5 or more drinks on one occasion (Government of Canada, 2022e). Those who met the criteria for alcohol dependence were counted as 'yes' and those who did not were 'no'. Alcohol abuse is also characterized by recurring patterns of use within 12 months, however only one of the following conditions must occur: failure to fulfill duties at home, work, or school; alcohol use in dangerous situations; repeated alcohol-related issues; consistent alcohol use despite relational and social problems caused or intensified by alcohol (Government of Canada, 2018). Respondents answered more questions about alcohol including, a) were there times in your life when you were often under the influence of alcohol in situations where you could get hurt, for example when riding a bicycle, driving, or operating a machine; and b) was there ever a time in your life when your drinking caused arguments or other serious or repeated problems with your family, friends, neighbours, or co-workers (Government of Canada, 2022e). Those who met the criteria for alcohol abuse were counted as 'yes' and those who did not were 'no'.

Respondents who had alcohol dependence were excluded from meeting the criteria for alcohol abuse. A final binary derived variable combined those who met the criteria for either alcohol dependence or alcohol abuse and those who did not meet the criteria for either. This dichotomous variable assessed alcohol abuse or dependence (i.e., AUD) as one variable in the current study.

CUD. The WHO-CIDI assessed whether respondents met the criteria for past year cannabis dependence or abuse. Cannabis can be classified as marijuana, pot, weed, hash, budder, shatter, or any other preparation of the cannabis plant such as edibles, concentrates or liquids or

other products. Cannabis dependence is described by repeated patterns within 12 months where at least three of these conditions must occur: increased tolerance, withdrawal, increased consumption, unsuccessful attempts to quit, time lost due to recovering or cannabis use, decreased activities, and continued cannabis use despite physical or psychological problems caused or intensified by cannabis use (Government of Canada, 2018). Respondents answered questions about cannabis such as, a) how often did you use cannabis in the past 12 months (Government of Canada, 2022e). Those who met the criteria for cannabis dependence were counted as 'yes' and those who did not were 'no'. Similarly, cannabis abuse is characterized by continuous patterns of use within 12 months, however only one of the following conditions must occur: failure to fulfill duties at home, work, or school; using cannabis in dangerous situations; repeated cannabis-related issues; consistent cannabis use despite relational and social problems caused or intensified by cannabis (Government of Canada, 2018). Respondents answered additional questions about their cannabis use including, a) was there ever a time in your life when your use of cannabis frequently interfered with your work or responsibilities at school, on a job, or at home; and b) did you continue to use cannabis even though it caused problems with your family, friends, neighbours, or co-workers (Government of Canada, 2022e). Those who met the criteria for cannabis abuse were counted as 'yes' and those who did not were 'no'.

Additionally, those who had cannabis dependence were excluded from meeting the criteria for cannabis abuse. A final binary derived variable combined those who met the criteria for either cannabis dependence or cannabis abuse and those who did not meet the criteria for either. This dichotomous variable assessed cannabis abuse or dependence (i.e., CUD) as one variable in the current study.

***Mental Disorders*.** A modified version of the WHO-CIDI was used to assess whether a respondent met the criteria for a clinical diagnosis of certain mental disorders, including anxiety and depression.

Generalized Anxiety Disorder. In the WHO-CIDI, GAD is defined by continuous worry and extreme anxiety about events or activities for at least 6 months. Symptoms include feeling on edge, fatigued, worsened concentration, irritability, muscle tension, shaking, problems with sleep, extreme sweating, palpitations, shortness of breath, and gastrointestinal symptoms (Government of Canada, 2022c). Respondents answered questions relating to feeling anxious, including, a) did you ever have a period lasting 6 months or longer when you were anxious and worried most days; and b) during this episode lasting 6 months or longer, did you often feel dizzy or lightheaded (Government of Canada, 2022e). A binary final variable was derived to assess lifetime GAD. Those who met the criteria were coded as 'yes' while those who did not meet the criteria were coded as 'no'.

Major Depressive Disorder. The WHO-CIDI defined MDD as persistent feelings of a depressed mood, loss of pleasure or interest in activities, reduced energy, changes in sleep and appetite, worsened concentration, and feelings of hopelessness, guilt or suicidal thoughts for at least two weeks (Government of Canada, 2022b). Respondents were asked a series of standardized questions relating to feeling depressed including, a) have you ever in your life had a period lasting several days or longer when most of the day you felt sad, empty or depressed; and b) During the episodes of being sad, empty or depressed, did you ever lose interest in most things like work, hobbies or other things you usually enjoyed (Government of Canada, 2022c). A derived final variable assessing lifetime MDE from these questions will be used in this study.

Those who met the criteria for lifetime MDE were coded as ‘yes’ and ‘no’ if any of these criteria are not met.

Composite Mental Disorder. A composite variable combining lifetime GAD and MDD was created. This variable includes the final derived variables previously described and used to assess GAD and MDD individually. Those who met the criteria for either GAD or MDDwere coded as ‘yes’ for this composite mental disorder final variable, and those who did not meet the criteria for either were coded as ‘no’.

***Child Abuse*.** Respondents aged 18 years and older were asked about childhood experiences using adapted items from the Childhood Experiences of Violence Questionnaire (CEVQ) and other assessments included on previous Statistics Canada surveys to assess physical abuse, sexual abuse, and EIPV. Responses were on an ordinal scale determining the frequency of exposure. All questions asked about experiences before age 16 years. EIPV was classified by how many times did you see or hear any one of your parents, stepparents or guardians hit each other or another adult in your home (Government of Canada, 2022e). Physical abuse was classified if the respondent experienced a) an adult slapping you on the face, head or ears or hit or spank you with something hard to hurt you; b) an adult pushing, grabbing, shoving or throwing something at you to hurt you; c) an adult kicking, biting, punching, choking, burning you, or physically attacking you in any way (Government of Canada, 2022e). Lastly, sexual abuse was classified if the respondent experienced a) an adult forcing or attempting to force unwanted sexual activity by threatening you, holding you down or hurting you; or b) an adult touching you against your will in a sexual way, which includes unwanted sexual touching or grabbing, kissing or fondling (Government of Canada, 2022e). Based on the recommendation of the CEVQ, all child abuse items will be dichotomized into never and one or more exposures. A

derived composite binary variable for any child abuse will also be computed and utilized for specific analysis, including moderation.

***Sociodemographic Covariates*.** Several sociodemographic variables were included as covariates in the regression models. These included age measured as a continuous variable, sex (i.e., male and female), highest educational attainment (i.e., college diploma or less and some post-secondary or more), and total household income (i.e., $39,999 or less, $40,000 to $99,999, $100,000 to $149,999, and $150,000 or more). Other mental disorder diagnoses were combined into a composite variable to include as a covariate in all regression models. This variable included social phobia and bipolar disorder. Social phobia was measured by the WHO-CIDI and it is described as persisting fear of social situations with unfamiliar individuals or fear that revealing one's anxiety will result in humiliation, and that these social situations will cause anxiety (Government of Canada, 2022a). Diagnostic criteria also stipulate that individuals must understand that this fear is excessive (Government of Canada, 2022a). Additional criteria include avoiding social situations due to fear and anxiety, and a significant interference with daily life activities. This derived variable was dichotomized for the final composite variable. Bipolar disorder was also measured using the WHO-CIDI and the final variable used in the current study composite variable includes bipolar disorder I or a hypomanic episode, which includes bipolar disorder II (Government of Canada, 2022b). A diagnosis of bipolar disorder requires certain criteria occurring over a 7 day period including an elevated mood and manic symptoms such as racing thoughts or speech, extreme spending, less need for sleep, pleasure seeking, or increased self-confidence (Government of Canada, 2022b). Oftentimes these symptoms are accompanied with a depressive episode (Government of Canada, 2022b). These derived variables were

collapsed into other mental disorders, and this composite variable was dichotomized as having at least one other mental disorder or no other mental disorder.

Data Analysis

Defining Emerging Adults. Theoretical evidence suggests there are differences in mental disorder and substance use among early and late emerging adults. However, empirical evidence provides varying age ranges for emerging adulthood. Several analyses were conducted across different age groups to empirically define age groups for this study using these data. Unweighted cross tabulations of independent and outcome variables among certain age groups (i.e., 15 to 17 years, 15 to 22 years, 18 to 22 years, 23 to 29 years) revealed that it was not possible to examine 15- to 17-year-olds. Additionally, these respondents were excluded from child abuse items and therefore analyses assessing child abuse would have been among a different sample size. Collapsing independent variables and outcome variables into composite variables to increase power still did not yield a large enough sample size among this age group. Therefore, it was decided that 15- to 17-year-olds could not be included in the analysis due to low power. This decision was also supported by theoretical evidence that typically defines the beginning of emerging adulthood as 18 years of age (Arnett et al., 2014). Unweighted cross tabulations of main independent variables and outcome variables among the other age groups (i.e., 18 to 22 years and 23 to 29 years) did yield sufficient sample sizes to move forward and test all hypotheses. Weighted univariate and multivariate logistic regression models between independent variables and outcome variables showed differences among both age groups, providing empirical support for testing hypotheses among early emerging adults (i.e., 18 to 22 years old) and late emerging adults (23 to 29 years old). In addition to this empirical evidence to support separating emerging adulthood into these 2 groups, theoretical evidence has proposed

that emerging adulthood can extend to 29 years of age and evidence has examined mental disorders and substance use with these specific age ranges (Arnett et al., 2014; Qadeer et al., 2019) Therefore, for the current study, early emerging adults refers to those between 18 and 22 years of age, late emerging adults refers to those between 23 and 29 years of age, and emerging adults refers to those between 18 and 29 years old.

Verifying Assumptions. The assumptions of logistic regression were checked before continuing with the data analysis. Logistic regression has several assumptions including linearity of the logit, independence of observations, and the absence of multicollinearity and outliers (Tabachnick & Fidell, 2013). Linearity of the logit specifically assesses the relationship between continuous independent variables and the log odds of the binary outcome variable (Tabachnick & Fidell, 2013). This study has no continuous independent variables, and therefore this assumption cannot be violated. The second assumption is independence of observations which can be inferred based on how the data were collected. The data are not longitudinal and are not related to other data previously collected and therefore observations are independent and not related, verifying that this assumption is met. Multicollinearity is a possibility in all types of multiple regression analyses, and it is important to check for the absence of high correlations between independent variables (Tabachnick & Fidell, 2013). To do this, phi correlations were computed in SPSS between all independent variables including MDD, GAD, mental disorders (i.e., MDD or GAD composite variable), any child abuse, sex, education, household income, and any other mental disorders among all age groups. This is the recommended correlations test when the independent variables are categorial variables (Myers et al., 2010). A correlation of 0.7 or higher suggests a multicollinear relationship between independent variables and should this occur creating a composite variable is the first step to solving this problem (Tabachnick & Fidell,

2013). After investigating the correlation between each independent variable among all age groups, no multicollinearity was found. The last assumption in logistic regression is to assess for outliers and make appropriate decisions about whether to exclude an observation in the data. Corresponding multivariate logistic regression models were conducted among early emerging adults and late emerging adults, and the outcome estimate, residuals, and standardized residuals were predicted from each model. Scatterplots of the standardized residuals and MDD and GAD were computed for each model and examined for outliers. A standardized residual value of approximately +/- 3.3 is the threshold for determining if there may be outliers present (Tabachnick & Fidell, 2013). The standardized residuals were examined, and outliers were detected between the standardized residuals and MDD and GAD in both age groups when assessing AUD and CUD outcomes. At this point it was decided to examine whether the standardized residuals and any mental disorder (MDD or GAD composite variable) also had outliers, and none were detected. Therefore, all analyses examining AUD and CUD as an outcome was assessed with any mental disorder instead of MDD and GAD individually. All other standardized residuals showed no outliers and therefore all assumptions for logistic regression analyses were met.

The assumptions for multinomial regression are the same as logistic regression except the method of testing for outliers is different. The assumptions of linearity of the logit also cannot be violated in multinomial regression, independence of observations is still met, and the absence of multicollinearity between independent variables still holds for these analyses. Concerning the investigation of outliers, it is recommended that individual logit models between the outcome base level and other levels (i.e., no-risk alcohol use versus low-risk alcohol use, no-risk alcohol use versus high-risk alcohol use) are run separately with independent variables (Multinomial

Logistic Regression | R Data Analysis Examples, n.d.). Steps to examine for outliers from this point forward are the same as logistic regression. Multivariate logistic regression models were conducted among early emerging adults and late emerging adults, and the outcome estimate, residuals, and standardized residuals were predicted from each model. Scatterplots of the standardized residuals and MDD and GAD were computed for each model investigating at-risk alcohol use and at-risk cannabis use and examined for outliers. Standardized residuals with a cut point of +/- 3.3 were examined, and no outliers were detected. All assumptions for multinomial regression were met.

Statistical Analysis. All statistical analyses were conducted using STATA 17. To ensure proper representation of the population, sample weights were applied to each respondent for the final sample version. Weighting was not equivalent across each respondent but rather respondents' final estimates were weighted individually. Considering the complex sampling design of the study, a generalized version of bootstrap resampling was developed and implemented to integrate variability from the study design and the 2021 Census.

Research Question 1. The prevalence of sociodemographic characteristics (i.e., sex, education, household income, any other mental disorder) and MDD, GAD, any alcohol and cannabis use, at-risk alcohol and cannabis use, AUD and CUD, and child abuse were determined among emerging adults. Associations between sociodemographic characteristics and these variables (i.e., MDD, GAD, and all alcohol and cannabis variables) were examined by univariate logistic regression models and univariate multinomial regression models.

Research Question 2. Cross tabulations and regression analyses were conducted to investigate the relationship between mental disorders and substance use. Multivariate logistic regression models were performed between a) MDD and alcohol use, b) MDD and cannabis use,

c) GAD and alcohol use, and d) GAD and cannabis use. These models were computed among early emerging adults, late emerging adults, and emerging adults. Multivariate multinomial regressions assessed at-risk alcohol use and at-risk cannabis use. The first few models examined any mental disorder (i.e., MDD and GAD composite variable) and at-risk alcohol use among early emerging adults, late emerging adults, and emerging adults. MDD and GAD could not be investigated independently? with at-risk alcohol use due to low power. Next, multinomial regressions were computed to examine a) MDD and at-risk cannabis use, and b) GAD and at-risk cannabis use among early emerging adults, late emerging adults, and emerging adults. Multivariate logistic regression models also investigated the relationship between a) MDD and binge drinking, b) GAD and binge drinking, c) any mental disorder (i.e., MDD or GAD) and AUD, and d) any mental disorder (i.e., MDD or GAD) and CUD among early emerging adults, late emerging adults, and emerging adults. All models adjusted for age, sex, education, household income, and any other mental disorder.

Research Question 3. Multivariate logistic regression models between mental disorders and substance use examined if a history of child abuse moderates this relationship among early emerging adults, late emerging adults, and all emerging adults. Each model included an interaction term with main effects between the independent variable and any child abuse. First, the association between a) MDD and alcohol use, b) GAD and alcohol use, c) MDD and cannabis use, and d) GAD and cannabis use was examined using multivariate logistic regression. Next, multivariate multinomial regressions investigated whether any child abuse moderates the association between any mental disorder (i.e., MDD or GAD) and at-risk alcohol use, and if child abuse moderates the association between MDD and at-risk cannabis use, and GAD and at-risk cannabis use. Additional multivariate logistic regression models assessed whether child

abuse worsens the association between a) MDD and binge drinking, b) GAD and binge drinking, and c) any mental disorder (i.e., MDD or GAD) and AUD. All models adjusted for age, sex, education, household income, and any other mental disorder.

Research Question 4. Sex was examined as a moderator between mental disorders and substance use among early emerging adults, late emerging adults, and emerging adults. Multivariate regression models included main effects and an interaction term of the independent variable and sex. First multivariate logistic regression models investigated a) MDD and alcohol use, b) GAD and alcohol use, c) MDD and cannabis use, d) GAD and cannabis use, e) MDD and binge drinking, f) GAD and binge drinking, g) MDD and AUD and h) GAD and AUD. Next, multivariate multinomial regressions investigated whether sex moderates each of the above associations. Multivariate multinomial regressions examined MDD and at-risk cannabis use, and GAD and at-risk cannabis use. All models adjusted for age, education, household income, and any other mental disorder. Models assessing MDD and CUD, GAD and CUD, and mental disorders and at-risk alcohol use were underpowered and could not compute output. Therefore, they are not included in the final results.

Ethical Considerations. The 2022 MHACS was conducted under the Statistics Act and all information collected is confidential. Participation was voluntary and all respondents provided consent before beginning the survey. These data were used in secondary analyses and therefore confidentiality of information is the primary ethical consideration for this study. The data are anonymized and stored in the Manitoba Research Data Centre where all analyses took place. There are stringent protocols surrounding access to data and vetting all results from the centre. Ethical approval for this secondary data analysis was obtained from the University of Manitoba Health Research Ethics Board (file #HS27039).

Results

Assessment of Missing Information

All variables were assessed to determine whether key variables had a large percentage of missing data. Missing data of approximately 5% or less is considered acceptable and not deemed a serious problem (Tabachnick & Fidell, 2013). All variables were tabulated unweighted and all had less than 5% missing data.

Prevalence of Sociodemographic Characteristics and Lifetime Mental Disorders

The prevalence of sociodemographic characteristics by lifetime MDD and GAD among emerging adults is reported in Table 1. The prevalence of females with MDD and GAD (i.e., 24.41% and 22.88% respectively) was higher than males. Compared to males, females were more likely to have lifetime MDD (Odds Ratio [OR] = 1.68; 95% Confidence Interval [CI] = 1.27, 2.21; $p < .000$) or GAD (OR = 2.36; 95% CI = 1.73, 3.21; $p < .000$). Emerging adults with a household income of $100,000 to $149,999 were less likely to have lifetime MDD (OR = 0.52; 95% CI = 0.31, 0.86, $p = .012$) compared to those with a household income of $39,999 or less. Approximately 19.22% of emerging adults with lifetime MDD have a household income of $150,000 or more. This level of household income was not associated with lifetime MDD; however, this model may be underpowered. Compared to emerging adults with no other mental disorders, those with other mental disorders were significantly more likely to have lifetime MDD (OR = 5.78; 95% CI = 4.24, 7.90; $p < .000$) or GAD (OR = 7.14; 95% CI = 5.12, 9.97; $p < .000$). There were no significant findings observed for level of education attained (i.e., college diploma or less, and some university or more) and lifetime MDD or GAD, and household income was not associated with lifetime GAD.

Table 1. *Association between sociodemographic characteristics and lifetime major depressive disorder, and generalized anxiety disorder among emerging adults*

Sociodemographic Characteristics	Emerging Adults (18 to 29 years old)					
	Major Depressive Disorder			Generalized Anxiety Disorder		
	Yes (%)	OR (95% CI)	*p*-value	Yes (%)	OR (95% CI)	*p*-value
Sex						
Male	16.13	1.00	--	11.18	1.00	--
Female	24.41	**1.68 (1.27, 2.21)**	**p<0.000**	22.88	**2.36 (1.73, 3.21)**	**p<0.000**
Education						
College diploma or less	19.93	1.00	--	16.00	1.00	--
Some university or more	19.04	0.94 (0.69, 1.29)	p=0.720	17.67	1.13 (0.81, 1.57)	p=0.480
Income						
$39,999 or less	27.77	1.00	--	17.80	1.00	--
$40,000 to $99,999	21.21	0.70 (0.42, 1.16)	p=0.166	18.60	1.06 (0.60, 1.86)	p=0.852
$100,000 to $149,999	16.59	**0.52 (0.31, 0.86)**	**p=0.012**	13.25	0.71 (0.40, 1.25)	p=0.232
$150,000 or more	19.22	0.62 (0.38, 1.01)	p=0.056	16.78	0.93 (0.54, 1.61)	p=0.800
Other Mental Disorders						
No	11.50	1.00	--	8.20	1.00	--
Yes	42.90	**5.78 (4.24, 7.90)**	**p<0.000**	38.94	**7.14 (5.12, 9.97)**	**p<0.000**

Note. Odds Ratio = OR, 95% Confidence Interval = 95% CI.

Prevalence of Sociodemographic Characteristics and Past Year Substance Use

Any Alcohol and Cannabis Use. Sociodemographic characteristics by any past year alcohol use and any past year cannabis use among emerging adults can be found in Table 2. Results indicated that compared to female emerging adults, males were significantly more likely to use cannabis (OR = 1.28; 95% CI = 1.02, 1.62; p = .035) but not alcohol. Additionally, emerging adults with some university experience or more were less likely to use cannabis (OR = 0.75; 95% CI = 0.58, 0.97; p = .029) compared to those with a college diploma or less. No association was found between level of education attained and past year alcohol use. Compared to those with a household income of $39,999 or less, emerging adults with a household income of $150,000 or more had higher odds of past year alcohol use (OR = 1.91; 95% CI = 1.21, 3.02; p = .006). Compared to emerging adults with no other mental disorder, those with other mental disorders were more likely to drink alcohol (OR = 1.45; 95% CI = 1.09, 1.92; p = .010) and use cannabis (OR = 1.56; 95% CI = 1.22, 1.99; p < .000). All other findings were not significant.

At-Risk Alcohol Use. The prevalence of sociodemographic characteristics and at-risk alcohol use among emerging adults can be found in Table 3. Compared to emerging adult females, males were at a significantly greater risk of high-risk alcohol use (Risk Ratio [RR] = 3.44; 95% CI = 1.65, 7.16; p = .001) compared to no past year use, however this association was not observed for low-risk alcohol use. Findings showed that compared to emerging adults with a household income of $99,999 or less, only those with a household income of $150,000 or more were at a significantly greater risk of low-risk alcohol use (RR = 1.59; 95% CI = 1.20, 2.11; p = .001) compared to no alcohol use, but this finding was not observed for high-risk alcohol use. Additionally, compared to emerging adults with a household income of $99,999 or less, those between $100,000 and $149,999 were at lesser risk of high-risk alcohol use (RR = 0.29; 95% CI = 0.10, 0.81; p = .019) compared to those with no past year alcohol use. No other significant

associations were found for household income and past year at-risk alcohol use. Compared to emerging adults with no other lifetime mental disorders, emerging adults with other lifetime mental disorders were at a significantly greater risk of low-risk alcohol use (RR = 1.43; 95% CI = 1.07, 1.90; p = .015) compared to no past year alcohol use, but this finding was not observed for high-risk alcohol use. Having other mental disorders and high-risk past year alcohol use was not associated, however this model may be underpowered due to the large effect size. No significant observations were found between educational attainment and at-risk alcohol use among emerging adults.

At-Risk Cannabis Use. Sociodemographic characteristics and at-risk cannabis use among emerging adults are reported in Table 4. Findings showed that compared to emerging adult females, males were at a significantly greater risk of high-risk cannabis use (RR = 1.61; 95% CI = 1.11, 2.35; p = .012) compared to no past year cannabis use, but this finding was not observed for low-risk cannabis use. Compared to emerging adults with a college diploma or less, those with some university experience or more were at significantly less risk of high-risk cannabis use (RR = 0.56; 95% CI = 0.36, 0.88; p = .013) compared to no past year cannabis use, but this finding was not observed for low-risk cannabis use. Compared to emerging adults without other mental disorders, those with other mental disorders were at greater risk of high-risk cannabis use (RR = 2.48; 95% CI = 1.70, 3.63; p < .000) compared to no past year cannabis use, but this finding was not observed for low-risk cannabis use. No significant observations were found for household income and past year at-risk cannabis use.

Table 2. *Association between sociodemographic characteristics and any past year alcohol use, and any past year cannabis use among emerging adults*

Sociodemographic Characteristics	Emerging Adults (18 to 29 years old)					
	Any Alcohol Use			Any Cannabis Use		
	%	OR (95% CI)	*p*-value	%	OR (95% CI)	*p*-value
Sex						
Female	73.19	1.00	--	36.36	1.00	--
Male	74.22	1.05 (0.83, 1.34)	p=0.666	42.30	**1.28 (1.02, 1.62)**	**p=0.035**
Education						
College diploma or less	72.44	1.00	--	41.17	1.00	--
Some university or more	76.24	1.22 (0.95, 1.56)	p=0.114	34.41	**0.75 (0.58, 0.97)**	**p=0.029**
Income						
$39,999 or less	67.32	1.00	--	41.61	1.00	--
$40,000 to $99,999	71.93	1.24 (0.79, 1.96)	p=0.346	38.92	0.89 (0.57, 1.40)	p=0.623
$100,000 to $149,999	70.67	1.17 (0.74, 1.86)	p=0.508	37.75	0.85 (0.53, 1.35)	p=0.495
$150,000 or more	79.74	**1.91 (1.21, 3.02)**	**p=0.006**	40.98	0.97 (0.62, 1.52)	p=0.909
Other Mental Disorders						
No	71.96	1.00	--	36.84	1.00	--
Yes	78.80	**1.45 (1.09, 1.92)**	**p=0.010**	47.61	**1.56 (1.22, 1.99)**	**p<0.000**

Note. Odds Ratio = OR, 95% Confidence Interval = 95% CI.

Table 3. *Association between sociodemographic characteristics and past year at-risk alcohol use among early emerging adults*

Sociodemographic Characteristics	At-Risk Alcohol Use Among Emerging Adults (18 to 29 years old)							
	No Past Year Use		Low-Risk			High-Risk		
	%	RR (95% CI)	%	RR (95% CI)	*p*-value	%	RR (95% CI)	*p*-value
Sex								
Female	26.84	--	71.34	--	--	1.82	--	--
Male	25.84	--	68.14	0.99 (0.78, 1.26)	p=0.948	6.02	**3.44 (1.65, 7.16)**	**p=0.001**
Education								
College diploma or less	27.58	--	68.75	--	--	3.67	--	--
Some university or more	23.86	--	72.10	1.21 (0.94, 1.56)	p=0.133	4.03	1.27 (0.65, 2.46)	p=0.478
Income								
$99,999 or less	29.01	--	66.43	--	--	4.55	--	--
$100,000 to $149,999	29.37	--	69.30	1.03 (0.76, 1.39)	p=0.845	1.33	**0.29 (0.10, 0.81)**	**p=0.019**
$150,000 or more	20.34	--	74.22	**1.59 (1.20, 2.11)**	**p=0.001**	5.44	1.70 (0.86, 3.39)	p=0.129
Other Mental Disorders								
No	28.06	--	68.35	--	--	3.59	--	--
Yes	21.20	--	73.62	**1.43 (1.07, 1.90)**	**p=0.015**	5.17	1.91 (0.98, 3.69)	p=0.056

Note. Risk Ratio = RR, 95% Confidence Interval = 95% CI.

Table 4. *Association between sociodemographic characteristics and past year at-risk cannabis use among early emerging adults*

Sociodemographic Characteristics	At-Risk Cannabis Use Among Emerging Adults (18 to 29 years old)							
	No Past Year Use		Low-Risk			High-Risk		
	%	RR (95% CI)	%	RR (95% CI)	*p*-value	%	RR (95% CI)	*p*-value
Sex								
Female	66.69	--	22.78	--	--	10.53	--	--
Male	60.24	--	24.41	1.19 (0.91, 1.55)	p=0.213	15.35	**1.61 (1.11, 2.35)**	**p=0.012**
Education								
College diploma or less	62.01	--	23.39	--	--	14.59	--	--
Some university or more	67.53	--	23.50	0.92 (0.69, 1.24)	p=0.590	8.97	**0.56 (0.36, 0.88)**	**p=0.013**
Income								
$39,999 or less	59.13	--	26.87	--	--	14.01	--	--
$40,000 to $99,999	63.92	--	19.62	0.68 (0.40, 1.15)	p=0.150	16.47	1.09 (0.55, 2.16)	p=0.810
$100,000 to $149,999	65.45	--	24.88	0.84 (0.49, 1.43)	p=0.514	9.67	0.62 (0.30, 1.29)	p=0.201
$150,000 or more	61.98	--	26.26	0.93 (0.55, 1.57)	p=0.793	11.76	0.80 (0.39, 1.63)	p=0.539
Other Mental Disorders								
No	65.68	--	24.17	--	--	10.15	--	--
Yes	55.98	--	22.52	1.09 (0.81, 1.47)	p=0.552	21.50	**2.48 (1.70, 3.63)**	**p<0.000**

Note. Risk Ratio = RR, 95% Confidence Interval = 95% CI.

Binge Drinking. Sociodemographic characteristics and past year binge drinking among emerging adults can be found in Table 5. Emerging adult males compared to females were significantly more likely to binge drink alcohol (OR = 1.44; 95% CI = 1.16, 1.79; $p < .001$). Compared to those with a household income of $39,999 or less, emerging adults with a household income of $150,000 or more were more likely to binge drink (OR = 1.89; 95% CI = 1.22, 2.93; $p = .004$). All other findings were not significant.

Table 5. *Association between sociodemographic characteristics and past year binge drinking among emerging adults*

Sociodemographic Characteristics	Binge Drinking Among Emerging Adults (18 to 29 years old)		
	%	OR (95% CI)	*p*-value
Sex			
Female	43.79	1.00	--
Male	52.87	**1.44 (1.16, 1.79)**	**p=0.001**
Education			
College diploma or less	47.87	1.00	--
Some university or more	50.19	1.10 (0.87, 1.39)	p=0.439
Income			
$39,999 or less	40.86	1.00	--
$40,000 to $99,999	48.72	1.38 (0.87, 2.18)	p=0.174
$100,000 to $149,999	40.75	1.00 (0.62, 1.60)	p=0.985
$150,000 or more	56.64	**1.89 (1.22, 2.93)**	**p=0.004**
Other Mental Disorders			
No	47.65	1.00	--
Yes	52.18	1.20 (0.93, 1.54)	p=0.153

Note. Odds Ratio = OR, 95% Confidence Interval = 95% CI.

AUD and CUD. The prevalence of sociodemographic characteristics by AUD and CUD among emerging adults are reported in Table 6. Emerging adults with other mental disorders were more likely to have AUD (OR = 3.60; 95% CI = 1.97, 6.59; $p < .000$) and/or CUD (OR = 4.02; 95% CI = 2.24, 7.18; $p < .000$) compared to those with no other mental disorders. Additionally, compared to females, emerging adult males were more likely to have CUD (OR = 1.84; 95% CI = 1.02, 3.32; $p = .043$). Emerging adults with some university education were less likely to have

CUD (OR = 0.27; 95% CI = 0.13, 0.58; p = .001) compared to those with a college diploma or less. Compared to emerging adults with a household income of $39,999 or less, those with a household income between $100,000 and $149,999 were less likely to have CUD (OR = 0.35; 95% CI = 0.13, 0.90; p = .029). All other results were not found to be significant.

Table 6. *Association between sociodemographic characteristics and past year alcohol use disorder and cannabis use disorder among emerging adults*

Sociodemographic Characteristics	Emerging Adults (18 to 29 years old)					
	Alcohol Use Disorder			Cannabis Use Disorder		
	%	OR (95% CI)	*p*-value	%	OR (95% CI)	*p*-value
Sex						
Female	3.16	1.00	--	2.77	1.00	--
Male	4.43	1.42 (0.82, 2.46)	p=0.210	4.98	**1.84 (1.02, 3.32)**	**p=0.043**
Education						
College diploma or less	3.76	1.00	--	4.97	1.00	--
Some university or more	3.69	0.98 (0.53, 1.80)	p=0.947	1.41	**0.27 (0.13, 0.58)**	**p=0.001**
Income						
$39,999 or less	5.13	1.00	--	7.24	1.00	--
$40,000 to $99,999	3.45	0.66 (0.26, 1.68)	p=0.384	3.57	0.47 (0.18, 1.26)	p=0.133
$100,000 to $149,999	2.05	0.39 (0.15, 1.02)	p=0.055	2.63	**0.35 (0.13, 0.90)**	**p=0.029**
$150,000 or more	5.25	1.03 (0.45, 2.33)	p=0.952	4.45	0.60 (0.24, 1.47)	p=0.260
Other Mental Disorders						
No	2.32	1.00	--	2.24	1.00	--
Yes	7.86	**3.60 (1.97, 6.59)**	**p<0.000**	8.41	**4.02 (2.24, 7.18)**	**p<0.000**

Note. Odds Ratio = OR, 95% Confidence Interval = 95% CI.

Prevalence of Sociodemographic Characteristics and Any Child Abuse

The prevalence of sociodemographic characteristics by any child abuse among emerging adults are reported in Table 7. Approximately 45% of emerging adults with a household income of $39,999 or less retrospectively self-reported a history of any child abuse. Compared to emerging adults with a household income of $39,999 or less, those who had an income between $100,000 and $149,999 (OR = 0.49; 95% CI = 0.31, 0.79; p = .003) and $150,000 or more (OR = 0.48; 95% CI = 0.31, 0.75; p = .001) were less likely to report a history of child abuse. The prevalence of emerging adults with other mental disorders and a history of any child abuse was 48.23%. Emerging adults with other mental disorders were more likely to report a history of child abuse (OR = 2.44; 95% CI = 1.88, 3.17; p < .000) compared to those with no other mental disorders. All other results were not significant.

Table 7. *Association between sociodemographic characteristics and any child abuse among emerging adults*

Sociodemographic Characteristics	Child Abuse History Among Emerging Adults (18 to 29 years old)		
	%	OR (95% CI)	p-value
Sex			
Male	33.91	1.00	--
Female	32.62	0.94 (0.75, 1.19)	p=0.625
Education			
College diploma or less	32.20	1.00	--
Some university or more	36.80	1.23 (0.41, 1.57)	p=0.110
Income			
$39,999 or less	45.13	1.00	--
$40,000 to $99,999	38.26	0.75 (0.48, 1.19)	p=0.228
$100,000 to $149,999	28.89	**0.49 (0.31, 0.79)**	**p=0.003**
$150,000 or more	28.30	**0.48 (0.31, 0.75)**	**p=0.001**
Other Mental Disorders			
No	27.64	1.00	--
Yes	48.23	**2.44 (1.88, 3.17)**	**p<0.000**

Note. Odds Ratio = OR, 95% Confidence Interval = 95% CI.

Association between Lifetime Mental Disorders and Past Year Substance Use

Any Alcohol and Cannabis Use. The results for MDD and GAD and any past year alcohol use and cannabis use can be found in Table 8. Among early emerging adults, 77.44% who have lifetime MDD reported past year alcohol use and 58.08% reported past year cannabis use. Multivariate logistic regression models were computed, and findings indicate that compared to early emerging adults without MDD, those with MDD were more likely to use cannabis in the past year (Adjusted Odds Ratio [AOR] = 2.12, 95% CI = 1.38, 3.25; $p = .001$) but not alcohol. Among late emerging adults with MDD, 81.67% reported alcohol use and 62.63% reported cannabis use, while 77.63% of those with GAD reported alcohol use and 55.14% reported cannabis use. Compared to late emerging adults without MDD, those with MDD had higher odds of past year alcohol use (AOR = 1.71; 95% CI = 1.00, 2.90; $p = .049$) and cannabis use (AOR = 3.27; 95% CI = 2.00, 5.35; $p < .000$). Compared to those without GAD, late emerging adults with GAD were more likely to report past year cannabis use (AOR = 1.79; 95% CI = 1.06, 2.93; $p = .030$) but not alcohol use. Among emerging adults with MDD, 79.83% reported past year alcohol use and 60.66% reported past year cannabis use. Among emerging adults with GAD, 79.29% reported past year alcohol use and 53.25% reported past year cannabis use. Compared to emerging adults without MDD, those with MDD had higher odds of reporting past year alcohol use (AOR = 1.43; 95% CI = 1.00, 2.05; $p = .050$) and cannabis use (AOR = 2.66; 95% CI = 1.91, 3.70; $p < .000$). Among emerging adults, GAD was significantly associated with past year cannabis use (AOR = 1.55; 95% CI = 1.08, 2.22; $p = .017$) but not alcohol use. All other findings were not significant.

Table 8. *Association between lifetime major depressive disorder and any past year alcohol use and any past year cannabis use, and lifetime generalized anxiety disorder and any past year alcohol use and any past year cannabis use among early emerging adults, late emerging adults, and emerging adults*

	Early Emerging Adults (18 to 22 years old)					
	Any Alcohol Use			Any Cannabis Use		
	Yes (%)	AOR (95% CI)	*p*-value	Yes (%)	AOR (95% CI)	*p*-value
MDD						
No	69.96	1.00	--	33.17	1.00	--
Yes	77.44	1.22 (0.75, 1.97)	p=0.422	58.08	**2.12 (1.38, 3.25)**	**p=0.001**
GAD						
No	68.98	1.00	--	35.19	1.00	--
Yes	81.66	1.57 (0.91, 2.71)	p=0.104	50.57	1.29 (0.79, 2.11)	p=0.315
	Late Emerging Adults (23 to 29 years old)					
	Any Alcohol Use			Any Cannabis Use		
	Yes (%)	AOR (95% CI)	*p*-value	Yes (%)	AOR (95% CI)	*p*-value
MDD						
No	74.43	1.00	--	35.44	1.00	--
Yes	81.67	**1.71 (1.00, 2.90)**	**p=0.049**	62.63	**3.27 (2.00, 5.35)**	**p<0.000**
GAD						
No	75.78	1.00	--	38.00	1.00	--
Yes	77.63	0.86 (0.50, 1.48)	p=0.585	55.14	**1.79 (1.06, 2.93)**	**p=0.030**
	Emerging Adults (18 to 29 years old)					
	Any Alcohol Use			Any Cannabis Use		
	Yes (%)	AOR (95% CI)	*p*-value	Yes (%)	AOR (95% CI)	*p*-value
MDD						
No	72.41	1.00	--	34.42	1.00	--
Yes	79.83	**1.43 (1.00, 2.05)**	**p=0.050**	60.66	**2.66 (1.91, 3.70)**	**p<0.000**
GAD						
No	72.67	1.00	--	36.72	1.00	--
Yes	79.29	1.14 (0.78, 1.69)	p=0.494	53.25	**1.55 (1.08, 2.22)**	**p=0.017**

Note. Adjusted Odds Ratio = AOR, 95% Confidence Interval = 95% CI. All models adjusted for age, sex, education, household income, and any other mental disorder. For models where MDD was the independent variable, GAD was a covariate. For models where GAD was the independent variable, MDD was a covariate.

At-Risk Alcohol Use. The association of mental disorders (i.e., MDD or GAD) with past year at-risk alcohol use was examined among early emerging adults, late emerging adults, and emerging adults. These findings can be found in Table 9. Multivariate multinomial regressions were computed to examine the association between having a mental disorder (i.e., MDD or GAD) and at-risk alcohol use. These analyses could not be conducted to assess MDD and GAD separately

with at-risk alcohol use as it violated the Statistics Canada vetting rules. Results indicated that compared to late emerging adults without a lifetime mental disorder (i.e., MDD or GAD), those with a lifetime mental disorder were at significantly greater risk of past year high-risk alcohol use (ARR = 2.91; 95% CI = 1.11, 7.59; p = .029) compared to no past year alcohol use, but this finding was not observed for low-risk alcohol use. This model may not have had sufficient power to detect a significant association based on the moderate to large effect size. Compared to emerging adults without lifetime mental disorders, those with mental disorders were at statistically significant greater risk of past year low-risk alcohol use (ARR = 1.51; 95% CI = 1.09, 2.07; p = .012) compared to no past year alcohol use, and high-risk alcohol use (ARR = 2.54; 95% CI = 1.15, 5.59; p = .021) compared to no past year alcohol use. No significant findings were observed among early emerging adults.

At-Risk Cannabis Use. The results for lifetime MDD and GAD and at-risk cannabis use are reported in Table 10. Multivariate multinomial regressions were performed and findings indicated that compared to early emerging adults without MDD, those with lifetime MDD were at significantly greater risk of low-risk cannabis use (ARR = 2.09; 95% CI = 1.30, 3.35; p = .002) compared to no past year cannabis use, and high-risk cannabis use (ARR = 2.77; 95% CI = 1.45, 5.27; p = .002) compared to no past year cannabis use. There was no association observed between lifetime GAD and past year at-risk cannabis use among early emerging adults. However, there may have been insufficient power to detect a significant association between GAD and low-risk cannabis use based on the moderate to large effect size and wide confidence intervals. Compared to late emerging adults without lifetime MDD, late emerging adults with lifetime MDD were at a significantly greater risk of low-risk cannabis use (ARR = 2.10; 95% CI = 1.15, 3.39; p = .016) compared to no past year cannabis use and high-risk cannabis use (ARR =

4.81; 95% CI = 2.52, 9.18; $p < .000$) compared to no past year cannabis use. Similarly, compared to late emerging adults without GAD, late emerging adults with lifetime GAD were at a significantly greater risk of low-risk cannabis use (ARR = 1.87; 95% CI = 1.03, 3.39; $p = .033$) compared to no past year cannabis use, but this finding was not observed for high-risk cannabis use. However, this model has a large effect size and wide confidence intervals indicating that there may have been insufficient power to detect a significant association between GAD and high-risk cannabis use. Compared to emerging adults without MDD, those with lifetime MDD were at significantly greater risk of low-risk cannabis use (ARR = 2.06; 95% CI = 1.39, 3.03; $p < .000$) compared to no past year cannabis use, and high-risk cannabis use (ARR = 3.85; 95% CI = 2.41, 6.15; $p < .000$) compared to no past year cannabis use. Similarly, compared to emerging adults without GAD, those with lifetime GAD were at significantly greater risk of low-risk cannabis use (ARR = 1.76; 95% CI = 1.17, 2.65; $p = .006$) compared to no past year cannabis use, and high-risk cannabis use (ARR = 1.68; 95% CI = 1.01, 2.79; $p = .046$) compared to no past year cannabis use.

Table 9. *Association between lifetime mental disorders (i.e., major depressive disorder or generalized anxiety disorder) and past year at-risk alcohol use among early emerging adults, late emerging adults, and emerging adults*

	Early Emerging Adults (18 to 22 years old)							
	No Past Year Alcohol Use		Low-Risk Alcohol Use			High-Risk Alcohol Use		
	Yes (%)	ARR (95% CI)	Yes (%)	ARR (95% CI)	p-value	Yes (%)	ARR (95% CI)	p-value
Mental Disorder								
No	31.23	--	67.34	1.00	--	1.44	1.00	--
Yes	22.23	--	75.17	1.42 (0.94, 2.14)	p=0.096	2.60	1.58 (0.45, 5.62)	p=0.479
	Late Emerging Adults (23 to 29 years old)							
	No Past Year Alcohol Use		Low-Risk Alcohol Use			High-Risk Alcohol Use		
	Yes (%)	ARR (95% CI)	Yes (%)	ARR (95% CI)	p-value	Yes (%)	ARR (95% CI)	p-value
Mental Disorder								
No	26.18	--	68.96	1.00	--	4.86	1.00	--
Yes	18.61	--	72.38	1.57 (0.97, 2.56)	p=0.067	9.01	**2.91 (1.11, 7.59)**	**p=0.029**
	Emerging Adults (18 to 29 years old)							
	No Past Year Alcohol Use		Low-Risk Alcohol Use			High-Risk Alcohol Use		
	Yes (%)	ARR (95% CI)	Yes (%)	ARR (95% CI)	p-value	Yes (%)	ARR (95% CI)	p-value
Mental Disorder								
No	28.45	--	68.23	1.00	--	3.32	1.00	--
Yes	20.19	--	73.60	**1.51 (1.09, 2.07)**	**p=0.012**	6.21	**2.54 (1.15, 5.59)**	**p=0.021**

Note. Adjusted Risk Ratio = ARR, 95% Confidence Interval = 95% CI. All models adjusted for age, sex, education, household income, and any other mental disorder.

Table 10. *Association between lifetime major depressive disorder and generalized anxiety disorder and past year at-risk cannabis use among early emerging adults, late emerging adults, and emerging adults*

	Early Emerging Adults (18 to 22 years old)							
	No Past Year Cannabis Use		Low-Risk Cannabis Use			High-Risk Cannabis Use		
	Yes (%)	ARR (95% CI)	Yes (%)	ARR (95% CI)	*p*-value	Yes (%)	ARR (95% CI)	*p*-value
MDD								
No	70.61	--	21.62	1.00	--	7.77	1.00	--
Yes	44.82	--	34.15	**2.09 (1.30, 3.35)**	**p=0.002**	21.02	**2.77 (1.45, 5.27)**	**p=0.002**
GAD								
No	69.09	--	21.74	1.00	--	9.17	1.00	--
Yes	50.81	--	33.84	1.66 (0.95, 2.91)	p=0.077	15.36	1.20 (0.60, 2.39)	p=0.551
	Late Emerging Adults (23 to 29 years old)							
	No Past Year Cannabis Use		Low-Risk Cannabis Use			High-Risk Cannabis Use		
	Yes (%)	ARR (95% CI)	Yes (%)	ARR (95% CI)	*p*-value	Yes (%)	ARR (95% CI)	*p*-value
MDD								
No	66.18	--	22.72	1.00	--	11.11	1.00	--
Yes	40.38	--	25.66	**2.10 (1.15, 3.82)**	**p=0.016**	33.95	**4.81 (2.52, 9.18)**	**p<0.000**
GAD								
No	64.05	--	23.48	1.00	--	12.48	1.00	--
Yes	46.08	--	25.56	**1.87 (1.03, 3.39)**	**p=0.033**	28.36	1.92 (0.96, 3.85)	p=0.065
	Emerging Adults (18 to 29 years old)							
	No Past Year Cannabis Use		Low-Risk Cannabis Use			High-Risk Cannabis Use		
	Yes (%)	ARR (95% CI)	Yes (%)	ARR (95% CI)	*p*-value	Yes (%)	ARR (95% CI)	*p*-value
MDD								
No	68.18	--	22.22	1.00	--	9.60	1.00	--
Yes	42.32	--	29.36	**2.06 (1.39, 3.03)**	**p<0.000**	28.32	**3.85 (2.41, 6.15)**	**p<0.000**
GAD								
No	66.35	--	22.68	1.00	--	10.96	1.00	--
Yes	48.04	--	28.98	**1.76 (1.17, 2.65)**	**p=0.006**	22.98	**1.68 (1.01, 2.79)**	**p=0.046**

Note. Adjusted Risk Ratio = ARR, 95% Confidence Interval = 95% CI. All models adjusted for age, sex, education, household income, and any other mental disorder. For models where MDD was the independent variable, GAD was a covariate. For models where GAD was the independent variable, MDD was a covariate.

Binge Drinking. The relationship between lifetime MDD and GAD and past year binge drinking was assessed among early emerging adults, late emerging adults, and emerging adults, and these results are reported in Table 11. Multivariate logistic regression models showed no relationship between having MDD or GAD and past year binge drinking among early emerging adults, late emerging adults, and emerging adults. Although these findings were not statistically significant, there may be underpowered models examining MDD and binge drinking among early emerging adults and emerging adults due to the moderate to large effect size which still have clinical relevance.

Table 11. *Association between lifetime major depressive disorder and generalized anxiety disorder and past year binge drinking among early emerging adults, late emerging adults, and emerging adults*

	Binge Drinking Among Early Emerging Adults (18 to 22 years old)		
	Yes (%)	AOR (95% CI)	*p*-value
MDD			
No	45.04	1.00	--
Yes	56.45	1.50 (0.98, 2.31)	p=0.064
GAD			
No	45.62	1.00	--
Yes	53.87	1.22 (0.76, 1.96)	p=0.413
	Late Emerging Adults (23 to 29 years old)		
	Yes (%)	AOR (95% CI)	*p*-value
MDD			
No	49.20	1.00	--
Yes	52.74	1.30 (0.83, 2.05)	p=0.254
GAD			
No	50.02	1.00	--
Yes	50.44	0.95 (0.56, 1.60)	p=0.847
	Emerging Adults (18 to 29 years old)		
	Yes (%)	AOR (95% CI)	*p*-value
MDD			
No	47.33	1.00	--
Yes	54.35	1.38 (0.99, 1.91)	p=0.054
GAD			
No	48.01	1.00	--
Yes	51.86	1.06 (0.74, 1.52)	p=0.746

Note. Adjusted Odds Ratio = AOR, 95% Confidence Interval = 95% CI. All models adjusted for age, sex, education, household income, and any other mental disorder. For models where MDD

was the independent variable, GAD was a covariate. For models where GAD was the independent variable, MDD was a covariate.

AUD and CUD. Results for lifetime mental disorders and AUD and CUD are reported in Table 12. Among early emerging adults with a mental disorder, 11.22% met the criteria for a CUD, and among late emerging adults with a mental disorder, 6.95% met the criteria for a CUD. Multivariate logistic regression models indicate that among early emerging adults without a mental disorder (i.e., MDD or GAD), those with a mental disorder were more likely to have a CUD (AOR = 2.34; 95% CI = 1.04, 5.23; p = .039) but not an AUD. Compared to late emerging adults without a mental disorder, those with a mental disorder had higher odds of having a CUD(AOR = 5.87; 95% CI = 1.85, 18.65; p = .003). Among emerging adults, compared to those without a mental disorder, emerging adults with a mental disorder were more likely to have a CUD (AOR = 3.18; 95% CI = 1.63, 6.23; p = .001). No significant findings were observed for AUD, however it is possible that all models examining AUD as an outcome were underpowered and therefore did not detect a significant association.

Table 12. *Association between lifetime mental disorders (i.e., major depressive disorder or generalized anxiety disorder) and past year alcohol use disorder and cannabis use disorder among early emerging adults, late emerging adults, and emerging adults*

	Early Emerging Adults (18 to 22 years old)					
	Alcohol Use Disorder			Cannabis Use Disorder		
	Yes (%)	AOR (95% CI)	*p*-value	Yes (%)	AOR (95% CI)	*p*-value
Mental Disorder						
No	3.40	1.00	--	3.99	1.00	--
Yes	6.76	1.47 (0.69, 3.14)	p=0.323	11.22	**2.34 (1.04, 5.23)**	**p=0.039**
	Late Emerging Adults (23 to 29 years old)					
	Alcohol Use Disorder			Cannabis Use Disorder		
	Yes (%)	AOR (95% CI)	*p*-value	Yes (%)	AOR (95% CI)	*p*-value
Mental Disorder						
No	1.95	1.00	--	0.75	1.00	--
Yes	7.00	2.42 (0.75, 7.80)	p=0.137	6.95	**5.87 (1.85, 18.65)**	**p=0.003**
	Emerging Adults (18 to 29 years old)					
	Alcohol Use Disorder			Cannabis Use Disorder		
	Yes (%)	AOR (95% CI)	*p*-value	Yes (%)	AOR (95% CI)	*p*-value
Mental Disorder						
No	2.61	1.00	--	2.22	1.00	--
Yes	6.90	1.89 (0.97, 3.66)	p=0.060	8.80	**3.18 (1.63, 6.23)**	**p=0.001**

Note. Adjusted Odds Ratio = AOR, 95% Confidence Interval = 95% CI. All models adjusted for age, sex, education, household income, and any other mental disorder.

Moderating Effects of Child Abuse on the Association Between Lifetime Mental Disorders and Past Year Substance Use

To examine if a history of any child abuse moderates the association between lifetime mental disorders and past year substance use among early emerging adults, late emerging adults, and emerging adults, multivariate logistic regression models and multinomial regression models were computed with interaction terms and main effects. Results from these analyses can be found in Appendix A. There were no significant moderation effects within these models, however it is very possible that these models were underpowered and that significant moderation

effects exist but were undetected due to sample size. Conclusions about child abuse as a moderator within the current study should be done with caution.

Moderating Effects of Sex on the Association Between Lifetime Mental Disorders and Past Year Substance Use

Sex was examined as a moderator between lifetime mental disorders and past year substance use among early emerging adults, late emerging adults, and emerging adults. To do this, multivariate logistic regression models and multinomial regression models with an interaction term and main effects were computed and interpreted using $\alpha < .10$.

Any Alcohol and Cannabis Use. Multivariate logistic regression models between lifetime MDD and GAD and any past year alcohol use and any past year cannabis use were computed, and results can be found in Table 13. Results indicated that sex significantly moderated the association between lifetime MDD and past year alcohol use among early emerging adults (AOR = 3.12; 95% CI = 1.28, 7.56; $p = .012$) and late emerging adults (AOR = 0.30; 95% CI = 0.10, 0.89; $p = .030$). Additionally, results from multivariate logistic regression models between MDD and any cannabis use showed that sex moderated this relationship among early emerging adults (AOR = 3.16; 95% CI = 1.42, 7.03; $p = .005$). Details on these models will be described later in this section. All other findings were not significant.

At-Risk Cannabis Use. Multivariate multinomial regression models between lifetime MDD and GAD and past year at-risk cannabis use were performed, and results are reported in Table 14. Findings showed that sex moderated the relationship between MDD and at-risk cannabis use among early emerging adults with low-risk cannabis use (AOR = 2.78; 95% CI = 1.10, 6.99; $p = .030$) compared to no past year cannabis use, and high-risk cannabis use (AOR = 4.67; 95% CI =

1.41, 15.52; p = .012) compared to no past year cannabis use. Details on these models will be described later in this section. All other results were not significant.

Table 13. *Examining moderating effects of sex on the association between lifetime major depressive disorder and generalized anxiety disorder and any past year alcohol use and any past year cannabis use among early emerging adults, late emerging adults, and emerging adults*

	Any Alcohol Use AOR (90% CI) of Interaction Term	*p*-value
MDD*Sex		
Early Emerging Adults	**3.12 (1.28, 7.56)**	**p=0.012**
Late Emerging Adults	**0.30 (0.10, 0.89)**	**p=0.030**
Emerging Adults	0.91 (0.46, 1.80)	p=0.787
GAD*Sex		
Early Emerging Adults	2.38 (0.83, 6.82)	p=0.107
Late Emerging Adults	0.84 (0.26, 2.74)	p=0.774
Emerging Adults	1.35 (0.60, 3.06)	p=0.465
	Any Cannabis Use AOR (90% CI) of Interaction Term	*p*-value
MDD*Sex		
Early Emerging Adults	**3.16 (1.42, 7.03)**	**p=0.005**
Late Emerging Adults	0.73 (0.31, 1.72)	p=0.475
Emerging Adults	1.38 (0.76, 2.51)	p=0.289
GAD*Sex		
Early Emerging Adults	2.00 (0.76, 5.30)	p=0.159
Late Emerging Adults	0.60 (0.22, 1.67)	p=0.329
Emerging Adults	1.06 (0.53, 2.10)	p=0.874

Note. Adjusted Odds Ratio = AOR, 95% Confidence Interval = 95% CI. All models adjusted for age, education, household income, and any other mental disorder. For models where MDD was the independent variable, GAD was a covariate. For models where GAD was the independent variable, MDD was a covariate.

Table 14. *Examining moderating effects of sex on the association between lifetime major depressive disorder and generalized anxiety disorder and past year at-risk cannabis use among early emerging adults, late emerging adults, and emerging adults*

	At-Risk Cannabis Use			
	Low-Risk		High-Risk	
	AOR (90% CI) of Interaction Term	p-value	AOR (90% CI) of Interaction Term	p-value
MDD*Sex				
Early Emerging Adults	**2.78 (1.10, 6.99)**	**p=0.030**	**4.67 (1.41, 15.52)**	**p=0.012**
Late Emerging Adults	0.97 (0.33, 2.89)	p=0.962	0.71 (0.22, 2.26)	p=0.564
Emerging Adults	1.60 (0.78, 3.26)	p=0.199	1.40 (0.60, 3.25)	p=0.432
GAD*Sex				
Early Emerging Adults	2.17(0.72, 6.54)	p=0.167	1.94 (0.50, 7.59)	p=0.340
Late Emerging Adults	1.16 (0.36, 3.72)	p=0.798	0.32 (0.08, 1.25)	p=0.102
Emerging Adults	1.74 (0.80, 3.78)	p=0.163	0.61 (0.23, 1.60)	p=0.310

Note. Adjusted Risk Ratio = ARR, 95% Confidence Interval = 95% CI. All models adjusted for age, education, household income, and any other mental disorder. For models where MDD was the independent variable, GAD was a covariate. For models where GAD was the independent variable, MDD was a covariate.

Binge Drinking. Multivariate logistic regression models between lifetime MDD and GAD and past year binge drinking were computed, and findings are reported in Table 15. Results showed that sex significantly moderated the association between GAD and binge drinking among early emerging adults (AOR = 2.61; 95% CI = 1.05, 6.45; p = .038). Details on these models will be described later in this section. All other findings were not significant.

Table 15. *Examining moderating effects of sex on the association between lifetime major depressive disorder and generalized anxiety disorder and past year binge drinking among early emerging adults, late emerging adults, and emerging adults*

	Binge Drinking	
	AOR (90% CI) of Interaction Term	p-value
MDD*Sex		
Early Emerging Adults	1.66 (0.75, 3.69)	p=0.214
Late Emerging Adults	0.60 (0.25, 1.44)	p=0.251
Emerging Adults	0.93 (0.50, 1.73)	p=0.819
GAD*Sex		
Early Emerging Adults	**2.61 (1.05, 6.45)**	**p=0.038**
Late Emerging Adults	0.80 (0.28, 2.25)	p=0.667
Emerging Adults	1.33 (0.64, 2.75)	p=0.445

Note. Adjusted Odds Ratio = AOR, 95% Confidence Interval = 95% CI. All models adjusted for age, education, household income, and any other mental disorder. For models where MDD was the independent variable, GAD was a covariate. For models where GAD was the independent variable, MDD was a covariate.

AUD. Multivariate logistic regression models between having a mental disorder (i.e., MDD or GAD) and AUD were computed and are reported in Table 16. Findings showed that sex moderated this relationship among early emerging adults only (AOR = 5.80; 95% CI = 0.60, 36.23; p = .060). Details on these models will be described later in this section. All other findings were not significant.

Table 16. *Examining moderating effects of sex on the association between lifetime mental disorders and past year alcohol use disorder among early emerging adults, late emerging adults, and emerging adults*

	Alcohol Use Disorder	
	AOR (90% CI) of Interaction Term	*p*-value
Mental Disorder*Sex		
Early Emerging Adults	**5.80 (0.93, 36.23)**	**p=0.060**
Late Emerging Adults	1.22 (0.20, 7.32)	p=0.830
Emerging Adults	2.74 (0.76, 9.90)	p=0.125

Note. Adjusted Odds Ratio = AOR, 95% Confidence Interval = 95% CI. All models adjusted for age, education, household income, and any other mental disorder.

Association between Lifetime Mental Disorders and Past Year Substance Use Sex-Stratified

Models indicating significant moderation were conducted sex stratified. Sex-stratified multivariate logistic regression models that assessed MDD and any alcohol use among early emerging adults and late emerging adults are reported in Table 17. Results showed that among early emerging adults, the association between lifetime MDD and any alcohol use was significantly stronger among females than males (AOR = 1.90; 95% CI = 1.10, 3.29; p = .053) Multivariate logistic regression models among late emerging adults show that the association between lifetime MDD and past year alcohol use was stronger among males than females (AOR = 3.87; 95% CI = 1.76, 8.49; p = .005). Sex-stratified multivariate logistic regressions between MDD and any cannabis use can be found in Table 18. Results indicated that among early emerging adults, the association between lifetime MDD and past year alcohol use was stronger among females than males(AOR = 3.46; 95% CI = 2.16, 5.54; p < .000).

Table 17. *Sex-stratified lifetime major depressive disorder with any past year alcohol use among early emerging adults and late emerging adults*

	Any Alcohol Use Among Early Emerging Adults (18 to 22 years old)					
	Males			Females		
	Yes (%)	AOR (90% CI)	*p*-value	Yes (%)	AOR (90% CI)	*p*-value
MDD						
No	72.03	1.00	--	67.42	1.00	--
Yes	70.74	0.65 (0.36, 1.15)	p=0.215	81.82	**1.90 (1.10, 3.29)**	**p=0.053**
	Any Alcohol Use Among Late Emerging Adults (23 to 29 years old)					
	Males			Females		
	Yes (%)	AOR (90% CI)	*p*-value	Yes (%)	AOR (90% CI)	*p*-value
MDD						
No	73.47	1.00	--	75.63	1.00	--
Yes	87.64	**3.87 (1.76, 8.49)**	**p=0.005**	76.79	1.08 (0.62, 1.90)	p=0.817

Note. Adjusted Odds Ratio = AOR, 90% Confidence Interval = 90% CI. All models adjusted for age, education, household income, and any other mental disorder.

Table 18. *Sex-stratified lifetime major depressive disorder with any past year cannabis use among early emerging adults*

	Any Cannabis Use Among Early Emerging Adults (18 to 22 years old)					
	Males			Females		
	Yes (%)	AOR (90% CI)	p-value	Yes (%)	AOR (90% CI)	p-value
MDD						
No	37.22	1.00	--	28.18	1.00	--
Yes	50.34	1.07 (0.60, 1.89)	p=0.856	63.19	**3.46 (2.16, 5.54)**	**p<0.000**

Note. Adjusted Odds Ratio = AOR, 90% Confidence Interval = 90% CI. All models adjusted for age, education, household income, and any other mental disorder.

Sex stratified univariate multinomial regression models examined the association between lifetime MDD and at-risk cannabis use among early emerging adults. These findings are reported in Table 19. Results indicated that the association between lifetime MDD and past year high-risk cannabis use was significant among males (RR = 2.50; 90% CI = 1.29, 4.83; p = .022) and females (RR = 8.50; 90% CI = 4.36, 16.60; p < .000). Although statistical differences were not tested between males and females, the large effect size in the model for females indicates this association may be stronger. The association between lifetime MDD and low-risk cannabis use was significantly stronger among females (RR = 3.55; 90% CI = 2.21, 5.74; p < .000) than males.

Sex-stratified multivariate logistic regression models reporting the association between GAD and past year binge drinking among early emerging adults can be found in Table 20. Results showed that among early emerging adults, the association between lifetime GAD and past year binge drinking was stronger among females (AOR = 1.70; 90% CI = 1.04, 2.78; p = .077), however this association was not observed among early emerging adult males.

Table 19. *Sex-stratified lifetime major depressive disorder with past year at-risk cannabis use among early emerging adults*

	Male Early Emerging Adults (18 to 22 years old)							
	No Past Year Cannabis Use		Low-Risk Cannabis Use			High-Risk Cannabis Use		
	Yes (%)	RR (90% CI)	Yes (%)	RR (90% CI)	p-value	Yes (%)	RR (90% CI)	p-value
MDD								
No	66.39	--	23.43	1.00	--	10.17	1.00	--
Yes	50.84	--	29.70	1.65 (0.95, 2.87)	p=0.133	19.46	**2.50 (1.29, 4.83)**	**p=0.022**
	Female Early Emerging Adults (18 to 22 years old)							
	No Past Year Cannabis Use		Low-Risk Cannabis Use			High-Risk Cannabis Use		
	Yes (%)	RR (90% CI)	Yes (%)	RR (90% CI)	p-value	Yes (%)	RR (90% CI)	p-value
MDD								
No	75.80	--	19.38	1.00	--	4.81	1.00	--
Yes	40.84	--	37.10	**3.55 (2.21, 5.74)**	**p<0.000**	22.06	**8.50 (4.36, 16.60)**	**p<0.000**

Note. Adjusted models did not compute output for males due to small n's. Unadjusted models, however, did produce output and had sufficient sample size for vetting and power. Therefore, unadjusted RR are reported for this analysis.

Table 20. *Sex-stratified lifetime generalized anxiety disorder with past year binge drinking among early emerging adults*

	Binge Drinking Among Early Emerging Adults (18 to 22 years old)					
	Males			Females		
	Yes (%)	AOR (90% CI)	p-value	Yes (%)	AOR (90% CI)	p-value
GAD						
No	51.60	1.00	--	38.04	1.00	--
Yes	44.89	0.69 (0.36, 1.33)	p=0.354	58.17	**1.70 (1.04, 2.78)**	**p=0.077**

Note. Adjusted Odds Ratio = AOR, 90% Confidence Interval = 90% CI. All models adjusted for age, education, household income, and any other mental disorder.

Sex-stratified multivariate logistic regression models were computed to assess the relationship between early emerging adults with lifetime MDD and past year AUD. However, sex-stratified models could not be produced with a large enough sample size without violating vetting rules, and therefore these results cannot be reported.

Discussion

Correlates of Mental Disorders, Substance Use and Child Abuse

The aims of the current study were to investigate mental disorders, specifically MDD and GAD, and how they are related to alcohol use and cannabis use among emerging adults in Canada. Although evidence suggests bidirectional and co-occurring relationships between non-substance use mental disorders and substance use, the current study sought to determine the current prevalence and trends among emerging adults using a conceptual framework combining the ecological systems theory with the self-medication hypothesis. Before testing hypotheses related to mental disorders and substance use behaviours, sociodemographic characteristics were assessed among emerging adults with mental disorders, varying levels of substance use, and a history of child abuse. The primary sociodemographic characteristics that were significantly related to outcomes were sex and having other mental disorders. Females were more likely to

have GAD and MDD, and males were more likely to have a past year history of substance use including any cannabis use, high-risk cannabis use, a CUD, high-risk alcohol use and binge drinking. The sex differences observed among individuals with mental disorders and substance use from the current study are consistent with prior research indicating that females are more likely to have GAD and MDD, and males have higher odds of using substances (Hawes et al., 2019; Knoll & MacLennan, 2017; Yeretzian et al., 2023).

Interestingly, there were no sex differences observed among emerging adults who report having a history of child abuse. Research examining sex differences among individuals who report a history of child abuse vary. A recent Canadian epidemiological study using MHACS data found that females were more likely to report sexual abuse, but less likely to report physical abuse or any child abuse history (Afifi et al., 2025). However, these data analyzed child abuse among the entire sample, and this study utilized a subsample of emerging adults. This indicates that male and female Canadians older than 29 years of age may have reported different child abuse experiences than emerging adult males and females. Having other mental disorders was also associated with higher odds of lifetime MDD and GAD, any past year alcohol and cannabis use, low-risk alcohol use, high-risk cannabis use, meeting the criteria for an AUD and CUD, and reporting childhood abuse. These findings are also consistent with past research (Alhammad et al., 2022; Lemyre et al., 2019; Rowland & Marwaha, 2018; Single et al., 2024; Yapici Eser et al., 2018). Having other mental disorders was not associated with high-risk alcohol use in the current study, however it is possible that there was insufficient power to detect a significant association. High-risk alcohol use, as measured in this study, may be less common at this age in this sample of emerging adults resulting in a sample too small to detect significant associations. Although statistically insignificant, this may still have clinical significance as alcohol use can persist and

become more frequent over time putting individuals at future risk for alcohol-related health issues. A surprising result from the current study was that having other mental disorders was not associated with binge drinking. Perhaps binge drinking behaviours differ from other types of substance use behaviours and are considered more normative and socially acceptable within this stage of development (Sheidow et al., 2012).

Other sociodemographic characteristics including education and household income were also assessed. Educational background was only significantly associated with cannabis use patterns (i.e., past year cannabis use, high-risk cannabis use, and meeting the criteria for a CUD) and outcomes showed that emerging adults with some university experience or more were less likely to use cannabis than those with a college diploma or less. Epidemiological evidence in the United States has similarly reported that among states with legalized recreational cannabis use, cannabis use is higher among college students than university students (Bae & Kerr, 2020). This finding highlights a potential area for targeted interventions and prevention strategies for emerging adults attending post-secondary institutions, but more notably college campuses and high schools. Household income had more variable findings in the current study. Income was not associated with past year alcohol or cannabis use or at-risk cannabis use, however households with an income between $100,000 and $149,999 were less likely to have depression, report high-risk alcohol use, meet the criteria for a CUD, and report a history of child abuse. Additionally, having a household income of $150,000 or more had higher odds of low-risk alcohol use and binge drinking, but lower odds of childhood abuse. While binge drinking is not recommended, low-risk alcohol use may not necessarily be a poor outcome if government guidelines are being followed (Government of Canada, 2021). Results from the current study are partially supported by existing research which has found that higher income is associated with better mental health

(Kirkbride et al., 2024). However, different findings have also been observed where poor mental health is related to living in a poorer socioeconomic status indicating that the association between mental health and socioeconomic status is not unidirectional (Kirkbride et al., 2024). Findings from the current study concerning higher income status and substance use, however, are interesting. It is difficult to affirm whether this is consistent with current evidence as many studies measure socioeconomic status by income, education, or occupation (Probst et al., 2020; Xu et al., 2022). However, it is possible that alcohol use is more likely among higher income families because of social norms (Sheidow et al., 2012). Lastly, findings concerning household income and child abuse are not consistent with Canadian epidemiological observations over the last decade. Household income has not been associated with retrospective self-reports of child abuse in Canada, however, observations from the current study indicate that emerging adults from higher income families are less likely to report a history of any child abuse (Afifi et al., 2014). This trend where socioeconomically disadvantaged households have a high prevalence of child abuse and adversity than other socioeconomically stable households (Kirkbride et al., 2024)It is important to note that the current study examined sociodemographic correlates using a subsample of emerging adults as opposed to examining trends among the general Canadian population. Observations made from the current study are important to note and possibly examine further in comparison to other stages of development.

Mental Disorders and Substance Use Among Early Emerging Adults

It was hypothesized that having MDD or GAD would be associated with an increased likelihood of alcohol and cannabis use among emerging adults. Results among early emerging adults partially support this hypothesis. Those with MDD had higher odds of any past year cannabis use, low-risk and high-risk cannabis use, and those with MDD or GAD were more

likely to meet the criteria for a CUD (after adjusting for covariates). These findings are interesting as there is a consistent significant relationship between mental disorders and substance use found among early emerging adults, specifically MDD and cannabis use. There is a multitude of evidence supporting the association between MDD and cannabis, however some evidence corroborates cannabis use increasing the odds of MDD while other research notes co-occurring cannabis use with MDD (Garey et al., 2020; Langlois et al., 2021; Lev-Ran et al., 2014; Sorkhou et al., 2024). Neurobiological mechanisms provides one explanation about how cannabis use can contribute to MDD (Langlois et al., 2021). Activity in the endogenous cannabinoid system is mediated by certain cannabinoid receptors and one of these receptors, the CB1 receptor, interacts with THC causing psychoactive effects (Langlois et al., 2021). These same receptors and other parts of the endogenous cannabinoid system are involved in the pathophysiology of depression which supports the substance-induced pathway, and therefore at times there is an overlap between symptoms of MDD and effects of cannabis use (e.g., anhedonia, weight, and sleep) (Davis et al., 2023; Langlois et al., 2021). Although literature supports alternate directions of the association between MDD and cannabis use, studies have supported the self-medication hypothesis guiding the current study (i.e., MDD leading to cannabis use) (Mennis et al., 2024; Qadeer et al., 2019; Turner et al., 2018).

Interestingly, there was no relationship observed between having a mental disorder and alcohol use among early emerging adults. In the current study, having a MDD or GAD was not statistically related to at-risk alcohol use or meeting the criteria for an AUD. Additionally, the association between GAD and low-risk alcohol use specifically and MDD and binge drinking both did not reach statistical significance in the current study. However, it is possible that these models had inadequate power to detect a statistically significant association indicating instability

in the model and a possible type II error. Research conducted within this stage of development has consistently shown that experimenting with substance use is normal behaviour among emerging adults, particularly those in college years (Sheidow et al., 2012). In Canada, the age of legal alcohol consumption is 18 or 19 years old, depending on the province, and alcohol use among peers at this age is very common (Sheidow et al., 2012). Some evidence suggests a relationship between mental disorders and alcohol use, however the relationship between specific disorders and their comorbidities and alcohol use patterns (e.g., binge drinking and meeting the criteria for an AUD) differ across studies (Ning et al., 2020; Puddephatt et al., 2022). This could provide another explanation for why alcohol use was high in this subsample but not related to having a mental disorder. Another possible explanation for this finding from the current study is that there is a ceiling effect whereby alcohol use is so common among this age group that there not a significant association between MDD or GAD and alcohol use in this specific sample.

Mental Disorders and Substance Use Among Late Emerging Adults

The hypothesis that having MDD or GAD would be associated with an increased likelihood of alcohol and cannabis use was also partially supported among late emerging adults in the current study; however different trends were observed than among early emerging adults. Some similar findings were found between MDD and any cannabis use and at-risk cannabis use as were found in early emerging adults. However, among late emerging adults, GAD was associated with any cannabis use and low-risk cannabis use, MDD was related to any alcohol use, and having MDD or GAD was associated with high-risk alcohol use and meeting the criteria for a CUD. Unlike early emerging adults, there was a significant relationship between GAD and varying levels of cannabis use among late emerging adults. Similar to research examining MDD and cannabis use, the directionality investigating GAD and cannabis use could be bidirectional

(Garey et al., 2020; Kedzior & Laeber, 2014; Leadbeater et al., 2019; Stapinski et al., 2016). Evidence supports cannabis use worsening or contributing to symptoms of GAD, and vice versa (Garey et al., 2020; Kedzior & Laeber, 2014; Leadbeater et al., 2019; Stapinski et al., 2016). It is important to recognize that there are various types of anxiety disorders, and some are more strongly associated with cannabis use than others (e.g., social anxiety disorder; Single et al., 2024). Some findings were surprisingly not supported among late emerging adults in the current study. Of note, the association between GAD and high-risk cannabis use, and having MDD or GAD and low-risk alcohol use and meeting the criteria for an AUD were not statistically significant; however, these models may have been underpowered as the confidence intervals observed were wide indicating instability within the model and a possible type II error.

Additionally, research also indicates that GAD symptoms can be associated to cannabis due to its neuropsychopharmacology (Moitra et al., 2015). Cannabis is composed of hundreds of chemicals and over 100 cannabinoids (CBDs) making it extremely variable in its effects (Sharpe et al., 2020). CBD is one component that has anxiolytic properties (i.e., anxiety reducing); however, these anxiolytic effects are often mitigated by tetrahydrocannabinol (THC) content, which varies in concentration (Sharpe et al., 2020). Lower doses of THC promote anxiolytic effects, while high doses have been known to be more anxiogenic (i.e., anxiety causing; Sharpe et al., 2020). Investigating CBD contents and THC concentrations in cannabis that individuals use in epidemiological research would be difficult and therefore challenges arise when trying to understand cannabis use among certain populations that frequently use cannabis and are at risk for developing CUD. Considering all these factors concerning GAD and cannabis use, there is still evidence to support the self-medication hypothesis in relation to GAD and cannabis use (Moitra et al., 2015; Stapinski et al., 2016). Findings from this study do support this perspective,

however it is important to recognize that the current study was cross-sectional and cannot infer causality. Future studies should utilize alternate methodologies and study designs to better understand the directionality of anxiety and cannabis use, particularly among emerging adults in Canada.

Having GAD or MDD were found to be significantly associated with high-risk alcohol and CUD in the current study. Unfortunately, due to insufficient power, MDD and GAD could not be examined individually with at-risk alcohol use, AUD and CUD among late emerging adults. For this reason, it is not possible to identify if either mental health disorder is more strongly associated with substance use behaviours. However, as previously discussed, evidence exists that supports the association between mood disorders, like depression and anxiety, and alcohol and cannabis use. This study conceptualized mental disorders as having either MDD or GAD. On the other hand, research indicates comorbidity between MDD and GAD (Patten et al., 2015; Zbozinek et al., 2012). Various types of study designs have found this and indicate that there may be genetic commonalities and similar diagnostic criteria among both disorders (Zbozinek et al., 2012). While it is important to understand the comorbid effects of MDD and GAD on substance use in Canadian emerging adults, that was beyond the scope of the current study, and future research should investigate if comorbid versus individual mental disorders account for more or less potentially problematic substance use behaviours. In addition to comorbid non-substance use disorders, it is worth discussing polysubstance use. This was also not within the scope of the current study; however, research does indicate that some substance users are using more than one substance regularly (i.e., alcohol and cannabis; Hayaki et al., 2016; Thompson et al., 2021; Williams et al., 2022). Future Canadian studies should further investigate individual, and poly-substance use among emerging adults.

Mental Disorders and Substance Use Among Emerging Adults

It was hypothesized that having MDD or GAD would be associated with an increased likelihood of alcohol and cannabis use among emerging adults. Results among emerging adults were again partially supported. Findings supported the association between MDD and any cannabis use and any alcohol use, and at-risk cannabis use, while GAD was related to any cannabis use, at-risk cannabis use, and having either MDD or GAD was associated with at-risk alcohol use and meeting the criteria for a CUD. Other findings did not support the current hypothesis, notably the relationship between MDD and binge drinking, and mental disorders and meeting the criteria for an AUD. Models investigating these relationships may be underpowered, especially the model assessing AUD, and therefore did not detect a statistically significant association. As previously discussed, an absence of statistical significance does not mean an absence of clinical relevance. Although these models might be underpowered, it is important to understand that mental disorders, including MDD, can be related to varying levels of alcohol use behaviours and this relationship should still be considered when implementing strategies for treatment and prevention.

Binge Drinking and Alcohol Use Disorder

To our surprise, this hypothesis was not supported, and no association was found between GAD or MDD and binge drinking, or having either GAD or MDD and meeting the criteria for an AUD among any group. Evidence reporting on mental disorders and binge drinking or heavy episodic drinking behaviours is inconsistent. Some literature has suggested that depression and binge drinking behaviours are associated, while others have not (Mushquash et al., 2013; Puddephatt et al., 2022). One longitudinal study among Canadian female undergraduate students did find that depressive symptoms resulted in heavy episodic drinking, supporting the same

directionality tested in our study (although our findings were not significant; Mushquash et al., 2013). Similar findings were observed in a longitudinal study among American adolescents (Wilkinson et al., 2016). This study asked respondents about depressive symptoms and cannabis use across 4 different age groups which are represented as 4 waves (Wilkinson et al., 2016). The aim was to examine evidence supporting both the substance-induced pathway and the self-medication hypothesis among various stages of development, including emerging adulthood (Wilkinson et al., 2016). Findings indicated that there is support for both the substance-induced and the self-medication hypothesis among males and females despite our findings not supporting the hypothesis when examining binge drinking among emerging adults (Wilkinson et al., 2016). Conversely, provincial cross-sectional research found no association between depression and anxiety symptoms with binge drinking behaviours among adolescents (Butler et al., 2019). Additionally, it is important to note that these Canadian studies used different terminology and measures to examine excessive drinking. The terms heavy episodic drinking and binge drinking are used interchangeably, however, the way they are measured is not always consistent. Sometimes it is measured by the number of alcoholic beverages consumed on one occasion, other times it goes beyond that and specifies the number of drinks within a specific timeframe (e.g., 2 hours), and some provide different specifications based on sex (Butler et al., 2019; Mushquash et al., 2013; Piano et al., 2017). Researchers going forward should work towards developing a more standardized assessment for binge drinking that captures quantity of drinks consumed, frequency of binge drinking, duration between drinks, type of alcohol consumed, and to better understand how mental disorders are associated with binge drinking behaviours.

Another unexpected finding from the current study was that having MDD or GAD was not associated with AUD. Previous national epidemiological evidence within Canada among

emerging adults found that GAD and MDD each had higher odds of an AUD (Qadeer et al., 2019). Systematic reviews and meta-analyses have also supported the significant relationship between mental disorders and AUD (Puddephatt et al., 2022). One possible reason for our finding is that this model was underpowered and may not have detected a possible significant association between mental disorders and meeting the criteria for an AUD in our subsample. Emerging adults with a mental disorder who also had AUD was approximately 7.00%. Another possibility is that individuals in this subsample have not yet met the criteria for an AUD due to their age. Researchers should further investigate varying levels of alcohol use across developmental periods to examine which stages individuals are at highest risk for various substance use behaviours.

Sex Moderation Effects

The current study did find results that partially supported hypotheses examining sex moderation effects between mental disorders and substance use in emerging adults. More sex differences were noted among early emerging adults (i.e., MDD and any alcohol use, MDD and any cannabis use, MDD and at-risk cannabis use, GAD and binge drinking, and having MDD or GAD and AUD). Findings among early emerging adults supported hypotheses and sex stratified models indicated that the significant association between MDD and past year cannabis use and at-risk cannabis use was stronger among females than males. Additionally, the significant association between GAD and binge drinking was stronger among females than males. This moderation effect was unexpected after observing no significant associations between mental disorders and binge drinking in the current study. However, the significant sex moderation observed is present but weak and only found at $\alpha < .10$ as opposed to $\alpha < .05$. Research, to our knowledge, has focused on examining binge drinking among males and females, among

adolescents or emerging adults, college/university students, or individuals with individual or concurrent mood disorders, but moderation analyses are fewer (Butler et al., 2019; Davis et al., 2023; Dyer et al., 2019; Mushquash et al., 2013; Piano et al., 2017; Wilkinson et al., 2016). Sex moderated findings from the current study provides an avenue of examine for future studies among emerging adults with mental disorders, GAD to be more specific, and binge drinking behaviours.

Sex differences were also observed in adjusted models investigating MDD and any alcohol use among early emerging adults and late emerging adults. Among early emerging adults, the association between MDD and alcohol use was stronger among females, whereas this association was stronger among late emerging adults males. Observations among early emerging adults were expected and support our hypothesis, however, findings among late emerging adults are a surprise. A national epidemiological study found age- and sex- specific MDE prevalence differences where among both 15- to 24-year-olds and 25- to 34-year-olds, the prevalence of MDE was higher in females than males (Patten et al., 2016). This is to be expected and is consistent with the literature. However, the prevalence of MDE among females is lower in the older age group (i.e., 25 to 34 years old) than the younger age group (i.e., 15 to 24 years old), while the prevalence of MDE among males is higher in the older age group than the younger age group (Patten et al., 2016). Although age- and sex- interactions were not statistically tested for in the current study, findings could support this interaction and could explain why, in our study, MDD and alcohol use was more strongly associated among male late emerging adults and female early emerging adults. Research going forward should further investigate sex-approaches to as findings may be crucial for developing targeted treatment programs for emerging adults with mental disorders and substance use.

Child Abuse Moderation Effects

To our knowledge, this is the first epidemiological study examining child abuse as a moderator between mental disorders and substance use. Evidence from previous studies indicates that child abuse is associated with mental disorders and substance use in adulthood (Afifi et al., 2014; Alhammad et al., 2022; Cameranesi et al., 2019; England-Mason et al., 2018), yet findings from the current study did not detect significant moderation effects among emerging adults. However, to detect moderation effects there needs to be a substantial amount of power, and evidence from the current study is quite possibly underpowered indicating a Type II error. There is existing evidence indicating that a history of child abuse and neglect negatively impacts mental health in adolescence and adulthood (Cameranesi et al., 2019). Canadian epidemiological evidence over the last decade has indicated that any child abuse experience before the age of 16 years is associated with many mental disorders in adulthood including anxiety, depression, and substance use (Afifi et al., 2014; Afifi et al., 2025). However, findings have also suggested that at times shared variance exists among the types of child abuse and neglect (Cecil et al., 2017). Significant associations often observed when child abuse types are examined individually can disappear when examining the effects of any child abuse on mental health outcomes (Cecil et al., 2017). It is possible that examining any child abuse as a moderator was not significant, but specific types of abuse or neglect may significantly moderate the relationship between certain mental disorders and substance use. However, this was not within the scope of the current study. Future research should examine specific forms of child abuse as a moderator and expand into assessing these relationships with neglect and household challenges.

Conceptual Framework

The current study was guided by a conceptual framework combining Bronfenbrenner's ecological theory and Khantzian's self-medication hypothesis (Bronfenbrenner, 1994; Khantzian, 1985, 1997). Bronfenbrenner's ecological theory discusses how systems are nested within one another and they interact directly and indirectly over time (Bronfenbrenner, 1994). Sex, mental disorders, and child abuse experiences are pivotal factors within the microsystem that can directly and indirectly interact with all other systems. If emerging adults have had lifetime mental disorders and/or a history of child abuse, the feelings of distress accompanied by these experiences may result in maladaptive coping mechanisms over time including substance use, as Khantzian would note (Khantzian, 1997). Sex and other socioeconomic factors like income and education may be associated with substance use, mental disorders and child abuse experiences. Findings from the current study do indicate that factors from various systems of the ecological theory are associated with one another. Sex and having other mental disorders (i.e., social phobia and bipolar disorder) were primarily associated with most forms of substance use. Additionally, education was only significantly associated with cannabis use in the current study, while income levels varied in relation to substance use and child abuse history. These findings indicate that there are associations and effects between higher level systems (i.e., education and income) and microsystem factors (i.e., sex, mental disorders and child abuse), and substance use behaviours and thereby findings do support the current study's conceptual framework. This conceptual framework also posited that child abuse history may worsen the association between lifetime mental disorders and substance use behaviours in emerging adulthood, however findings did not support this in the current study. However, this association was different among males and females indicating that there is possible support for this aspect of the framework based on the findings in this study. This conceptual framework combining Bronfenbrenner's ecological theory

and Khantzian's self-medication hypothesis together conceptualize important factors that can contribute to the development of non-substance use related mental disorders and then later substance use related mental disorders. Future studies can potentially utilize this perspective in their own research across various stages of development.

Implications

The current study found that MDD and GAD were associated with varying levels of cannabis use among early emerging adults, while MDD and GAD were associated with both cannabis and alcohol use among late emerging adults. Sex also moderated the association between MDD or GAD and alcohol and cannabis use in the current study. These findings have important implications for educators and policy makers, in addition to knowledge mobilization, clinical practice, and health care systems at the community and provincial level. Many emerging adults attend post-secondary institutions and in the current study education was significantly associated with cannabis use only. College and university educators must be aware of how vulnerable their students are to using cannabis in this stage of development. Early emerging adults with MDD were more likely to report past year cannabis use, and late emerging adults with MDD or GAD had higher odds of alcohol and drug use. Instructors and professors should have additional training to recognize the signs of mental disorders including MDD and GAD, and problematic substance use behaviours including alcohol and cannabis. This training can provide guidance on how to approach openly discussing mental health to support early and late emerging adults and direct them to where they can find help (Kirkbride et al., 2024).

Promotion and prevention strategies aimed at reducing mental disorder and substance use can be implemented within provincial and community health care clinics and hospitals. Harm reduction is one strategy aimed at reducing substance use and possible related harms without

forcing individuals to abstain from using their substance of choice ("Harm Reduction," n.d.). Supplemental training should be delivered to primary care physicians and emergency medicine specialists that provides information on support systems available to help emerging adults who may be struggling with mental health and addiction. More specifically, clinicians should be aware that females may be using substances more than males and that this is possibly related to mental disorders that may be undiagnosed or have been left untreated.

Public health interventions should be targeting emerging adults that may have undiagnosed mental disorders and who are at risk for developing mental disorders and SUDs. Initiatives to raise awareness of alcohol and cannabis use and what factors may contribute to their use including MDD and GAD can be developed and promoted in business where substances are distributed. Additionally, interventions can be developed and put into place to prevent the onset of mental disorders and problematic substance use behaviours. More research is needed to better understand effective, sustainable, long-term interventions for emerging adults with mental disorders.

Strengths and Limitations

There are several strengths to this study. One of the primary strengths of this research is that findings provide up to date national epidemiological evidence about mental disorders and substance use among emerging adults. Evidence from the current study also provides important information on cannabis use post-legalization, however comparisons were not made between pre- and post-legalization. Data drawn for this study are recent, robust, nationally representative across all ten Canadian provinces, has a large sample size with adequate size to examine sex differences, and includes many measures of mental health and substance use. It specifically examines the mental health of Canadians using high-quality measures designed for

diagnostically assessing mental disorders in epidemiological surveys. The WHO developed the WHO-CIDI specifically for administering surveys such as the MHACS, and it is widely used and accepted in epidemiological research. The MHACS also included a module on childhood experiences capturing three forms of child abuse before the age of 16 years including physical abuse, sexual abuse, and EIPV. The CEVQ, a valid and reliable measure, was utilized to assess these types of abuse among respondents over the age of 18 years.

In addition to the many strengths of this study, there are limitations worth addressing. One is that this is a retrospective self-reported survey study design which increases the chances of recall bias. Considering this is a secondary data analysis, unmeasured confounders could not be examined or included in the models. Additionally, cross-sectional data have limitations, most importantly that findings are not always generalizable, nor can we make any claims about causal inference. Longitudinal data can better capture relationships since individuals can be tracked over time, retrospectively or prospectively. Other limitations to this survey are that it is not representative at the provincial level, and individuals residing in the Territories were not included in the sample. The response rate for this survey was 25%, considerably low compared to past Statistics Canada surveys, and findings may not accurately represent the entire population. However, this survey is still high-quality with questions from validated measures. Another limitation to this study is that it unfortunately does not capture those who have the most severe mental disorders and substance use problems. Individuals living in collective dwellings such as institutional residences were excluded from the data collection sources. Additionally, it does not capture anyone who did not at the time of data collection have a permanent address and therefore unhoused individuals with possible mental disorders and problematic substance use behaviours would not have been captured in the current study. Although this measure is widely

used and accepted for epidemiological surveys, the WHO-CIDI questionnaire was developed from the DSM-IV, not the DSM-V which is the current version. Although Statistics Canada reports that their questionnaire was modified from the WHO-CIDI, they do not indicate how it was modified. The MHACS questionnaire only asked about 4 diagnostic disorders, MDD, GAD, SOP, BIP and therefore the current study was limited to only assessing any of these disorders. Lastly, the conceptual framework guiding the current study could not include all factors that may contribute to mental disorders contributing to substance use, specifically distress. Future work should investigate how this can be measured and included in understanding mental disorders and substance use behaviours using the self-medication hypothesis.

Another issue that can arise is making Type I and/or Type II errors. Running many models increases the possibility of making a Type I error, and therefore reducing the number of models, adjusting the α level, or performing post-hoc tests such as Bonferroni corrections may reduce this possibility. However, running post-hoc corrections can have the reverse effect and increase the likelihood of making a Type II error. In the current study, there are possible Type I and Type II errors to note. The current study had many models with 2 or 3 independent variables and 8 outcome variables investigated among 3 age cohorts and further stratified by child abuse and sex. This may have increased the possibility of making a Type I error, and perhaps reducing the number of models ran would have reduced this possibility. The α level could have also been adjusted to be more stringent which may have reduced the chances of making a Type I error. In addition to Type I errors, there was a possibility that Type II errors were made. Type II errors often occur when there is insufficient sample size to detect significant differences between groups. A way to decrease the risk of this happening is by running a power analysis, however, the current study did not compute a power analysis. In the current study some models had

insufficient power to examine MDD or GAD alone with certain substances and therefore they were collapsed into any mental disorder and examined together with substance use. This was specifically for analyses examining at-risk alcohol use, AUD and CUD. Additionally, several models in the current study had a large effect size and/or wide confidence intervals indicating instability within the model to accurately detect significant differences. A larger sample would more accurately indicate the association between these variables.

When deciding how to code at-risk alcohol use and at-risk cannabis use, federal guidelines on low-risk use were explored. Low-risk alcohol guidelines are quite detailed with recommendations on the maximum number of drinks to consume per day, per week, and on special occasions for both males and females with descriptions of what qualifies as a standard drink based on the various types of alcoholic beverages that exist. This survey was not designed to validate or measure the governments' guidelines on low-risk alcohol use, and so recoding past year alcohol use frequency to follow exactly the governments' guidelines was not possible. Therefore, conclusions from this study about low-risk alcohol use cannot be interpreted directly with federal guidelines. However, these recommendations did guide how to recode this variable for the current study and interpretations about low-risk alcohol use can still be considered. At-risk cannabis use guidelines, on the other hand, are far less detailed and only define low-risk cannabis use as once a week or less. Sex differences are also not noted. Therefore, low-risk cannabis guidelines were more feasible to follow from cannabis use frequency in the current study. However, the cannabis used by respondents varies in THC and CBD content and therefore may have impacted decisions about future cannabis use and possibility for addiction (i.e., a higher THC content could make the cannabis more addictive).

Knowledge Mobilization

The current study provides updated national information about mental disorders among emerging adults. The goal is to capture these findings and aid healthcare professionals, educators, and community organizations with understanding current risk factors and poor outcomes prevalent among this vulnerable population across Canada. In addition to a Master of Science thesis, expected products are at least two journal publications, presentations at conferences, and infographics. Specifically, targeted infographics created in collaboration with national, provincial, and community organizations can disseminate important findings to raise awareness and stimulate new research ideas to address current gaps and future directions within research investigating mental disorders and substance use among emerging adults.

Future Directions and Conclusion

One of the main findings from the current study is that mental disorders are significantly associated with substance use behaviours in Canadian emerging adults, particularly the youngest individuals between 18 and 22 years of age. The other important finding to note is that the primary substance emerging adults with mental disorders are using is cannabis. This is why investigations about cannabis use as a licit drug are crucial for the development of programs for prevention, intervention, and public health policy changes. Findings from the current research does support the self-medication hypothesis, notably for the relationship between depression and cannabis use. Although respondents were not asked directly why they used cannabis, there is a clear and important association between emerging adults who have depression and use cannabis at varying levels. Therefore, self-medication is a possible motivation. Future studies should be designed to qualitatively understand motivations behind cannabis use and examine whether reasons differ by sex and gender, and child abuse experiences. Findings from studies examining these motivations can help inform policies and interventions targeting emerging adults with

mental disorders, specifically depression and cannabis use. Emerging adulthood is a formative stage of development and investments made to reduce and prevent mental disorders and substance abuse in this stage can have longitudinal benefits into young adulthood and later years in life.

References

Afifi, T. O., MacMillan, H., Boyle, M., Taillieu, T., Kristene, C., & Sareen, J. (2014). Child abuse and mental disorders in Canada. *CMAJ*, *186*(9), E324–E332.

Afifi, T. O., McCarthy, J.-A., Osorio, A., MacGowan, L., Taillieu, T. L., Stewart-Tufescu, A., Sareen, J., MacMillan, H. L., Tonmyr, L., Colman, I., Ferro, M. A., Anderson, K. K., & Edwards, J. (2025). Child abuse prevalence estimates in Canada; comparisons of nationally representative data from 2012 to 2022: A population-based study. *The Lancet Regional Health - Americas*, *45*, 101072. https://doi.org/10.1016/j.lana.2025.101072

Afifi, T., Salmon, S., Garcés, I., Struck, S., Fortier, J., Taillieu, T., Stewart-Tufescu, A., Asmundson, G., Sareen, J., & MacMillan, H. (2020). Confirmatory factor analysis of adverse childhood experiences (ACEs) among a community-based sample of parents and adolescents. *BMC Pediatrics*, *20*(1), 178. https://doi.org/10.1186/s12887-020-02063-3

Afifi, T., Taillieu, T., Zamorski, M., Turner, S., Cheung, K., & Sareen, J. (2016). Association of child abuse exposure with suicidal ideation, suicide plans, and suicide attempts in military personnel and the general population in Canada. *JAMA Psychiatry*, *73*(3), 229. https://doi.org/10.1001/jamapsychiatry.2015.2732

Alhammad, M., Aljedani, R., Alsaleh, M., Atyia, N., Alsmakh, M., Alfaraj, A., Alkhunaizi, A., Alwabari, J., & Alzaidi, M. (2022). Family, individual, and other risk factors contributing to risk of substance abuse in young adults: A narrative review. *Cureus*. https://doi.org/10.7759/cureus.32316

American Psychiatric Association. (2014). *Diagnostic and Statistical Manual of Mental Disorders* (5th Ed.). American Psychiatric Association.

Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist*, *55*(5), 469–480. https://doi.org/10.1037/0003-066X.55.5.469

Arnett, J. J., Žukauskienė, R., & Sugimura, K. (2014). The new life stage of emerging adulthood at ages 18–29 years: Implications for mental health. *Lancet Psychiatry*, *1*, 569–576.

Arruda, W., Bélanger, S., Cohen, J., Hrycko, S., Kawamura, A., Lane, M., Patriquin, M., & Korczak, D. (2023). Promoting optimal mental health outcomes for children and youth. *Paediatrics & Child Health*, *28*(7), 417–425. https://doi.org/10.1093/pch/pxad032

Bae, H., & Kerr, D. C. R. (2020). Marijuana use trends among college students in states with and without legalization of recreational use: Initial and longer-term changes from 2008 to 2018. *Addiction*, *115*(6), 1115–1124. https://doi.org/10.1111/add.14939

Bahji, A., Kaur, S., Devoe, D., & Patten, S. (2022). Trends in Canadian cannabis consumption over time: A two-step meta-analysis of Canadian household survey data. *Canadian Journal of Addiction*, *13*(3), 6–13. https://doi.org/10.1097/CXA.0000000000000154

Berger, M., Fernando, S., Churchill, A., Cornish, P., Henderson, J., Shah, J., Tee, K., & Salmon, A. (2022). Scoping review of stepped care interventions for mental health and substance use service delivery to youth and young adults. *Early Intervention in Psychiatry*, *16*(4), 327–341. https://doi.org/10.1111/eip.13180

Bovasso, G. B. (2001). Cannabis Abuse as a Risk Factor for Depressive Symptoms. *American Journal of Psychiatry*, *158*(12), 2033–2037. https://doi.org/10.1176/appi.ajp.158.12.2033

Bragazzi, N. L., Beamish, D., Kong, J. D., & Wu, J. (2021). Illicit drug use in Canada and implications for suicidal behaviors, and household food insecurity: Findings from a large,

nationally representative survey. *International Journal of Environmental Research and Public Health*, *18*(12), 6425. https://doi.org/10.3390/ijerph18126425

Bronfenbrenner, U. (1994). Ecological models of human development. In *International Encyclopedia of Education* (2nd ed., Vol. 2). Elsevier.

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

Cameranesi, M., Lix, L., & Piotrowski, C. (2019). Linking a history of childhood abuse to adult health among Canadians: A structural equation modelling analysis. *International Journal of Environmental Research and Public Health*, *16*(11), 1942. https://doi.org/10.3390/ijerph16111942

Cecil, C. A. M., Viding, E., Fearon, P., Glaser, D., & McCrory, E. J. (2017). Disentangling the mental health impact of childhood abuse and neglect. *Child Abuse & Neglect*, *63*, 106–119. https://doi.org/10.1016/j.chiabu.2016.11.024

Children and youth mental health in Canada | CIHI. (n.d.). Retrieved April 22, 2025, from https://www.cihi.ca/en/children-and-youth-mental-health-in-canada

Connery, H., McHugh, R., Reilly, M., Shin, S., & Greenfield, S. (2020). Substance use disorders in global mental health delivery: Epidemiology, treatment gap, and implementation of evidence-based treatments. *Harvard Review of Psychiatry*, *28*(5), 316–327. https://doi.org/10.1097/HRP.0000000000000271

Davis, J. P., Pedersen, E. R., Tucker, J. S., Prindle, J., Dunbar, M. S., Rodriguez, A., Seelam, R., & D'Amico, E. J. (2023). Directional associations between cannabis use and depression

from late adolescence to young adulthood: The role of adverse childhood experiences. *Addiction*, *118*(6), 1083–1092. https://doi.org/10.1111/add.16130

Deep, P. D., Ghosh, N., Gaither, C., & Rahaman, Md. S. (2024). The factors affecting substance use and the most effective mental health interventions in adolescents and young adults. *Psychoactives*, *3*(4), 461–475. https://doi.org/10.3390/psychoactives3040028

Degenhardt, L., Hall, W., & Lynskey, M. (2003). Exploring the association between cannabis use and depression. *Addiction*, *98*(11), 1493–1504. https://doi.org/10.1046/j.1360-0443.2003.00437.x

Dyer, M. L., Easey, K. E., Heron, J., Hickman, M., & Munafò, M. R. (2019). Associations of child and adolescent anxiety with later alcohol use and disorders: A systematic review and meta-analysis of prospective cohort studies. *Addiction*, *114*(6), 968–982. https://doi.org/10.1111/add.14575

England-Mason, G., Casey, R., Ferro, M., MacMillan, H., Tonmyr, L., & Gonzalez, A. (2018). Child maltreatment and adult multimorbidity: Results from the Canadian community health survey. *Canadian Journal of Public Health*, *109*(4), 561–572. https://doi.org/10.17269/s41997-018-0069-y

Galambos, N., Leadbeater, B., & Barker, E. (2004). Gender differences in and risk factors for depression in adolescence: A 4-year longitudinal study. *International Journal of Behavioral Development*, *28*(1), 16–25. https://doi.org/10.1080/01650250344000235

Garey, L., Olofsson, H., Garza, T., Rogers, A. H., Kauffman, B. Y., & Zvolensky, M. J. (2020). Directional effects of anxiety and depressive disorders with substance use: A review of recent prospective research. *Current Addiction Reports*, *7*(3), 344–355. https://doi.org/10.1007/s40429-020-00321-z

GHO | World Health Statistics data visualizations dashboard | Harmful use of alcohol. (n.d.). WHO; World Health Organization. Retrieved April 21, 2025, from https://apps.who.int/gho/data/node.sdg.3-5-viz?lang=en

Global Burden of Disease 2019 Mental Disorders Collaborators. (2022). Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019. *The Lancet Psychiatry*, *9*(2), 137–150. https://doi.org/10.1016/S2215-0366(21)00395-3

Goldstein, A. L., Henriksen, C. A., Davidov, D. M., Kimber, M., Pitre, N. Y., & Afifi, T. O. (2013). Childhood maltreatment, alcohol use disorders, and treatment utilization in a national sample of emerging adults. *Journal of Studies on Alcohol and Drugs*, *74*(2), 185–194. https://doi.org/10.15288/jsad.2013.74.185

Government of Canada. (2018, February 1). *Classification of substance use disorders*. https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=467190&CVD=467190&CLV=0&MLV=1&D=1

Government of Canada. (2020, January 22). *Canada's lower-risk cannabis use guidelines* [Education and awareness;frequently asked questions]. https://www.canada.ca/en/health-canada/services/drugs-medication/cannabis/resources/lower-risk-cannabis-use-guidelines.html

Government of Canada. (2021, July 5). *Low-risk alcohol drinking guidelines* [Education and awareness]. https://www.canada.ca/en/health-canada/services/substance-use/alcohol/low-risk-alcohol-drinking-guidelines.html

Government of Canada. (2022a). *MHACS data dictionary*.

Government of Canada. (2022b, February 17). *Bipolar disorder*. https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=assembleDESurv&DECId=463363&RepClass=583&Id=1378635&DFId=180520

Government of Canada. (2022c, February 17). *Generalized anxiety disorder*. https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=assembleDESurv&DECId=463367&RepClass=583&Id=1378635&DFId=180520

Government of Canada. (2022d, February 17). *Major depressive episode*. https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=assembleDESurv&DECId=463359&RepClass=583&Id=1378635&DFId=180520

Government of Canada. (2022e, March 2). *Mental health and access to care survey questionnaire*. https://www.statcan.gc.ca/en/statistical-programs/instrument/5015_Q2_V1

Government of Canada. (2023a, September 22). *Mental disorders and access to mental health care*. https://www150.statcan.gc.ca/n1/pub/75-006-x/2023001/article/00011-eng.htm#

Government of Canada. (2023b, September 22). *Mental disorders in Canada, 2022*. https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2023053-eng.htm

Government of Canada. (2024, September 5). *The Canadian drugs and substances strategy: The Government of Canada's approach to substance use related harms and the overdose crisis* [Policies]. https://www.canada.ca/en/health-canada/services/publications/healthy-living/canadian-drugs-substances-strategy-approach-related-harms-overdose-crisis.html

Hall, D. H., & Queener, J. E. (2007). Self-medication hypothesis of substance use: Testing Khantzian's updated theory. *Journal of Psychoactive Drugs*, *39*(2), 151–158. https://doi.org/10.1080/02791072.2007.10399873

Hammond, D., Wadsworth, E., Reid, J. L., & Burkhalter, R. (2021). Prevalence and modes of cannabis use among youth in Canada, England, and the US, 2017 to 2019. *Drug and Alcohol Dependence*, *219*, 108505. https://doi.org/10.1016/j.drugalcdep.2020.108505

Harm Reduction. (n.d.). *Shared Health, Health Sciences Winnipeg*. Retrieved December 16, 2025, from https://hsc.mb.ca/adults/harm-reduction/

Harris-Lane, L. M., Drakes, D. H., Donnan, J. R., Rowe, E. C., Bishop, L. D., & Harris, N. (2023). Emerging adult perceptions of cannabis consumption post-legalization: Considering age and sex differences. *Journal of Adolescent Health*, *72*(3), 404–411. https://doi.org/10.1016/j.jadohealth.2022.10.008

Hawes, S., Trucco, E., Duperrouzel, J., Coxe, S., & Gonzalez, R. (2019). Developmental pathways of adolescent cannabis use: Risk factors, outcomes and sex-specific differences. *Substance Use & Misuse*, *54*(2), 271–281. https://doi.org/10.1080/10826084.2018.1517177

Hayaki, J., Anderson, B. J., & Stein, M. D. (2016). Dual cannabis and alcohol use disorders in young adults: Problems magnified. *Substance Abuse*, *37*(4), 579–583. https://doi.org/10.1080/08897077.2016.1176613

Hovdestad, W., Shields, M., Shaw, A., & Tonmyr, L. (2020). Childhood maltreatment as a risk factor for cancer: Findings from a population-based survey of Canadian adults. *BMC Cancer*, *20*(70), 1–11. https://doi.org/10.1186/s12885-019-6481-8

Kedzior, K. K., & Laeber, L. T. (2014). A positive association between anxiety disorders and cannabis use or cannabis use disorders in the general population- a meta-analysis of 31 studies. *BMC Psychiatry*, *14*(1), 136. https://doi.org/10.1186/1471-244X-14-136

Keen, C., Kinner, S., Young, J., Jang, K., Gan, W., Samji, H., Zhao, B., Krausz, M., & Slaunwhite, A. (2022). Prevalence of co-occurring mental illness and substance use disorder and association with overdose: A linked data cohort study among residents of British Columbia, Canada. *Addiction*, *117*(1), 129–140. https://doi.org/10.1111/add.15580

Khantzian, E. (1985). The self-medication hypothesis of addictive disorders: Focus on heroin and cocaine dependence. *American Journal of Psychiatry*, *142*(11), 1259–1264.

Khantzian, E. (1997). The self-medication hypothesis of substance use disorders: A reconsideration and recent applications. *Harvard Review Psychiatry*, *4*(5), 231–244.

Kirkbride, J. B., Anglin, D. M., Colman, I., Dykxhoorn, J., Jones, P. B., Patalay, P., Pitman, A., Soneson, E., Steare, T., Wright, T., & Griffiths, S. L. (2024). The social determinants of mental health and disorder: Evidence, prevention and recommendations. *World Psychiatry*, *23*(1), 58–90. https://doi.org/10.1002/wps.21160

Knoll, A., & MacLennan, R. (2017). Prevalence and correlates of depression in Canada: Findings from the Canadian Community Health Survey. *Canadian Psychology*, *58*(2), 116–123. https://doi.org/10.1037/cap0000103

Langlois, C., Potvin, S., Khullar, A., & Tourjman, S. V. (2021). Down and high: Reflections regarding depression and cannabis. *Frontiers in Psychiatry*, *12*, 625158. https://doi.org/10.3389/fpsyt.2021.625158

Lawrence, T., Mcfield, A., Byrne, M., S.Tarver, S., & Stewart, T. (2023). Depression and substance use as consequences of exposure to family violence: A moderation mediation and self-medication hypothesis study. *Journal of Child & Adolescent Trauma*, *16*(1), 69–79. https://doi.org/10.1007/s40653-022-00464-3

Leadbeater, B. J., Ames, M. E., & Linden-Carmichael, A. N. (2019). Age-varying effects of cannabis use frequency and disorder on symptoms of psychosis, depression and anxiety in adolescents and adults. *Addiction*, *114*(2), 278–293. https://doi.org/10.1111/add.14459

Lemyre, A., Gauthier-Légaré, A., & Bélanger, R. E. (2019). Shyness, social anxiety, social anxiety disorder, and substance use among normative adolescent populations: A systematic review. *The American Journal of Drug and Alcohol Abuse*, *45*(3), 230–247. https://doi.org/10.1080/00952990.2018.1536882

Lev-Ran, S., Roerecke, M., Le Foll, B., George, T. P., McKenzie, K., & Rehm, J. (2014). The association between cannabis use and depression: A systematic review and meta-analysis of longitudinal studies. *Psychological Medicine*, *44*(4), 797–810. https://doi.org/10.1017/S0033291713001438

Lo, T. W., Yeung, J. W. K., & Tam, C. H. L. (2020). Substance abuse and public health: A multilevel perspective and multiple responses. *International Journal of Environmental Research and Public Health*, *17*(7), 2610. https://doi.org/10.3390/ijerph17072610

Luther, A. W. M., Reaume, S. V., Qadeer, R. A., Thompson, K., & Ferro, M. A. (2020). Substance use disorders among youth with chronic physical illness. *Addictive Behaviors*, *110*, 106517. https://doi.org/10.1016/j.addbeh.2020.106517

Marquette, A., Iraniparast, M., & Hammond, D. (2024). Adverse outcomes of cannabis use in Canada, before and after legalisation of non-medical cannabis: Cross-sectional analysis of the International Cannabis Policy Study. *BMJ Open*, *14*(1), e077908. https://doi.org/10.1136/bmjopen-2023-077908

Mason, W., Kosterman, R., Haggerty, K., Hawkins, J., Redmond, C., Spoth, R., & Shin, C. (2008). Dimensions of adolescent alcohol involvement as predictors of young-adult

major depression. *Journal of Studies on Alcohol and Drugs*, *69*(2), 275–285. https://doi.org/10.15288/jsad.2008.69.275

Mennis, J., Mason, M. J., Coatsworth, J. D., Russell, M., & Zaharakis, N. M. (2024). Young adult depression and cannabis use: Associations before and after recreational legalization. *American Journal of Preventive Medicine*, *66*(2), 333–341. https://doi.org/10.1016/j.amepre.2023.09.023

Moin Syed. (2016). Emerging adulthood: Developmental stage, theory, or nonsense? In *The Oxford handbook of emerging adulthood* (pp. 11–25). Oxford University Press.

Moitra, E., Christopher, P. P., Anderson, B. J., & Stein, M. D. (2015). Coping-motivated marijuana use correlates with DSM-5 cannabis use disorder and psychological distress among emerging adults. *Psychology of Addictive Behaviors*, *29*(3), 627–632. https://doi.org/10.1037/adb0000083

Multinomial Logistic Regression | R Data Analysis Examples. (n.d.). Retrieved August 14, 2025, from https://stats.oarc.ucla.edu/r/dae/multinomial-logistic-regression/

Mushquash, A. R., Stewart, S. H., Sherry, S. B., Sherry, D. L., Mushquash, C. J., & MacKinnon, A. L. (2013). Depressive symptoms are a vulnerability factor for heavy episodic drinking: A short-term, four-wave longitudinal study of undergraduate women. *Addictive Behaviors*, *38*(5), 2180–2186. https://doi.org/10.1016/j.addbeh.2012.11.008

Myers, J. L., Well, A. D., & Lorch, R. F. J. (2010). *Research Design and Statistical Analysis* (Third). Routledge.

Nawi, A. M., Ismail, R., Ibrahim, F., Hassan, M. R., Manaf, M. R. A., Amit, N., Ibrahim, N., & Shafurdin, N. S. (2021). Risk and protective factors of drug abuse among adolescents: A

systematic review. *BMC Public Health*, *21*(1), 2088. https://doi.org/10.1186/s12889-021-11906-2

Ning, K., Gondek, D., Patalay, P., & Ploubidis, G. B. (2020). The association between early life mental health and alcohol use behaviours in adulthood: A systematic review. *PLOS ONE*, *15*(2), e0228667. https://doi.org/10.1371/journal.pone.0228667

Palay, J., Taillieu, T., Afifi, T., Turner, S., Bolton, J., Enns, M., Smith, M., Lesage, A., Bakal, J., Rush, B., Adair, C., Vigod, S., Clelland, S., Rittenbach, K., Kurdyak, P., & Sareen, J. (2019). Prevalence of mental disorders and suicidality in Canadian provinces. *The Canadian Journal of Psychiatry*, *64*(11), 761–769. https://doi.org/10.1177/0706743719878987

Patten, S., Williams, J., Lavorato, D., Wang, J., Bulloch, A., & Sajobi, T. (2016). The association between major depression prevalence and sex becomes weaker with age. *Social Psychiatry and Psychiatric Epidemiology*, *51*(2), 203–210. https://doi.org/10.1007/s00127-015-1166-3

Patten, S., Williams, J., Lavorato, D., Wang, J., McDonald, K., & Bulloch, A. (2015). Descriptive epidemiology of major depressive disorder in Canada in 2012. *The Canadian Journal of Psychiatry*, *60*(1), 23–30. https://doi.org/10.1177/070674371506000106

Pelletier, L., O'Donnell, S., McRae, L., & Grenier, J. (2017). The burden of generalized anxiety disorder in Canada. *Health Promotion and Chronic Disease Prevention in Canada*, *37*(2), 54–62. https://doi.org/10.24095/hpcdp.37.2.04

Piano, M. R., Mazzuco, A., Kang, M., & Phillips, S. A. (2017). Binge drinking episodes in young adults: How should we measure them in a research setting? *Journal of Studies on Alcohol and Drugs*, *78*(4), 502–511. https://doi.org/10.15288/jsad.2017.78.502

Poudel, A., & Gautam, S. (2017). Age of onset of substance use and psychosocial problems among individuals with substance use disorders. *BMC Psychiatry*, *17*(1), 10. https://doi.org/10.1186/s12888-016-1191-0

Probst, C., Kilian, C., Sanchez, S., Lange, S., & Rehm, J. (2020). The role of alcohol use and drinking patterns in socioeconomic inequalities in mortality: A systematic review. *The Lancet Public Health*, *5*(6), e324–e332. https://doi.org/10.1016/S2468-2667(20)30052-9

Puddephatt, J., Irizar, P., Jones, A., Gage, S. H., & Goodwin, L. (2022). Associations of common mental disorder with alcohol use in the adult general population: A systematic review and meta-analysis. *Addiction*, *117*(6), 1543–1572. https://doi.org/10.1111/add.15735

Qadeer, R. A., Georgiades, K., Boyle, M. H., & Ferro, M. A. (2019). An epidemiological study of substance use disorders among emerging and young adults. *The Canadian Journal of Psychiatry*, *64*(5), 313–322. https://doi.org/10.1177/0706743718792189

Romano, I., Patte, K. A., De Groh, M., Jiang, Y., Wade, T. J., Bélanger, R. E., & Leatherdale, S. T. (2021). Substance-related coping behaviours among youth during the early months of the COVID-19 pandemic. *Addictive Behaviors Reports*, *14*, 100392. https://doi.org/10.1016/j.abrep.2021.100392

Rowland, T. A., & Marwaha, S. (2018). Epidemiology and risk factors for bipolar disorder. *Therapeutic Advances in Psychopharmacology*, *8*(9), 251–269. https://doi.org/10.1177/2045125318769235

Rush, B., Urbanoski, K., Bassani, D., Castel, S., Wild, C., Strike, C., Kimberley, D., & Somers, J. (2008). Prevalence of co-occruing substance use and other mental disorders in the Canadian population. *Canadian Journal of Psychiatry*, *53*(12), 800–809.

Scott, R., Lasiuk, G., & Norris, C. (2016). Sexual orientation and depression in Canada. *Canadian Journal of Public Health*, *107*(6), e545–e549. https://doi.org/10.17269/CJPH.107.5506

Sharpe, L., Sinclair, J., Kramer, A., De Manincor, M., & Sarris, J. (2020). Cannabis, a cause for anxiety? A critical appraisal of the anxiogenic and anxiolytic properties. *Journal of Translational Medicine*, *18*(1), 374. https://doi.org/10.1186/s12967-020-02518-2

Sheidow, A. J., McCart, M., Zajac, K., & Davis, M. (2012). Prevalence and impact of substance use among emerging adults with serious mental health conditions. *Psychiatric Rehabilitation Journal*, *35*(3), 235–243. https://doi.org/10.2975/35.3.2012.235.243

Shek, D. T. L., Dou, D., & Cheng, M. N. S. (2020). Transition From Adolescence to Emerging Adulthood. In S. Hupp & J. Jewell (Eds.), *The Encyclopedia of Child and Adolescent Development* (1st ed., pp. 1–10). Wiley. https://doi.org/10.1002/9781119171492.wecad325

Shen, J., Hua, G., Li, C., Liu, S., Liu, L., & Jiao, J. (2023). Prevalence, incidence, deaths, and disability-adjusted life-years of drug use disorders for 204 countries and territories during the past 30 years. *Asian Journal of Psychiatry*, *86*, 103677. https://doi.org/10.1016/j.ajp.2023.103677

Shields, M., Hovdestad, W., Pelletier, C., Dykxhoorn, J., O'Donnell, S., & Tonmyr, L. (2016). Childhood maltreatment as a risk factor for diabetes: Findings from a population-based survey of Canadian adults. *BMC Public Health*, *16*(879), 1–12. https://doi.org/10.1186/s12889-016-3491-1

Single, A., Alcolado, G., Keough, M. T., & Mota, N. (2024). Cannabis use and social anxiety disorder in emerging adulthood: Results from a nationally representative sample. *Journal of Anxiety Disorders*, *101*, 102808. https://doi.org/10.1016/j.janxdis.2023.102808

Sivayoganathan, T., & Reid, G. (2023). Trends in population characteristics associated with mental health service use among youth and emerging adults in Canada from 2011 to 2016. *Canadian Journal of Public Health*, *114*(3), 464–473. https://doi.org/10.17269/s41997-022-00734-5

Solmi, M., Radua, J., Olivola, M., Croce, E., Soardo, L., Salazar De Pablo, G., Il Shin, J., Kirkbride, J. B., Jones, P., Kim, J., Kim, J., Carvalho, A., Seeman, M., Correll, C., & Fusar-Poli, P. (2022). Age at onset of mental disorders worldwide: Large-scale meta-analysis of 192 epidemiological studies. *Molecular Psychiatry*, *27*(1), 281–295. https://doi.org/10.1038/s41380-021-01161-7

Sorkhou, M., Dent, E. L., & George, T. P. (2024). Cannabis use and mood disorders: A systematic review. *Frontiers in Public Health*, *12*, 1346207. https://doi.org/10.3389/fpubh.2024.1346207

Stapinski, L. A., Montgomery, A. A., & Araya, R. (2016). Anxiety, depression and risk of cannabis use: Examining the internalising pathway to use among Chilean adolescents. *Drug and Alcohol Dependence*, *166*, 109–115. https://doi.org/10.1016/j.drugalcdep.2016.06.032

Su, Y., Meng, X., Yang, G., & D'Arcy, C. (2022). The relationship between childhood maltreatment and mental health problems: Coping strategies and social support act as mediators. *BMC Psychiatry*, *22*(359), 1–11. https://doi.org/10.1186/s12888-022-04001-2

Tabachnick, B. G., & Fidell, L. S. (2013). *Using Multivariate Statistics* (6th ed.). Pearson.

Tapert, S., Caldwell, L., & Burke, C. (2004). Alcohol and the adolescent brain: Human studies. *Alcohol Research & Health*, *28*(4), 205–212.

The Composite International Diagnostic Interview. (1988). Archives of General Psychiatry.

Thompson, K., Holley, M., Sturgess, C., & Leadbeater, B. (2021). Co-use of alcohol and cannabis: Longitudinal associations with mental health outcomes in young adulthood. *International Journal of Environmental Research and Public Health*, *18*(7), 3652. https://doi.org/10.3390/ijerph18073652

Turner, S., Mota, N., Bolton, J., & Sareen, J. (2018). Self-medication with alcohol or drugs for mood and anxiety disorders: A narrative review of the epidemiological literature. *Depression and Anxiety*, *35*(9), 851–860. https://doi.org/10.1002/da.22771

Vida, R., Brownlie, E., Beitchman, J., Adlaf, E., Atkinson, L., Escobar, M., Johnson, C., Jiang, H., Koyama, E., & Bender, D. (2009). Emerging adult outcomes of adolescent psychiatric and substance use disorders. *Addictive Behaviors*, *34*(10), 800–805. https://doi.org/10.1016/j.addbeh.2009.03.035

Wadsworth, E., Craft, S., Calder, R., & Hammond, D. (2022). Prevalence and use of cannabis products and routes of administration among youth and young adults in Canada and the United States: A systematic review. *Addictive Behaviors*, *129*, 107258. https://doi.org/10.1016/j.addbeh.2022.107258

Watterson, R., Williams, J., Lavorato, D., & Patten, S. (2017). Descriptive epidemiology of generalized anxiety disorder in Canada. *The Canadian Journal of Psychiatry*, *62*(1), 24–29. https://doi.org/10.1177/0706743716645304

Wilkinson, A. L., Halpern, C. T., Herring, A. H., Shanahan, M., Ennett, S. T., Hussey, J. M., & Harris, K. M. (2016). Testing longitudinal relationships between binge drinking,

marijuana use, and depressive symptoms and moderation by sex. *Journal of Adolescent Health*, *59*(6), 681–687. https://doi.org/10.1016/j.jadohealth.2016.07.010

Williams, G., Patte, K., Ferro, M., & Leatherdale, S. (2022). Exploring the bi-directional associations between poly-substance use and symptoms of anxiety and depression among a large sample of Canadian adolescents. *Canadian Journal of Addiction*, *13*(2), 7–16. https://doi.org/10.1097/CXA.0000000000000144

Wittchen, H. U. (1994). Reliability and Validity Studies of the WHO-Composite International Diagnostic Interview (CIDI): A Critical Review. *Journal of Psychiatric Research*.

Wu, L. T., & Anthony, J. C. (1999). Tobacco smoking and depressed mood in late childhood and early adolescence. *American Journal of Public Health*, *89*(12), 1837–1840. https://doi.org/10.2105/AJPH.89.12.1837

Xu, Y., Geldsetzer, P., Manne-Goehler, J., Theilmann, M., Marcus, M.-E., Zhumadilov, Z., Quesnel-Crooks, S., Mwalim, O., Moghaddam, S. S., Koolaji, S., Karki, K. B., Farzadfar, F., Ebrahimi, N., Damasceno, A., Aryal, K. K., Agoudavi, K., Atun, R., Bärnighausen, T., Davies, J., … Probst, C. (2022). The socioeconomic gradient of alcohol use: An analysis of nationally representative survey data from 55 low-income and middle-income countries. *The Lancet Global Health*, *10*(9), e1268–e1280. https://doi.org/10.1016/S2214-109X(22)00273-X

Yapici Eser, H., Kacar, A. S., Kilciksiz, C. M., Yalçinay-Inan, M., & Ongur, D. (2018). Prevalence and associated features of anxiety disorder comorbidity in bipolar disorder: A meta-analysis and meta-regression study. *Frontiers in Psychiatry*, *9*, 229. https://doi.org/10.3389/fpsyt.2018.00229

Yeretzian, S., Sahakyan, Y., Kozloff, N., & Abrahamyan, L. (2023). Sex differences in the prevalence and factors associated with anxiety disorders in Canada: A population-based study. *Journal of Psychiatric Research*, *164*, 125–132. https://doi.org/10.1016/j.jpsychires.2023.06.018

Zbozinek, T. D., Rose, R. D., Wolitzky-Taylor, K. B., Sherbourne, C., Sullivan, G., Stein, M. B., Roy-Byrne, P. P., & Craske, M. G. (2012). Diagnostic overlap of generalized anxiety disorder and major depressive disorder in primary care sample: Research Article: GAD and MDD Diagnostic Overlap. *Depression and Anxiety*, *29*(12), 1065–1071. https://doi.org/10.1002/da.22026

Appendix A

Table 1. *Examining moderating effects of child abuse on the association between lifetime major depressive disorder and generalized anxiety disorder and any past year alcohol use and any past year cannabis use among early emerging adults, late emerging adults, and emerging adults*

	Any Alcohol Use AOR (95% CI) of Interaction Term	*p*-value
MDD*Any Child Abuse		
Early Emerging Adults	1.23 (0.63, 2.25)	p=0.585
Late Emerging Adults	0.41 (0.14, 1.25)	p=0.117
Emerging Adults	0.67 (0.33, 1.33)	p=0.241
GAD*Any Child Abuse		
Early Emerging Adults	1.99 (0.63, 6.26)	p=0.241
Late Emerging Adults	1.21 (0.39, 3.72)	p=0.744
Emerging Adults	1.42 (0.64, 3.16)	p=0.383
	Any Cannabis Use AOR (95% CI) of Interaction Term	*p*-value
MDD*Any Child Abuse		
Early Emerging Adults	0.93 (0.44, 1.99)	p=0.856
Late Emerging Adults	1.54 (0.64, 3.69)	p=0.333
Emerging Adults	1.21 (0.67, 2.20)	p=0.533
GAD*Any Child Abuse		
Early Emerging Adults	1.68 (0.68, 4.18)	p=0.260
Late Emerging Adults	1.00 (0.38, 2.64)	p=0.997
Emerging Adults	1.35 (0.69, 2.65)	p=0.378

Note. Adjusted Odds Ratio = AOR, 95% Confidence Interval = 95% CI. All models adjusted for sex, age, education, household income, and any other mental disorder.

Table 2. *Examining moderating effects of child abuse on the association between lifetime mental disorders and past year at-risk alcohol use among early emerging adults, late emerging adults, and emerging adults*

	At-Risk Alcohol Use			
	Low-Risk		High-Risk	
	AOR (95% CI) of Interaction Term	*p*-value	AOR (95% CI) of Interaction Term	*p*-value
Mental Disorder*Any Child Abuse				
Early Emerging Adults	1.27 (0.56, 2.86)	p=0.568	3.85 (0.17, 87.88)	p=0.398
Late Emerging Adults	0.78 (0.29, 2.06)	p=0.613	0.84 (0.14, 5.23)	p=0.853
Emerging Adults	0.97 (0.51, 1.83)	p=0.925	1.16 (0.25, 5.33)	p=0.844

Note. Adjusted Odds Ratio = AOR, 95% Confidence Interval = 95% CI. All models adjusted for sex, age, education, household income, and any other mental disorder.

Table 3. *Examining moderating effects of child abuse on the association between lifetime major depressive disorder and generalized anxiety disorder and past year at-risk cannabis use among early emerging adults, late emerging adults, and emerging adults*

	At-Risk Cannabis Use			
	Low-Risk		High-Risk	
	AOR (95% CI) of Interaction Term	*p*-value	AOR (95% CI) of Interaction Term	*p*-value
MDD*Any Child Abuse				
Early Emerging Adults	0.58 (0.24, 1.41)	p=0.228	1.09 (0.32, 3.66)	p=0.893
Late Emerging Adults	1.99 (0.64, 6.15)	p=0.232	0.86 (0.27, 2.72)	p=0.799
Emerging Adults	1.06 (0.52, 2.15)	p=0.869	0.82 (0.35, 1.92)	p=0.653
GAD*Any Child Abuse				
Early Emerging Adults	1.28 (0.46, 3.58)	p=0.631	3.26 (0.76, 14.00)	p=0.113
Late Emerging Adults	1.35 (0.45, 4.04)	p=0.590	0.82 (0.22, 3.13)	p=0.775
Emerging Adults	1.47 (0.71, 3.02)	p=0.303	1.27 (0.46, 3.50)	p=0.650

Note. Adjusted Odds Ratio = AOR, 95% Confidence Interval = 95% CI. All models adjusted for sex, age, education, household income, and any other mental disorder.

Table 4. *Examining moderating effects of child abuse on the association between lifetime major depressive disorder and generalized anxiety disorder and past year binge drinking among early emerging adults, late emerging adults, and emerging adults*

	Binge Drinking	
	AOR (95% CI) of Interaction Term	*p*-value
MDD*Any Child Abuse		
Early Emerging Adults	1.14 (0.50, 2.59)	p=0.749
Late Emerging Adults	0.77 (0.33, 1.83)	p=0.559
Emerging Adults	0.86 (0.46, 1.58)	p=0.621
GAD*Any Child Abuse		
Early Emerging Adults	2.11 (0.82, 5.40)	p=0.120
Late Emerging Adults	1.45 (0.55, 3.80)	p=0.452
Emerging Adults	1.65 (0.82, 3.33)	p=0.158

Note. Adjusted Odds Ratio = AOR, 95% Confidence Interval = 95% CI. All models adjusted for sex, age, education, household income, and any other mental disorder.

Table 5. *Examining moderating effects of child abuse on the association between lifetime mental disorders and past year alcohol use disorder among early emerging adults, late emerging adults, and emerging adults*

	Alcohol Use Disorder AOR (95% CI) of Interaction Term	*p*-value
Mental Disorder*Any Child Abuse		
Early Emerging Adults	1.88 (0.41, 8.55)	p=0.412
Late Emerging Adults	3.54 (0.52, 24.28)	p=0.198
Emerging Adults	2.51 (0.74, 8.50)	p=0.138

Note. Adjusted Odds Ratio = AOR, 95% Confidence Interval = 95% CI. All models adjusted for sex, age, education, household income, and any other mental disorder.