

Examining the Association Between Climate Worry and Psychological Distress in Canadian
Youth

by

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Author's Declaration

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

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Abstract

Young people are highly susceptible to the development of mental illnesses, which may be measured through psychological distress scores. Mental illnesses in youth may vary by gender as cis-gendered girls and gender minorities are more likely to experience mental illnesses than their cis-gendered boy counterparts. Within Canada, one in four youth meet the diagnostic criteria for a mental illness regardless of gender.

While effects of climate change and associated health outcomes are experienced by diverse populations, these outcomes are particularly concerning pertaining to youth as they will inherit the environment in its current state. One factor that may be associated with increases in psychological distress is that of climate worry: the feelings of worry or fear associated with the ongoing climate change crisis. However, climate worry remains a novel topic with limited existing literature.

For youth, climate worry may result in negative emotions including worry, fear, or sadness attributed to their concern for the worsening global climate. Youth are likely to access information regarding climate change through online channels, prompting interest in screen time as a covariate. Climate worry may also be associated with difficulties in focus on daily tasks and may impact sleep due to excessive worry, as well as causing a sense of responsibility to “act.” These concerns are measured through the climate worry section of the Compass Questionnaire.

The objective of this thesis was to examine whether climate worry is associated with psychological distress among youth in the COMPASS Study, and whether selected covariates impact this association using linear regression modelling. This thesis used data from the 2022/23 Compass Study cohort of 31,042 high school students from across Alberta, British Columbia, Ontario, Prince Edward Island, and Quebec, Canada.

Findings from this study support the hypothesis that climate worry is associated with psychological distress in Canadian youth. Across all genders, the mean psychological distress score was 18.3 (std. dev. 12.1, $p = <0.05$) and the mean climate worry score was 9.0 (std. dev. 1.9, $p = <0.05$). The results of this study show that as scores of climate worry increase, scores of psychological distress also increase ($\beta = 0.7$, $p = <0.05$). Gender-stratified models were run to ascertain differences in the experience of climate worry and psychological distress for cis-gendered boys, cis-gendered girls, and gender diverse individuals.

Results of this thesis reveal that climate worry is modestly associated with increases in psychological distress and may be used to inform future research on the associations between climate worry and psychological distress. Future studies should aim to explore potential causal pathways for the inception of climate worry (e.g., media literacy and climate worry rooted in media use), and outcomes of climate worry (e.g., psychological distress, anxious, or depressive symptoms).

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List of Abbreviations

GAD	Generalized Anxiety Disorder
MDD	Major Depressive Disorder
WHO	World Health Organization
CCHS	Canadian Community Health Survey
DSM	Diagnostic and Statistical Manual of Mental Disorders
IPCC	Intergovernmental Panel on Climate Change
REAL	Research on Eating and Adolescent Lifestyles
OSDUS	Ontario Student Drug Use Survey
Cq	COMPASS Study questionnaire
AB	Alberta
BC	British Columbia
ON	Ontario
QC	Quebec
PEI	Prince Edward Island
CESD-R	Center for Epidemiologic Studies Depression Scale Revised
GAD-7	General Anxiety Disorder-7
ORE	Office of Research Ethics
STD. DEV.	Standard Deviation
MPD	Minutes per Day

List of Symbols

β	Beta value
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SECTION ONE: Introduction

Depression and anxiety are among the most pervasive mental illnesses among youth, both as individual and comorbid conditions (e.g., the co-occurrence of an anxiety disorder with major depressive disorder).¹ The commonality of anxiety and depression as mental illnesses experienced by youth highlight the importance of assessing psychological distress by combining psychometric scores of anxiety and depression symptoms.² Numerous factors have been long evaluated to develop a broad approach to the treatment and prevention of these disorders.^{3,4} One of these factors is gender as gender may impact the susceptibility of an individual to developing a mental illness with a higher prevalence of depression and anxiety in girls than boys in those under 18 years of age.^{5,6}

An emerging concern within the youth mental health landscape is climate worry.⁷ This term may be used to identify the feelings of worry or fear regarding the current climate crisis and real or perceived climate threats.⁸ Youth are more vulnerable to climate change as they lack the ability to choose their living environment due to their age or household restrictions. Further, they will outlive older generations who are less at-risk.

Young people are known to spend a considerable duration of time each day on online modes of screen use, from texting, to screen media (e.g., social media, scrolling the internet, TV), to gaming.⁹ Excessive screen time may be associated with higher occurrences of mental illnesses among youth.¹⁰ There is a need to better understand how these modes of screen use may be associated with psychological distress among youth.

Not all young people are consistently achieving recommended levels of sleep (~8-10 hours per night).¹¹ As sleep disturbances are known to affect individuals experiencing anxiety symptoms, this may be extended to assume sleep disturbances are present in those who are climate anxious as well.¹¹ Climate worry may affect sleep attainment by contributing to difficulties in falling or staying asleep due to excess worry. Considering that approximately one third of adolescents lack adequate sleep¹² there is a need to assess sleep duration and its association with climate worry and psychological distress.

This thesis sought to analyze the association between climate worry and psychological distress in a large sample of Canadian youth by using data collected within the COMPASS study (est. 2012). COMPASS is a prospective cohort study aimed at collecting longitudinal data on a range of health and wellbeing indicators within the adolescent population (grades 9-12). The COMPASS study collects annual survey data on youth health indicators including cannabis use, obesity, mental health, physical activity, alcohol, smoking, and sedentary behaviour.

SECTION TWO: Literature Review

2.1 Mental Health in Canadian Youth

2.1.1 Anxiety

In Canada, anxiety disorders are the most commonly occurring mental illnesses affecting children and youth.¹⁴ Overall, 12% to 20% of Canadian youth experience chronic or acute anxiety,⁹ with those aged 10-15 experiencing higher rates than their younger counterparts.¹⁵ The 2016 Global Burden of Disease Study ranked anxiety as the 9th overall leading health-related burden of disease worldwide.¹⁶ Overall, anxiety disorders are one of the most frequently diagnosed families of mental illnesses (generalized anxiety disorder being the most common (GAD)), with primary onset occurring before or during young adulthood.¹⁷ This is especially worrisome for mental health professionals as anxiety disorders are underdiagnosed in all settings of care.¹⁸ It is estimated that approximately 40% of worldwide mental illnesses experienced by youth ages 10-19 were either depression or anxiety.¹⁹

While anxiety disorders are known to be comorbid with mood disorders, there is sparse evidence regarding an association between the clinical symptoms of these mental illnesses and emerging concerns such as climate worry.²⁰ Climate worry may be viewed by some researchers as a subsection of anxiety disorders, however, worry about the climate change crisis may simply be a contributor to anxiety, rather than its own subsection of the mental illness. As such it is important to examine the association between climate worry and anxiety symptoms.

2.1.2 Depression

Approximately 5% to 9% of adolescents are categorized as clinically depressed, while between 21% and 50% of adolescents report experiencing depressed moods.⁸ Depression, or major depressive disorder (MDD), is a clinically-classified mental illness characterized by persistent low mood, decreased interest in activities, feelings of low self-worth or guilt, suicidal thoughts, and more.²¹ The World Health Organization (WHO) ranks MDD as the third leading burden of disease cause in 2008, predicting a rise to first by 2030.²² Depression is frequently comorbid with GAD and other anxiety disorders, both individually and as a grouping of comorbidities.²³ This indicates a strong need for improved research in addition to prevention and intervention strategies aimed at safeguarding youth mental health.

Many of the known factors contributing to youth depression overlap with the factors contributing to anxiety, including isolation, academic pressure, interpersonal relationships, and bullying.²⁴ However, there are additional symptoms that are indicative of depression that are not as prevalent among anxiety disorders including loss of interest in pleasurable activities, substance abuse, and suicidal ideations.²⁴ Subclinical depressive symptomology (the experience of moderate depressive symptoms) may be used to identify individuals at risk for developing MDD or other mood-related mental illnesses.²⁵

2.1.3 Anxiety and Depression Co-occurrences and Demographics

The prevalence of anxiety and mood disorders among Canadian youth (aged 12-24 years) increased (most notably among young girls), between 2011 and 2018 as per data obtained via the annual Canadian Community Health Survey (CCHS).¹ The 2014 Ontario Child Health Study concluded that 18%-22% of children and youth (aged 4-17 years) met the diagnostic criteria for a mental illness including anxiety and depression.² Roughly half of all youth with depression will

subsequently meet the criteria for an anxiety disorder (often social or generalized anxiety),^{26,27} while one tenth to one half with a primary anxiety diagnosis will experience a concurrent depressive disorder.^{26,27}

The comorbidity of anxiety and depression may further be influenced by their overlapping age at first onset. The average ages at first onset for anxiety and depression exhibit a degree of commonality, with anxiety disorders often manifesting in childhood (up to 12 years old) to adolescence (ages 13-17)²⁸ and depressive disorders emerging in adolescence (ages 13-17) to young adulthood (Ages 18-25).²⁹ Earlier onset of one or both mental illnesses is a substantial risk factor for greater and lasting functional impairments and psychiatric comorbidity into adulthood.³⁰ Canadian youth (ages 10-18 years) who reported experiencing elevated social anxiety symptom trajectories were found to have a 20-fold increase in likelihood of experiencing depression.³¹ This statistic presents an alarming overview on the persistence and worsening of poor mental health statuses among Canadian youth and provides rationale for further research on the topic.

Gender can be a risk factor for negative mental health outcomes as young girls and gender diverse individuals tend to experience symptoms and receive diagnoses of depression⁵ and anxiety⁶ more often than boys. One study found that by age 18, the prevalence of depression and anxiety disorders was higher for girls than boys.⁶ This posits mental health as an important health concern facing young people, with a specific emphasis on young girls and gender diverse individuals.

2.1.4 Psychological Distress

As a great deal of evidence exists demonstrating covariation between depression and anxiety diagnoses and symptoms,^{26,27,31} it can be advantageous to assess symptoms of both mental illnesses as a combined measure of psychological distress. Psychological distress may be measured in some studies through the combination of self-reported depression and anxiety symptoms into a composite score or the use of a pre-determined combined scale. One such combined scale, discussed in a study by Chorpita et al., outlines the use of a measurement tool for assessing the combined psychological distress of anxiety and depression congruent with the Diagnostic and Statistical Manual of Mental Disorders (DSM) through a combination scale of 56 anxiety and depression items.³² This study recruited 1641 children and adolescents in grades 3-12 (mean age of 12.87 years old) to test their scale, with outcome results supporting the reliability and validity of using a combined anxiety and depression scale for measuring youth DSM mental illness.³² This study aids in providing rationale for the use of combined anxiety and depression item scales to measure occurrences of psychological distress in youth without making clinical inferences.

2.2 Current Climate Worry Literature

As young people across the globe continue to experience a range of direct and/or indirect effects of climate change, their mental health and wellbeing is likely to be continuously and diversely impacted.^{1,33} This mounting and chronic environmental worry is commonly referred to as either climate anxiety or climate worry, terms that may be used interchangeably.⁷ The American Psychological Association describes climate worry as a ‘chronic fear of environmental doom.’⁸ While climate worry is not included in the current 5th version of the DSM, climate worry may be associated with DSM recognized disorders (e.g., MDD, GAD).³⁴ As a relatively new

field of study, the existing literature on climate worry is sparse, particularly regarding the climate perceptions of vulnerable populations including youth.

When surveyed, individual sentiments towards climate change include worry, anxiety, anger, and “feelings of impending doom related to the overarching awareness of climate change and the risks it poses to planetary and public well-being.”³⁵ It is additionally relevant to consider whether the worry and fear associated with thoughts or experiences of climate change should be pathologized as a mental illness rather than a justified or healthy reaction to the climate crisis. Although beyond the scope of this thesis, future studies should seek to determine the threshold for labeling climate worry or distress as a mental illness.

Youth currently experience differences in the perception of climate change; reporting varied views on the threat of climate change as a factor of their social locations and access to climate-related information.³⁴ These perceptual differences link to the question of whether climate worry may be a mental illness as an individual’s perception of climate change may influence their regard for their own climate-related anxiety levels as alarming or justified. This may influence the ability to diagnose climate worry or cause hesitancy in such diagnoses if the level of anxiety is viewed as warranted. As such researchers need to better understand if and how climate worry is associated with depression and anxiety to determine whether climate worry is a correlated condition or its own issue. It may be clinically advantageous to refrain from pathologizing a rational symptomology stemming from current global circumstances.

This mounting worry or fear regarding the ongoing climate change crisis indicates a greater need for research on the topic of climate worry and populations that may be greatly affected. Given the lack of evidence pertaining to Canadian youth, it is important to gain insight into current perceptions and effects of climate change on Canada’s younger population as they represent the minds of the future. The protection and maintenance of young people's mental well-being amid the ongoing climate crisis is paramount to promoting resilience as climate events will likely continue to occur.

2.2.1 Existing research on Climate Worry

Although the evidence pertaining to climate worry among youth is sparse, there is an emerging body of evidence which posits that this is a topic worthy of additional investigation. One such study conducted by Hickman et al. surveyed 10,000 youth and young adults (aged 16-25 years) to examine climate change perceptions across ten countries (1,000 participants/country in: Australia, Brazil, Finland, France, India, Nigeria, the Philippines, Portugal, the United Kingdom, and the United States).³⁵ Hickman et al.’s third survey question was of particular interest; ‘My feelings about climate change negatively affect my daily life (at least one of the following: ...)’ where one of ‘the following’ was sleep.³⁵ Respondents across all countries expressed worries regarding climate change (where 59% were “very or extremely worried” and 84% were at minimum “moderately worried”).³⁵ More than 50% of respondents reported emotions including: sadness, anxiety, anger, powerlessness, helplessness, and guilt.³⁵ Upwards of 45% of respondents reported their feelings about climate change negatively impacted their daily life, with many reporting a high number of negative thoughts surrounding climate change.³⁵

A 2024 study pertaining to climate worry among Canadian youth (11-19) was conducted by Man and colleagues.³⁶ The data used in this study was a secondary analysis of the 2021 Ontario Student Drug Use and Health Survey of students in grades 7-12.³⁶ The researchers controlled for psychological distress to evaluate what they called “eco-depression” and “eco-anxiety.”³⁶ The researchers conducted both sex- and gender-based analyses.³⁶ The results of the sex-based

analysis showed that youth who were assigned female at birth reported higher scores of eco-depression and climate worry than those who were assigned male at birth. It was also found that individuals experiencing greater psychological distress had higher scores for both eco-depression and climate worry.³⁶ For the gender-based analysis, cis-gendered girls reported higher rates of eco-depression and climate worry than cis-gendered boys, while gender diverse individuals reported higher rates eco-depression and climate worry than both cis-girls and cis-boys.³⁶ The results of this study suggest assessing the gender differences in outcomes of climate worry, referred to as climate worry in this study.

While several additional studies assessing the effects of climate worry on youth exist, the two above studies serve to articulate the need for the assessment of the association between climate worry and psychological distress with the inclusion of gender stratified data.

2.2.2 Climate Change

The World Health Organization has asserted that climate change is the 21st century's greatest risk to improving and maintaining global health.^{37,38} The Intergovernmental Panel on Climate Change (IPCC) released its sixth assessment in 2023, noting that human-attributed factors trigger climate and weather extremes in all regions of the globe.³⁹ There is a vast array of environmental impacts resulting from climate change including rising sea levels, floods and droughts, heat waves, and natural disasters which range in severity as a result of global and regional origin.⁴⁰ Canada is one nation uniquely positioned to experience a wide range of climate-related challenges from coast to coast; seen though the extreme wildfires in British Columbia,⁴¹ sea-ice deterioration in the northern territories,⁴² and tri-variate extremes (flooding, precipitation, storm surges) wracking the east coast.⁴³ The effects of climate change on individual and global health are continually evolving as more extreme climate trends emerge and over one-third of the global population lives in climate-vulnerable regions.⁴⁴

2.2.3 Climate Change and Mental Health

Increasing research on climate-related health outcomes has left gaps in underscoring the importance of mental health and wellbeing in relation to climate change, which may be a key factor in promoting resilience in climate-vulnerable regions.⁴⁵ One study outlining the effects of gender on climate change knowledge in the United States found that women expressed more concern for environmental problems than men, particularly those relevant to health outcomes.⁴⁶ Mental health outcomes associated with climate change may be acute or chronic and could stem from individual or combined sudden and/or prolonged climate events that may be direct or indirectly experienced.⁴⁷ However it is important to note that there is a difference between climate change events impacting mental health directly, and worries regarding climate change impacting mental health. It is important to shift the spotlight to the faces of the future: youth, and how they are affected by the climate crisis with specific regard for their mental wellbeing.

2.2.4 Climate Worry and Screen Time

Climate worry can be attributed to a multitude of climate-related exposures including direct or indirect exposure through various forms of media.⁹ As the existing literature is relatively sparse regarding associations between screen time and climate worry (or eco anxiety as it was originally called in the literature), it is particularly important to assess the possible connection. Many individuals using social media (Instagram, Twitter, TikTok, etc.) during their screen time are plausibly more exposed to information regarding climate change through various videos, articles,

and media posts.⁴⁸ Their engagement in this content may be active or passive and can be influenced by algorithm technology within the applications to share more content with users based on the content they have interacted with across platforms.⁴⁸ One study found that participants (aged 18-26) reported exposure to information about climate change, especially from news, social media, and television programs several times per week.⁴⁸ Across a 17-year period (2000-2016), Barkemeyer et al. analyzed trends in sustainability-related media coverage across five countries, including Canada, and noted an increase in climate change-related media coverage over the timeline.⁴⁹

2.4 Factors affecting Mental Health

2.4.1 Screen Time

In Canada, youth spend an average of seven to eight hours per day engaging in screen-based activities.¹⁰ This duration far exceeds the daily recommendation of two hours of recreational screen time¹⁰ and begets concern regarding the association between screen time and mental health. Relevant to the research interests of this thesis, screen time may also be associated with increased levels of climate worry as it is hypothesized that youth access and absorb information on climate change through media use.

Mental health data collected from 2006-2010 using the Research on Eating and Adolescent Lifestyles (REAL) determined that screen time could be an indicator or risk factor for depression and anxiety in Canadian youth.¹⁰ Similarly, a 2016 study conducted using data from the 1970 British Cohort Study assessing participants at pre-set follow-ups over roughly 30 years concluded that poor mental health outcomes in youth (aged 16 years) are associated with increased screen time (excess of 2+ hrs/day).¹¹ However, screen time has not been consistently associated with mental health across genders⁵⁰ or modes of device use⁵¹ in the literature. As such, this warrants additional investigation.

Non-recreational screen time displayed no association with any mental health outcomes, while recreational screen time was associated with poor mental health outcomes.⁵² Gender differences in the association between screen time and mental health may be attributed in part to online behaviours (e.g., cyberbullying) which disproportionately affect adolescent girls (grades 7-12).⁵² Girls are additionally more likely to spend their screen time on social media, while boys typically favour spending their screen time playing video games alone or with friends.⁵² For gender diverse youth, one study identified streaming services and social networks as significant predictors of depressive symptoms.⁵³

2.4.2 Sleep

There is currently little existing literature detailing the association between climate worry and sleep, however a myriad of articles exist connecting sleep with generalized anxiety and other associated mental illnesses such as depression. Sleep disturbances, can affect individuals experiencing anxious symptoms which may in turn worsen the anxiety condition itself.¹¹ As recommended by the Canadian 24-h Movement Guidelines, the ideal daily duration of sleep for youth ages 14-17 is 8-10hrs of uninterrupted sleep with consistent sleep/wake times.⁵⁴ One study examining sleep duration in Canadian adolescents (aged 14-17 years) determined that 26% of students were considered “short sleepers” with almost one third of adolescents failing to meet the recommended sleep targets.¹² This association between anxiety and sleep-related disturbances¹¹ paired with 1/3 of adolescents lacking proper sleep¹² rationalizes examining climate worry’s

association with sleep in the analysis of climate worry's association with psychological distress and is further discussed within the research questions.

2.4.3 School Connectedness

Youth spend a considerable amount of time in school settings. As such, it is important to measure the impact that their experiences of the school environment may have on their mental wellbeing in the association between climate worry and psychological distress. Youth who feel disconnected to their peers are more likely to struggle with their mental health and emotional wellbeing.⁵⁵

2.4.4 Grade

A study conducted on Swedish high-school aged youth found that there was a negative relationship between mental health and educational achievement wherein poorer mental health status was associated with lower educational attainment.⁵⁶ Further, as grade level increased, so too did the prevalence of mental illnesses within the target population.⁵⁶ This denotes that as grade increases, students may experience more psychological distress.

2.4.5 Substance Use

A meta-analysis examining the association between substance use and mental health disorders found that there was a positive association between both depression and anxiety and use of alcohol and cannabis among adolescents and young adults in the United States and Canada.⁵⁷ Reported rates of drug use (excluding use of inhalants) were found to increase with age during adolescence and were similar among boys and girls according to the Ontario Student Drug Use Survey (OSDUS).⁵⁸ The 2007 OSDUS data indicated that of youth in grades 7–12, 64.7% reported lifetime use of alcohol and 29.9% reported lifetime use of cannabis.⁵⁸

2.4.6 Home Life

Stress within a family unit may directly influence an adolescent's ability to cope with their individual stressors and subsequently have a negative impact on their self-esteem and sense of the future.⁵⁹ Youth in unstable households are more likely to have increased rates of binge drinking and cannabis use.⁶⁰ The risk of developing anxiety and/or depression for youth is increased when the individual has a parent or grandparent who has previously experienced or is currently experiencing depression.⁶¹ Sibling aggression may also contribute to increased rates of depression and even greater rates of anxiety.⁶²

2.4.7 Affluence

Previous research has identified the mental health risks of low relative affluence and poverty for youth.⁶³ Attending a school with more affluent peers was found to increase rates of intoxication and drug use in attending students, while youth attending more impoverished schools had higher rates of anxiety and depression.⁶³ This research supports the assertion that adolescent health risks vary by level of affluence and association with health behaviours.⁶³

2.4.8 Race

Among adolescents, poorer health statuses are associated with race among other social and cultural variables.⁶⁴ Further, symptoms of mental illnesses may be under-identified by racial minority parents wherein a number of studies have identified lower rates of mental health

problems among African American and Latino youth by their parents even when the youth exhibit equivalent levels of symptoms.⁶⁵ Per the Institute of Medicine Report, racialized youth are less likely to receive care for mental health concerns compared to their non-Latino white counterparts.⁶⁶

2.5 Factors Associated with Missingness in Mental Health Data

Missing data can be a common occurrence in questionnaire-based, population studies, and as such, it is important to recognize factors that may be associated with missing data. Despite the commonality of missing data in self-report or questionnaire-based studies, there is limited existing research regarding factors associated with this issue. One study found that factors associated with missingness in a self-report psychological multi-item instrument included age, gender, education level, and unhealthy lifestyle habits.⁶⁷ These factors informed the evaluation of missingness for this thesis wherein grade (as a proxy for age), gender, and lifestyle factors such as cannabis use, and binge drinking were evaluated as potential factors contributing to missingness in this study.

2.6 Relevance and Gaps in Current Literature

As a relatively new area of research, the literature currently available on climate worry among youth, and in particular Canadian youth, is incredibly limited. That being said, the emerging climate worry literature can contribute to the existing mental health literature by giving a name to an emerging set of fears, stressors, and influences associated with concerns about the environment. This allows researchers assessing current and future health impacts of climate worry to identify more specific mental health outcomes in a given population specific to environmental concern as the determinant. Researchers may also desire to investigate the impact of ecological and social determinants of health on youth mental health as an effect of climate change.

With the majority of literature addressing mental health outcomes of climate change having been published in the last seven years (since approx. 2018), this thesis contributes to a growing body of research on a highly novel topic.^{9,21,32,35,36} This paper also gives rise to additional queries not included in the scope of this thesis; however, it may spur future topical or related academic inquiries. The gap that this thesis seeks to address is that of the association between climate worry and psychological distress.

Further research is needed to determine which populations are most at risk of developing climate worry, which existing mental illnesses are most concurrent with climate worry, whether this will become a DSM-recognized diagnosis, and more. These questions contribute to the basis of this paper by informing the identification of a target population and the development of research questions.

SECTION THREE: Study Rationale and Research Questions

3.1 Study Rationale

As climate worry is a novel topic emerging in health and environmental research, this paper contributes to the existing literature by identifying the association between climate worry and psychological distress. This identification of potential links may be used by schools, policy developers, and mental health professionals to mitigate the occurrence and severity of negative mental health outcomes associated with climate worry. This mitigation of negative mental health outcomes may come in the form of school programs, counselling, public health initiatives, or other available services. These results may also be used to inform initiatives aimed at cultivating and promoting resilience within communities to improve health and wellbeing outcomes.

There is currently a growing body of research aimed at examining the association between climate events and adverse mental health outcomes; some of which encompasses current climate worry literature. While this knowledge cache is continuously growing, gaps remain regarding the association between climate worry and psychological distress. It is important to assess climate worry to determine whether such associations exist, and the degree to which they are associated.

The COMPASS Study questionnaire (Cq) is a robust measurement tool capable of evaluating a range of youth health behaviours and outcomes, the results of which guide policy and program development across Canada.⁶⁸ This thesis will assess the possible association between psychological distress and feelings of climate worry among respondents of the 2022-2023 study with the inclusion of covariates.

3.2 Research Questions

3.2.1 Primary Research Questions:

For this thesis, the following research questions were explored using data from the 2022/23 collection year of the COMPASS Study. Within these research questions, the covariates include demographic characteristics (gender, grade, race, affluence) and behaviours (sleep, screentime, mode of screen use (scrolling social media, surfing the internet), substance use (binge drinking and/or cannabis use in the past 30 days)) as well as school connectedness and home life.

Research Question 1:

What is the distribution of students reporting climate worry within the 2022/23 cohort of the COMPASS Study population and does it vary by gender?

Research Question 2:

Is climate worry associated with psychological distress in the 2022/23 cohort of the COMPASS Study population while controlling for covariates?

Research Question 3:

Is climate worry associated with psychological distress in the 2022/23 cohort of the COMPASS Study population when stratified by gender (cis-boys, cis-girls, gender diverse) while controlling for covariates?

3.3 Thesis Statement

This thesis sought to examine the prevalence of climate worry among Canadian youth and its association with psychological distress scores, controlling for relevant covariates.

3.4 Hypotheses

Research Question 1 Hypothesis:

I hypothesize that the climate worry scores for all genders will be concentrated towards the mid-point of possible scores (10/20 possible points) with higher scores among cis-gendered girls and gender diverse individuals when compared with scores of cis-gendered boys within the 2022/23 cohort of the COMPASS Study.

Research Question 2 Hypothesis:

I hypothesize that climate worry will be associated with higher psychological distress scores in the 2022/23 cohort of the COMPASS Study population while controlling for covariates.

Research Question 3 Hypothesis:

I hypothesize that climate worry will be associated with higher psychological distress scores in the 2022/23 cohort of the COMPASS Study population for all three gender groups with higher values among gender diverse individuals and cis-girls than cis-boys while controlling for covariates.

SECTION FOUR: Methods

4.1 Data Source

The COMPASS Study (est. 2012) collects data on a range of health outcomes and behaviours from a prospective cohort of grade 7-12 students across five Canadian provinces: Alberta (AB), British Columbia (BC), Ontario (ON), Quebec (QC), and most recently, Prince Edward Island (PEI).⁶⁸ The measures on climate worry were added to the COMPASS questionnaire during the 2021-2022 data collection cycle. For the purpose of this thesis, students in grades 9-12 from all provinces were included in the data analysis. Students in grades seven and eight were excluded from the data analysis as the scope of this thesis specifically focused on high school students. The grade options for students in Quebec included secondary one to five, with this study excluding secondary one and two as these grade levels are equivalent to grades seven and eight in the other provinces.

4.1.1 The COMPASS Questionnaire

The COMPASS self-report student questionnaire (Cq) is an online assessment tool encompassing a broad scope of youth health behaviours, health outcomes, and sociodemographic characteristics.⁶⁸ The students' health data are measured in-part through their responses to questions such as those concerning diet and weight perceptions, alcohol, cannabis, and tobacco use, bullying and school connectedness, sleep and sedentary behaviours, physical activity, academic achievement and performance, and mental health. The specific questions under each of these response sections are regarded as externally valid and reliable as they have been formulated and scored in accordance with Canadian public health guidelines and health surveillance tools.⁶⁸

Since 2017 COMPASS has included mental health measures through the mental health module (MHm) of the Cq. The MHm was developed to identify youth mental health concerns through population survey measures such as the Center for Epidemiologic Studies Depression Scale Revised (CESD-R) and the General Anxiety Disorder-7 (GAD-7).⁶⁸

4.2 Study Design and Participants

This thesis sought to determine the association between measures of psychological distress symptoms and climate worry using COMPASS data from the 2022/2023 wave of the COMPASS host study. Complete student-level data from 2022/23 for all eligible participants was drawn from the AB, BC, ON, PEI, and QC datasets. All data used within this study was collected through the self-report questionnaires which were completed during class time. For the purpose of this thesis data was used from students in grades 9-12 across the five provinces who were provided a version of the Cq that included the climate anxiety section. A full description of the COMPASS host study is available through the University of Waterloo 's online [COMPASS Study homepage](#).

Schools and school boards participating in the COMPASS study are selected as a convenience sample located within one of the five aforementioned provinces and must be willing to provide class time for survey completion and permit passive consent. Every student attending a participating school is eligible to complete the Cq and has done so online during class time as the Cq is able to be completed within a standard class period. Students who are absent on the day in which the Cq is administered, are unwilling to complete the Cq on their own time within two weeks, or who wish to dissent, will forego the opportunity to participate. Additionally, the parent

or guardian of each student may withdraw consent for their child's participation in advance of the survey's administration.

4.2.1 Ethics

The COMPASS study has received ethics approval per the Office of Research Ethics at the University of Waterloo, ORE #: 30118. Study investigators have obtained the necessary ethics clearance for the analysis of collected data. Participating school boards, schools, and students (including parents/guardians) have provided informed consent for the use of collected data. Parental consent is provided passively with the option to opt their child out of participating in the data collection. Students provide assent to complete the questionnaire and can withdraw at any time.

4.2.2 Sample

Overall, 2022/2023 data are available from 173 schools and 43,874 students from grades 9-12 (secondary 3-5 in QC). There were 6,788 unavailable responses within the climate worry portion of the dataset, reducing the sample to 37,086 responses. This sample was further reduced by removing missing psychological distress responses (combined GAD7 and CESD-R scores) (-3,188) and missing gender responses (-1,014) leaving 32,884 remaining responses. Following the removal of missing and incomplete data from the 13 additional covariates, data from 31,042 students was used in the final sample of this study.

4.2.2.1 Sample Factors Associated with Missingness

In addition to the factors associated with missingness as discussed in section 2.5 of the literature review, grade (as a proxy for age), gender, and lifestyle factors such as cannabis use, and binge drinking were evaluated as potential factors contributing to missingness in this study. Further, province of residence was evaluated as a potential geographical factor contributing to missingness. Factors associated with missingness were evaluated for both the GAD7 and CESD-R data individually rather than their combined measure of psychological distress. Missingness was evaluated using logistic regression modelling.

For the GAD7 data, grade nine was the reference category, and grade was revealed to not be significantly associated with missing data for the GAD7 variable. For binge drinking, individuals who had not engaged in this behaviour within the past month were set as the reference group, with those engaging in binge drinking monthly or more frequently (OR = 1.40, CI = [1.17, 1.67], $p < 0.05$) having higher occurrences of missing GAD7 data. Cannabis use had the reference category set as those who had not used within the past month, with output revealing those who used monthly or more frequently (OR = 1.32, CI = [1.12, 1.57], $p < 0.05$) had higher occurrences of missing GAD7 data. For province of residence, Alberta was used as the reference category, and the output showed all provinces to be a source of missingness for GAD7 data with PEI displaying the most missingness as per the following output; Ontario (OR = 1.55, CI = [1.21, 2.03], $p < 0.05$), Prince Edward Island (OR = 1.65, CI = [1.20, 2.29], $p < 0.05$), Quebec (OR = 1.34, CI = [1.03, 1.77], $p < 0.05$), and British Columbia having non-significant output. The analysis for gender and missingness in GAD7 scores revealed that compared to cis-girls, cis-gendered boys had the highest rates of missing data (OR = 1.31, CI = [1.16, 1.48], $p < 0.05$), with gender diverse individuals displaying non-significant output.

For the CESD-R data, grade nine was the reference category, and grade was revealed to not be significantly associated with missing data for the CESD-R variable. For binge drinking, those

having not engaged in binge drinking within the past month were the reference category, with those engaging in binge drinking monthly or more frequently (OR = 1.48, CI = [1.29, 1.70], $p < 0.05$) having higher occurrences of missing CESD-R data. Cannabis use had the reference category set as those who had not used within the past month, with output revealing those who used monthly or more frequently (OR = 1.19, CI = [1.04, 1.36], $p < 0.05$) had higher occurrences of missing CESD-R data. For province of residence, Alberta was used as the reference category, and the output showed British Columbia and Ontario as having non-significant output, while Quebec (OR = 0.63, CI = [0.53, 0.77], $p < 0.05$) displaying lower levels of missing responses than other provinces, with Prince Edward Island (OR = 1.30, CI = [1.05, 1.62], $p < 0.05$) presenting the highest level of missingness for CESD-R data. The analysis for gender and missingness in CESD-R scores revealed that, compared with cis-gender girls, cis-gendered boys (OR = 1.26, CI = [1.14, 1.38], $p < 0.05$) had higher occurrences of missing data, with gender diverse individuals (OR = 1.36, CI = [1.08, 1.70], $p < 0.05$) having the highest occurrences missing data but viewed as less significant as gender diverse individuals comprise a much smaller portion (3.8%) of the sample population.

4.3 Data Measurement

4.3.1 Psychological Distress

Depressive symptoms are measured using a standard scoring procedure through the CESD-R-10; a ten-item scale tailored to the assessment of depressive symptoms in adolescent and adult populations within a seven-day period.⁶⁹ This scale includes sections on positive and negative affectivity, interpersonal relationships, and somatic symptoms.⁶⁹ The symptom frequency is measured using a four-point Likert scale wherein higher scores are indicative of increased depressive symptom frequency; with a score greater than or equal to ten serving as the cut-off to indicate clinically-relevant symptomatology.⁶⁹

Anxiety symptom data was effectively scored using the GAD-7 screening tool, which is used to assess the presence of generalized anxiety disorders in clinical settings.⁷⁰ The GAD-7 is reflective of the DSM-5 criteria for assessing generalized anxiety disorder through utilization of a self-report scale inclusive of the necessary diagnostic items.⁷⁰ These seven items are scored using a four-point scale where the points achieved correlate to an absence (0-4) or presence of mild (5-9), moderate (10-14), or severe (15+) anxiety.⁷⁰

Studies pertaining to measures of anxiety and depression in general population samples based off of the criteria used in the CESD-R-10 and the GAD-7 have validated this method of mental health research for screening the risk of anxiety and depression in adolescents.⁷¹ While the outcomes of such studies may not be reflective of clinical diagnoses, they serve to indicate potential risk factors and at-risk populations for the worsening or development of symptoms of psychological distress.

Psychological distress was measured as a continuous variable through the combination of the anxiety and depression scales included in the Cq. This combined scale ranged from 0-51 as a combination of the 0-30 and 0-21 item scales of depressive and anxious symptoms, respectively. Numerous existing studies support the combination of CESD-R and GAD-7 scores when the correlation between these two items is significant,⁷²⁻⁷⁴ as seen in this study ($r=0.77$), supporting the use of a combined psychological distress variable. The internal consistency test for the combined psychological distress variable yielded a value of 0.87 suggesting that this combined variable is reliable. As stated above, missing data for the psychological distress variable (i.e., GAD and CESD-R values) were omitted from the analysis.

4.3.2 Climate Worry

Climate worry will be measured on a continuous scale using the four climate worry questions derived from a study by Clayton and Karazsia.⁷⁵ Since we did not use the complete (unnamed “questionnaire items”) scale of 22 measures given space concerns for the COMPASS questionnaire, we focused on including four measures relevant to climate worry: a) Thinking about climate change makes it difficult for me to sleep; b) My concerns about climate change interfere with my ability to get work or school assignments done; c) I try to reduce my behaviors that contribute to climate change, and; d) I believe I can do something to help address the problem of climate change.

The first two statements relate directly to the explicit presence of climate worry as it pertains to somatic experiences and workload capacities affecting everyday behaviours, while the latter two statements are used as proxy questions to garner the implicit presence of climate worry through calls to action. While it may be argued that questions c) and d) may elicit responses that correlate to what could be considered “normal” behaviours, behaviour change theories⁷⁶ may be applied to rationalize the association between the sentiment of a “need to act” and feelings of worry regarding the climate. Essentially denoting that when students feel they have an obligation to reduce behaviours contributing to climate change or believe they can do something to combat climate change, their anxiety or worry surrounding those feelings and calls to action may be heightened.

Response options for these four questions were ‘never,’ ‘rarely,’ ‘sometimes,’ ‘often,’ and ‘almost always.’ Responses were scored from one to five for questions a), b), and c) while responses were reverse scored from five to one for question d) as d) was a question where responses of ‘never’ were more likely to correlate to climate worry due to feelings of helplessness and an inability to act. The four measures for climate worry were then coded as a continuous scale (from 0-20). An internal consistency test of the four individual climate worry items from the Cq revealed low internal consistency ($\alpha = -0.35$) between the items, likely due to the need for reverse-coding of the responses to question D.

4.3.3 Screen Time and Mode of Screen Use Variables

Within the COMPASS questionnaire, screen time was assessed using the question; “How much time per day do you usually spend doing the following activities?” This question contained prompts asking students to fill-in the number of hours and minutes for each individual mode of screen use as follows: watching TV shows or movies, playing video or computer games, surfing the Internet, scrolling social media, and messaging, texting, and emailing. The daily total hours and minutes of screen time as assessed by these questions may be compared to national recommendations for meeting or exceeding daily recommendations. As per the Canadian 24-hour Movement Guideline, children and youth aged 5 to 17 years recommended to engage in no more than two hours of recreational screen time per day.^{77,78}

Screen time was assessed as a continuous covariate in minutes per day through the inclusion of multiple modes of screen use (TV use, video games, texting, social media use, internet surfing) as well as an overall measure of total daily screen time.

4.3.4 Sleep Duration

Sleep duration was assessed through the Cq indicator assessing how much time in hours and minutes students typically spend sleeping per day through two questions asking “during the past week, what time have you usually turned out the light and gone to sleep...” and “during the past

week, what time have you usually woken up in the morning...” with the option to identify the hour of day (0-12) and minute (0, 15, 30, 45). Responses were evaluated as a continuous measure of sleep duration in minutes per day. Self-report sleep surveys have been demonstrated to represent a valid measure for identifying group-level patterns in large samples of youth.⁷⁹

4.3.5 Gender Variable

The gender variable was created using a combination of student responses to the sex assigned at birth and current gender identity items to produce three categories: cis-girl, cis-boy, and gender diverse individuals. Sex and gender identity data were combined in R studio using the mutate function to develop these three gender categories. The rationale behind this coding is that girls and gender minorities are more likely to experience adverse mental health outcomes and have negative experiences when using different forms of media than boys.³³ Gender was controlled for in model 2 and was used to stratify results specific to each of the three gender identities for models 3-8.

4.3.6 Grade

Grade (9-12) was added as a covariate with grade nine being set as the reference group. To calculate the accurate mean and standard deviation for the grade variable, students who responded “other” were omitted in addition to the blanket omission of N/A responses and missing data. Grade data from Quebec ranged from secondary three to five (grades 9-11).

4.3.7 Race

Race (Multiethnic, Black, East Asian, Latino, Middle Eastern, South Asian, Southeast Asian, White, another category) was added as a demographic covariate where the reference group was set as “White” identifying students.

4.3.9 Affluence

Perceived relative affluence was measured using the Cq question ‘Would you say that you and your family are more or less comfortable financially than the average student in your class?’ with the response options of ‘more comfortable,’ ‘as comfortable’ and ‘less comfortable.’ This measure of relative household financial comfort was used as a proxy for affluence as perceived by students. Students reporting that they were ‘more comfortable’ than their peers were set as the reference group.

4.3.9 School Connectedness

The school connectedness (scored 6-24) covariate was added to the models as a continuous measure to gauge student’s perceptions of their school environment. School connectedness is measured through questions asking students questions regarding their perceived level of happiness and safety in school, their perceptions of how they are treated by peers and staff, their closeness to their peers, and their grades.⁶⁷

4.3.10 Home Life Happiness

Students reported on their home life through the question “How much do you agree or disagree with the following statement? I have a happy home life” (response options: strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). For this study, the responses to this question were grouped into 3 categories (strongly agree AND agree = happy

home life, neither agree nor disagree = neutral home life, and disagree AND strongly disagree = unhappy home life) where students reporting a happy home life were set as the reference category.

4.3.11 Cannabis Use

Participants reported on their cannabis use over the previous 12 months (I have never used marijuana, I have used marijuana but not in the last 12 months, less than once a month, once a month, 2–3 times a month, once a week, 2–3 times a week, 4–6 times a week, and every day). Students who reported that they had not used cannabis in the past month or used less than once per month were set at the reference category ‘no current cannabis use.’ Students reporting cannabis use at least once per month were categorized as engaging in ‘current cannabis use.’

4.3.13 Binge Drinking

Participant reported their occurrences of totaling or exceeding five drinks of alcohol at one time (i.e., binge drinking) (I have never done this, I did not have 5 or more drinks on one occasion in the last 12 months, less than once a month, once a month, 2–3 times a month, once a week, 2–5 times/week, daily or almost daily, and valid skip). The “valid skip” option for binge drinking was coded as “I have never done this” to achieve accurate mean and standard deviation calculations. Students who reported that they had not engaged in binge drinking in the past month or have done this less than once per month were set at the reference category ‘no current binge drinking.’ Students reporting incidence of binge drinking at least once per month were categorized as engaging in ‘current binge drinking.’

4.4 Data Analysis

Descriptive statistics, available in Table 1 and Table 2 as well as appendix Tables app1-app5 were created using data from R Studio output. Table 1 shows demographic characteristics of the sample population including gender identity, grade, province of residence, and racial identity. The latter three demographics were presented as both total population percentages as well as gender-stratified percentages. The data in Table 2 displays the gender-stratified mean and standard deviation for the variables of interest and the continuous covariates included in the below models for Research Question 3. The data for the remaining covariates of interest are presented in appendix Tables app1-app5 and stratified by gender.

As there was potential for overlap of indicators based on the inclusion of the depression measure “my sleep was restless” and the climate worry measure “thinking about climate change makes it difficult for me to sleep,” a cross-table (Table app1) of these responses has been provided in the appendix. Approximately 47% of students who were non-restless sleepers also reported that they were not experiencing climate worry while 35% of students who experienced restless sleep also experienced climate worry. These results displayed variations in the data which support the ability to regress depression scores as a component of the psychological distress variable on climate worry scores without confounding between these similar response options.

4.4.1 Research Question 1

The distribution of climate worry as stratified by gender identity was determined by creating a bar plot of climate worry by gender with the barplot function in R Studio. The graphical output of this data is available in Figure 1.

4.4.1.1 Research Question 1 Secondary Analysis

Given the distribution of climate worry by gender seen in Figure 1, the association between climate worry and mean psychological distress scores as stratified by gender identity was of interest as a means of visualizing this association. As such, Figure 2 was produced in R Studio by creating a new variable to represent the mean psychological distress scores which were graphed along with the climate worry scores using the ggplot function. Mean psychological distress scores were used rather than the raw data to produce a cleaner result.

4.4.2 Research Question 2

To determine if climate worry was associated with psychological distress in the 2022/23 cohort of the COMPASS study population, an initial base linear regression model was performed (appendix Table app5 Model 1) without the inclusion of additional covariates. A second linear regression model was performed examining the association between psychological distress and climate worry with the inclusion of the additional covariates for grade, gender, affluence, race, school connectedness, home life, cannabis use, binge drinking, sleep average, social media use, TV use, internet surfing, texting, video game play, and total daily screen time (Table 3, Model 2).

4.4.3 Research Question 3

For Research Question 3, the data was stratified into the three gender categories (previously coded and defined), as lifestyle behaviours¹⁹⁻²⁶ and mental health¹⁻⁵ may differ by gender identity.^{6,7} The gender-stratified regression models were first run using only the climate worry and psychological distress measures to ascertain the bivariate correlations (appendix Table app6 Models 3, 5, & 7). The gender-stratified models were then run again with the inclusion of the additional covariates (Table 4, Models 4, 6, & 8).

SECTION FIVE: Results and Discussion

5.1 Descriptives

5.1.1 Participant Characteristics and Demographics

Participant characteristics are available below in Table 1. The majority of students (46.6%) were from Ontario. Overall, 51.0% were cis-girls, 45.2% were cis-boys, and 3.8% were classified as gender diverse youth. White-identifying students comprised 66.1% of respondents.

Table 1: Characteristics of Participants in the COMPASS Study in the 2022/2023 Cohort

Variable of Interest	Total (n = 31,042)	Cis- Gendered Girl (n=15,851)	Cis- Gendered Boy (n=14,020)	Gender Diverse Youth (n=1,171)
Gender %	N/A	51.0%	45.2%	3.8%
Province %				
Alberta	8.6%	49.9%	45.2%	4.9%
British Columbia	8.2%	49.9%	45.9%	4.2%
Ontario	46.4%	50.2%	45.6%	4.2%
Prince Edward Island	7.1%	49.4%	46.1%	4.5%
Quebec	29.7%	53.5%	44.1%	2.4%
Grade %				
Grade 9	30.9%	50.7%	46.4%	2.9%
Grade 10	30.2%	50.9%	45.3%	3.8%
Grade 11	25.5%	51.8%	44.0%	4.2%
Grade 12	13.4%	51.0%	44.3%	4.7%
Race %				
Multiethnic	7.5%	44.9%	49.2%	5.9%
Black	3.3%	47.3%	47.6%	5.1%
East Asian	4.1%	52.6%	44.7%	2.7%
Latino	2.8%	49.7%	46.3%	4.0%
Middle Eastern	2.2%	49.2%	48.6%	2.2%
South Asian	2.4%	52.9%	45.0%	2.1%
Southeast Asian	3.6%	49.9%	47.2%	2.9%
White	66.1%	52.3%	44.5%	3.2%
Another Category	4.5%	49.7%	42.4%	7.9%
Prefer not to Answer	0.9%	45.6%	47.0%	7.4%
Do not Know	2.6%	48.3%	44.7%	7.0%

5.1.2 Gender-Stratified Mean and Standard Deviation of Continuous Variables of Interest

Table 2 shows the mean and standard deviation by gender for the continuous variables relevant to this study. The output displayed that the mean and standard deviation for the main variables of interest regardless of gender were 18.3 (std. dev. = 21.1) for psychological distress and 9.0 (std. dev. = 1.9) for climate worry.

Table 2: Mean and Standard Deviation of Variables Grouped by Gender in the COMPASS Study in the 2022/2023 Cohort

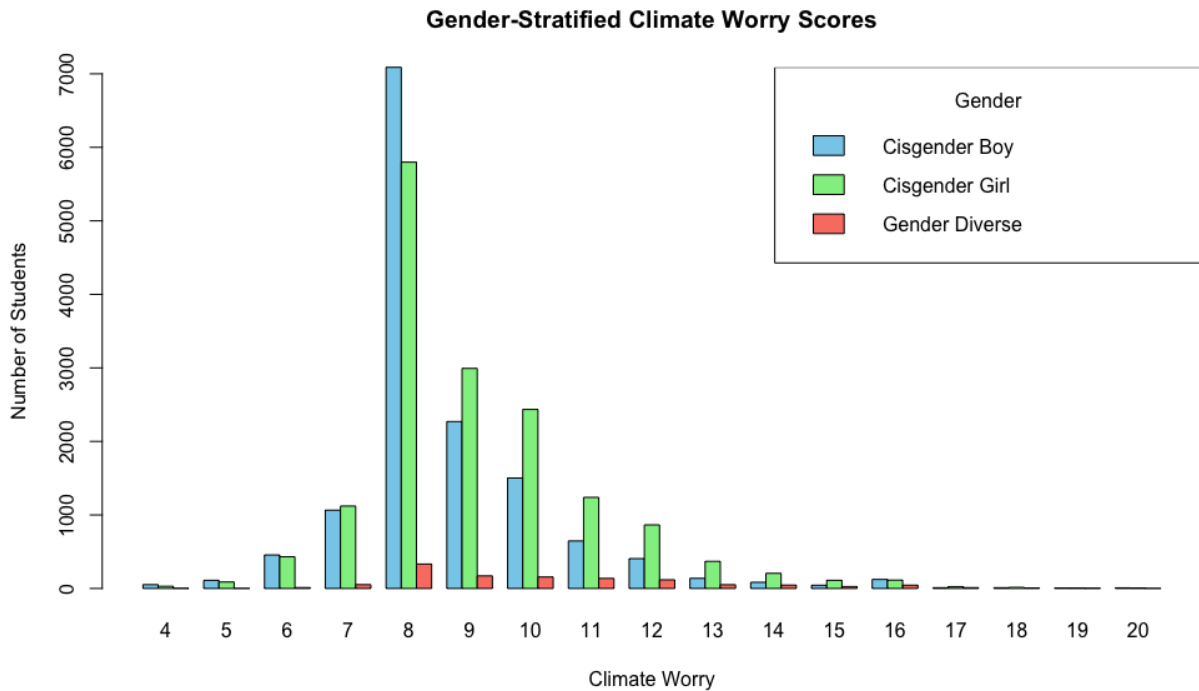
Variable of Interest	Total		Cis-Gendered Girl (n=15851)		Cis-Gendered Boy (n=14020)		Gender Diverse (n=1171)	
	ME AN	ST D. DEV.	ME AN	ST D. DEV.	ME AN	ST D. DEV.	ME AN	ST D. DEV.
Psychological Distress (0-51)	18.3	12.1	21.9	12.0	13.4	10.1	28.8	12.8
Climate Worry (0-20)	9.0	1.9	9.1	1.9	8.7	1.7	10.2	2.6
School Connectedness (6-24)	17.8	3.4	17.5	3.2	18.2	3.5	15.6	3.7
Sleep Average MPD*	487.1	90.0	487.0	83.8	489.0	92.2	472.0	124.0
Social Media Use MPD*	167.4	139.9	191.0	139.0	138.0	130.0	202.0	184.0
TV Use MPD*	107.4	105.8	110.0	97.9	102.0	108.0	143.0	159.0
Internet Surfing MPD*	78.2	119.4	74.1	112.0	77.9	120.0	136.0	179.0
Texting MPD*	87.3	116.0	95.6	115.0	73.8	108.0	138.0	178.0
Video Game Use MPD*	91.8	130.9	37.6	81.8	147.0	145.0	159.0	177.0
Total Daily Screen Time MPD*	588.0	473.2	570.0	430.0	585.0	483.0	860.0	752.0

*Where MPD = minutes per day.

5.2 Research Question 1: Gender-Stratified Climate Worry Score Distribution

Figure 1 shows the distribution of climate worry scores by gender for the 2022/2023 cohort of the COMPASS Study. This bar plot illustrates that the climate worry scores for the three included gender identities; cis-gender boy, cis-gender girl, and gender diverse all display relatively similar trends. All three gender identities peak at a climate worry score of eight out of a maximum of twenty points, subsequently tapering down to a score of nine, then gradually decreasing to scores of sixteen before the frequency of scores become negligible. When divided into three response categories (low = 4-9, moderate = 10-15, high = 15-20), this plot suggests that students across genders typically experience low-to-moderate levels of climate worry (7-12/20 total points).

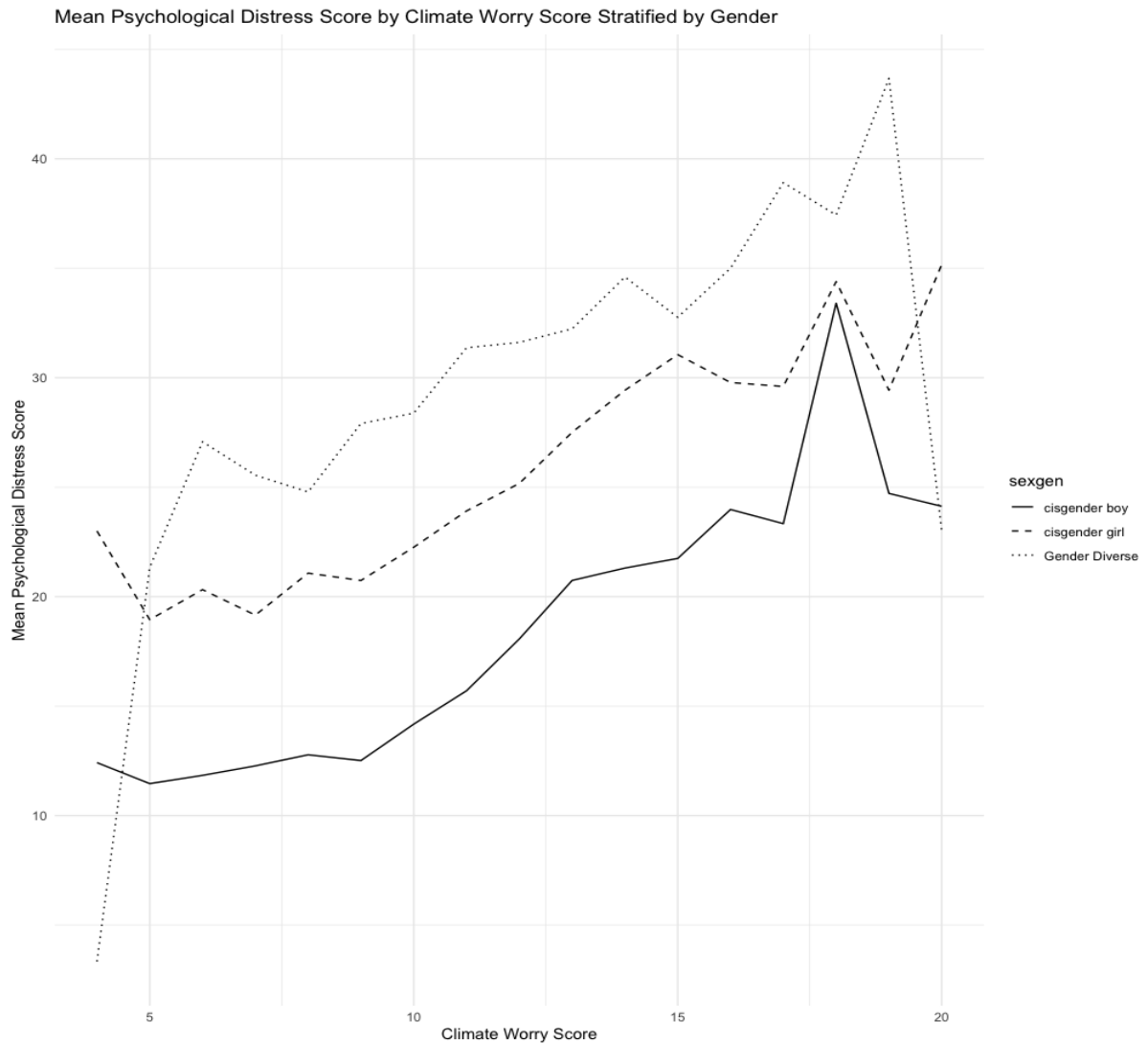
Figure 1: Distribution of Climate Worry Scores by Gender Identity in the 2022/2023 Cohort of the COMPASS Study



5.2.1 Gender-Stratified Mean Psychological Distress Score by Climate Worry Score

Figure 2 shows the gender-stratified mean psychological distress scores by the climate worry scores which demonstrates that as climate worry scores increase, mean psychological distress scores also increase. Higher climate worry scores (i.e., a climate worry score greater than 5) correlate to higher mean psychological distress scores for cis-gendered girls and gender diverse individuals, with more modest psychological distress scores for cis-gendered boys at the same climate worry score. Cis-gendered boys display higher mean psychological distress scores when climate worry scores are greater than 15, where psychological distress scores for cis-gendered girls and gender diverse youth are higher at the same climate worry score. Psychological distress scores for gender diverse individuals slightly decrease when climate worry scores are between 17 and 20 due to the relatively small number of responses for that portion of the data.

Figure 2: Gender-stratified Mean Psychological Distress Scores by Climate Worry Score in the 2022/2023 COMPASS Cohort



5.3 Research Question 2: Non-Gender Stratified Model 2 for Climate Worry and Psychological Distress Including Covariates

As shown in Table 3, Model 2, which explores the association between climate worry and psychological distress while adjusting for covariates for all gender identities, the estimate for climate worry is $\beta = 0.7$. This denotes that for each single-unit increase in climate worry, the psychological distress variable also increases by 0.7 units. Refer to appendix Table app6 for the non-gender stratified base model without covariates for model-building. A variable for climate worry and gender ($\beta = -0.07$) was created prior to the creation of the gender-stratified models seen below in table 4.

School connectedness ($\beta = -0.9$), sleep duration ($\beta = -0.01$ per minute), daily time spent gaming ($\beta = -0.003$ per minute) and identifying as Black ($\beta = -3.0$) or East Asian ($\beta = -1.2$) relative to white were shown to have protective effects against outcomes of higher psychological distress scores. Identifying as a cis-gender boy/man was also a protective factor wherein psychological distress scores were decreased by $\beta = 5.9$ compared to cis-gendered girls/women. Gender diverse individuals were more likely to experience psychological distress symptoms with an increase of $\beta = 1.5$ over cis-gendered girls/women.

Relative to grade 9, being in grade 10 ($\beta = 0.5$), grade 11 ($\beta = 0.9$), and grade 12 ($\beta = 2.0$) were risk factors for higher psychological distress scores. Further, being less affluent than peers ($\beta = 2.0$) relative to those who identified as more affluent, having a neutral ($\beta = 6.0$) or unhappy home life ($\beta = 10.0$) relative to a happy home life, using cannabis in the past month ($\beta = 1.8$) relative to those who have not, social media use ($\beta = 0.007$ per minute), TV use ($\beta = 0.002$ per minute), texting ($\beta = 0.005$ per minute), and internet surfing ($\beta = 0.002$ per minute) were all revealed to be risk factors for higher psychological distress scores. Binge drinking within the past month, TV use, internet surfing, being as affluent as one’s peers as well as the following racial categories; unknown race, Latino, Middle Eastern, South Asian, and Southeast Asian were not significantly associated with psychological distress in Model 2.

Overall, the below model indicates that climate worry scores are associated with psychological distress scores for any gender identity. Other associated covariates included sleep duration, all modes of screen use (social media use, TV use, internet surfing, texting, video game play), cannabis use, home life, low affluence, school connectedness, grade, and Black and East Asian racial descent. Being as affluent as one’s peers, most ethnicities, and binge drinking were revealed to not be statistically relevant for associations with psychological distress across gender identities in Model 2.

The adjusted R-squared indicates that after adjusting for the number of predictors, the degree of variance seen in psychological distress that is explained by the model is approximately 43%. This indicates that there are external factors not accounted for in the model that have an impact on the association between climate worry and psychological distress. Compared with existing literature, the adjusted R-squared value for this model is higher than the R-squared values for the association between “climate change anxiety” and GAD symptoms (R-Squared = 23.1) and MDD symptoms (R-squared = 17.2).⁸⁰

Table 3: Model 2 Psychological Distress and Climate Worry with Covariates Regression Model Output in the COMPASS study in the 2022/2023 Cohort for all Genders

	Estimate	Std. Error	Pr(> t)
(Intercept)	26.6	0.6	<0.05
Climate Worry	0.7	0.04**	<0.05

Climate Worry x Gender	-0.02	0.05**	0.8
Gender			
Cis-Girl	Ref		
Cis-Boy	-6.6	1.0	<0.05
Gender Diverse	1.4	0.4	0.3
Grade			
Grade 9	Ref		
Grade 10	0.5	0.1	<0.05
Grade 11	0.9	0.1	<0.05
Grade 12	2.0	0.2	<0.05
Perceived Affluence			
More Affluent than Peers	Ref		
As Affluent as Peers	-0.02	0.1	0.9
Less Affluent than Peers	2.0	0.2	<0.05
Race			
White	Ref		
Unknown/Unidentified Race	0.1	0.2	0.7
Multiethnic	0.2	0.2	0.5
Black	-3.0	0.3	<0.05
East Asian	-1.2	0.3	<0.05
Latino	-0.4	0.3	0.2
Middle Eastern	0.3	0.4	0.4
South Asian	-0.2	0.3	0.6
Southeast Asian	0.4	0.3	0.1
Home Life			
Happy Home Life	Ref		
Neutral Home Life	6.0	0.1	<0.05
Unhappy home Life	10.0	0.2	<0.05
School Connectedness (6-24) (each 1 unit change)	-0.9	0.02	<0.05
Cannabis Use			
No Current Cannabis Use	Ref		
Current Cannabis Use	1.8	0.2	<0.05
Binge Drinking			
No Current Binge Drinking	Ref		
Current Binge Drinking	0.1	0.2	0.4
Sleep Average (MPD*) (each 1-unit change)	-0.01**	0.001**	<0.05
Mode of Screen Use MPD* (each 1-unit change)			
Social Media Use	0.007**	0.001**	<0.05
TV Use	0.002**	0.001**	<0.05
Internet Surfing	0.002**	0.001**	<0.05
Texting	0.005**	0.001**	<0.05
Video Game Play	-0.003**	0.001**	<0.05
Adjusted R-squared:			0.43

*Where MPD = minutes per day. **Table values rounded to 1 decimal place where possible, additional decimal places provided for output to display non-zero outcomes.

5.4 Research Question 3: Gender-Stratified Models for Climate Worry and Psychological Distress Including Covariates

Table 6 explored the association between climate worry and psychological distress while including relevant covariates for cis-gendered boys, cis-gendered girls, and gender diverse individuals. For cis-gendered boys, the climate worry estimate is $\beta = 0.6$, for cis-gendered girls, this estimate is $\beta = 0.7$, and for gender diverse individuals, this estimate is $\beta = 0.9$. These estimates denote that for each single unit increase in climate worry, the psychological distress scores also increase by approximately 0.6, 0.7, and 0.9 units respectively. Refer to appendix Table app7 for the base models for each gender identity without covariates for model-building.

5.4.1 Cis-Gendered Boys

School connectedness ($\beta = -0.8$), sleep duration ($\beta = -0.01$ per minute), and being Black ($\beta = -1.2$) relative to being white were all shown to have protective effects against outcomes of higher psychological distress scores. Relative to a student in grade 9, being in grade 11 ($\beta = 0.9$) and grade 12 ($\beta = 2.3$) were risk factors for higher psychological distress scores. Further, being less affluent than peers ($\beta = 1.8$), being Middle Eastern ($\beta = 1.1$) or Southeast Asian ($\beta = 1.6$) relative to being White, having neutral ($\beta = 6.4$) or unhappy home life ($\beta = 10.6$), cannabis use within the past month ($\beta = 2.1$), social media use ($\beta = 0.003$ per minute), internet surfing ($\beta = 0.002$ per minute), and texting ($\beta = 0.003$ per minute) were all revealed to be risk factors for higher psychological distress scores. Being in grade 10, binge drinking within the past month, TV use, total daily screen time, and being from one of the following ethnic categories; unknown race, Multiethnic, Latino, East Asian, and South Asian, were not relevant to psychological distress scores for cis-boys in Model 4.

5.4.2 Cis-Gendered Girls

School connectedness ($\beta = -1.0$), sleep duration ($\beta = -0.02$ per minute), and being Black ($\beta = -4.6$), Latino ($\beta = -1.0$), East Asian ($\beta = -2.5$), and Southeast Asian ($\beta = -0.9$) relative to being white were shown to have protective effects against outcomes of higher psychological distress scores. Relative to a student in grade 9, being in grade 10 ($\beta = 0.8$), grade 11 ($\beta = 1.1$), and grade 12 ($\beta = 2.0$) were risk factors for higher psychological distress scores. Further, being less affluent than peers ($\beta = 2.1$), having a neutral ($\beta = 5.4$) or unhappy home life ($\beta = 9.3$), cannabis use within the past month ($\beta = 1.6$), binge drinking within the past month ($\beta = 0.6$), social media use ($\beta = 0.004$ per minute), internet surfing ($\beta = 0.002$), texting ($\beta = 0.004$), and video game play ($\beta = 0.001$) were all revealed to be risk factors for higher psychological distress scores. TV use, being as affluent as one's peers, and being from one of the following ethnic categories; unknown race, Multiethnic, Middle Eastern, and South Asian, were not relevant to psychological distress scores for cis-girls in Model 6.

5.4.3 Gender Diverse Individuals

Binge drinking within the past month ($\beta = -2.1$), school connectedness ($\beta = -0.9$), sleep duration ($\beta = 0.01$), and being Multiethnic ($\beta = -2.6$) or Black ($\beta = -3.9$) relative to being White were shown to have protective effects against outcomes of higher psychological distress scores. Neutral ($\beta = 6.6$) or unhappy home life ($\beta = 10.4$), being as affluent as peers ($\beta = 1.8$) and less affluent than peers ($\beta = 2.3$), and texting ($\beta = 0.005$ per minute) were revealed to be risk factors for higher psychological distress scores. TV use, social media use, internet surfing, video game

play, being in any grade, cannabis use within the past month and being from one of the following ethnic categories; unknown race, East Asian, Latino, Middle Eastern, Southeast Asian, and South Asian, were not relevant to psychological distress scores for gender diverse individuals in Model 8.

5.4.4 Adjusted R-Squared

The adjusted R-squared values indicate that after adjusting for the number of predictors, the degree of variance seen in psychological distress that is explained by the model is approximately 32% for cis-gendered boys, 35% for cis-gendered girls, and 37% for gender diverse individuals. This indicates that there are external factors not accounted for that have an impact on psychological distress for all gender groups. As mentioned at the end of section 5.3, compared with existing literature, the adjusted R-squared value for these models is higher than the R-squared values for other studies exploring the association between “climate change anxiety” and GAD symptoms (R-Squared = 23.1) and MDD symptoms (R-squared = 17.2).⁸⁰

**Table 4: Models 4, 6, 8 Psychological Distress and Climate Worry with Covariates
Regression Model Output in the COMPASS study in the 2022/2023 Cohort for Cis-
Gendered Boys, Cis-Gendered Girls, and Gender Diverse Individuals**

	Model 4: Cis-Boys			Model 6: Cis-Girls			Model 8: Gender Diverse		
	Estimate	Std. Error	Pr(> t)	Estimate	Std. Error	Pr(> t)	Estimate	Std. Error	Pr(> t)
(Intercept)	23.3	0.7	<0.05	36.6	0.8	<0.05	31.8	2.5	<0.05
Climate Worry	0.6	0.04**	<0.05	0.7	0.04**	<0.05	0.9	0.1	<0.05
Grade									
Grade 9	Ref			Ref			Ref		
Grade 10	0.3	0.2	0.15	0.8	0.2	<0.05	0.3	0.8	0.7
Grade 11	0.9	0.2	<0.05	1.1	0.2	0.05	-0.3	0.9	0.7
Grade 12	2.3	0.2	<0.05	2.0	0.3	<0.05	-0.9	1.0	0.4
Perceived Affluence									
More Affluent than Peers	Ref			Ref			Ref		
As Affluent as Peers	-0.2	0.2	0.45	-0.1	0.2	0.6	1.8	0.8	<0.05
Less Affluent than Peers	1.8	0.3	<0.05	2.1	0.3	<0.05	2.3	1.0	<0.05
Race									
White/Caucasian	Ref			Ref			Ref		
Unknown/Unidentified Race	0.5	0.3	0.15	-0.2	0.3	0.6	-1.3	0.9	0.1
Multiethnic	0.3	0.3	0.3	0.3	0.3	0.3	-2.6	1.0	<0.05
Black	-1.2	0.4	<0.05	-4.6	0.5	<0.05	-3.9	1.5	0.05
East Asian	0.4	0.4	0.5	-2.5	0.4	0.05	-2.0	1.8	<0.05
Latino	0.4	0.4	0.2	-1.0	0.5	<0.05	-2.4	1.8	0.05
Middle Eastern	1.1	0.5	0.4	-0.2	0.5	0.05	-2.6	2.7	0.3
South Asian	0.9	0.5	<0.05	-1.0	0.5	<0.05	-4.6	2.6	0.2
Southeast Asian	1.6	0.4	0.05	-0.9	0.4	0.05	-0.5	1.8	0.3
			<0.05			0.7			0.1
			<0.05			0.1			0.8
			0.05			<0.05			0.8
Home Life									
Happy Home Life	Ref			Ref			Ref		
Neutral Home Life	6.4	0.2	<0.05	5.4	0.2	<0.05	6.5	0.8	<0.05
Unhappy Home Life	10.6	0.3	0.05	9.3	0.3	0.05	10.3	0.8	0.05

			<0.0 5			<0. 05			<0. 05
School Connectedness (6-24) (each 1-unit change)	-0.8	0.02 **	<0.0 5	-1.0	0.03 **	<0. 05	-0.9	0.1	<0. 05
Cannabis Use									
Not Current Cannabis User	Ref			Ref			Ref		
Current Cannabis User	2.1	0.3	<0.0 5	1.6	0.3	<0. 05	0.9	0.9	0.3
Binge Drinking									
Not Current Binge Drinker	Ref			Ref			Ref		
Current Binge Drinker	-0.3	0.2	0.2	0.6	0.2	<0. 05	-2.1	1.0	<0. 05
Sleep Average (MPD*) (each 1-unit change)	- 0.01**	0.00 1**	<0.0 5	-0.02	0.00 1	<0. 05	- 0.01	0.002	<0. 05
Mode of Screen Use MPD* (each 1-unit change)									
Social Media Use	0.003 **	0.00 1**	<0.0 5	0.007 **	0.00 1**	<0. 05	0.00 4**	0.002 **	0.3 0.7
TV Use									
Internet Surfing	0.000 4**	0.00 1**	0.6	0.001 **	0.00 1**	0.2	0.00 1**	- 0.001**	0.8 <0.
Texting			<0.0 5			<0. 05			
Video Game Play	0.002 **	0.00 1**	<0.0 5	0.002 **	0.00 1**	<0. 05	0.00 1**	- 0.001**	0.5 0.8
	0.004 **	0.00 1**	0.6	0.004 **	0.00 1**	<0. 05	0.01 **	0.005 **	
	0.000 3**	0.00 1**		0.001 **	0.00 1**	0.5	0.00 1**	- 0.001**	
Adjusted R-Squared			0.32			0.35			0.37

*Where MPD = minutes per day. **Table values rounded to 1 decimal place where possible, additional decimal places provided for output to display non-zero outcomes.

5.5 Discussion

Youth mental health is a highly important topic of psychiatric epidemiological research and is relevant to promoting public health, education, and overall societal wellbeing. This study identified that among our large sample of secondary students, psychological distress was common, as was climate worry, with climate worry and psychological distress displaying a modest association with each other. As such, promoting youth mental health and improving resilience to the effects of climate change on mental health should be a public health priority. While climate worry is a moderate risk factor for increasing scores of psychological distress in this study and shows variations by gender (highest association experienced by gender diverse individuals), it is not generally a key risk factor for outcomes of psychological distress. This is due to the modest increases in psychological distress scores associated with increases in climate worry scores. As well, when the climate worry variable is removed from Model 2 and the model is rerun, the R-Squared value decreases by 0.0053%, denoting not a meaningful change. Additional covariates associated with psychological distress included mode of screen use, duration of total daily screen time, sleep attainment, substance use, home life, school connectedness, grade, race, and affluence. These covariates had varying effect sizes across the gendered models.

5.5.1 Climate Worry Associated with Psychological Distress

Regardless of gender, this study identified that each 0.7-unit increase in climate worry was associated with increases in scores of psychological distress. When stratified by gender, the association between climate worry and psychological distress was largest for gender diverse youth relative to cis-gender boys and cis-gender girls (despite being a small proportion of the sample). Relative to cis-gendered boys ($\beta = 0.6$), cis-gendered girls ($\beta = 0.7$) and gender diverse individuals ($\beta = 0.9$) displayed a slightly higher association between climate worry and psychological distress. While the gender diverse cohort is statistically more at risk, the actual difference in beta values is modest across all genders. These findings are somewhat consistent with existing literature where a study of young people (aged 16-25 years) found that girls/women expressed modestly higher levels of negative emotions and concern than boys/men regarding climate change.⁸¹ Another study from 2024 conducted on young Australians (aged 15-19 years) found that girls and gender diverse individuals expressed more climate concerns than boys, consistent with the findings from this thesis.⁸²

These results denote that while the associations may be modest for low to moderate climate worry scores (those scoring 0-10 on the climate worry scale (0-20), $n = 26,166$ (84% of sample)), moderate to high scores (those scoring 11-20, $n = 4876$ (16% of sample)) of climate worry produce higher psychological distress scores. It may additionally be noted that the hypothesis for this study expected a larger association between climate worry and psychological distress than what was seen in the displayed results, however the importance of this research remains.

Karazsia used to inform the creation of this study's climate worry questionnaire component, have reported similar findings.⁷⁵ Clayton and Karazsia also found that climate anxiety was associated with a general measure of depression and anxiety.⁷⁵ Additionally, a study by Leger-Goodes and colleagues found that for youth, feelings of climate worry were associated with poor mental health outcomes including anxiety, depression, and general psychological distress as well as feelings of sadness, worry, and anger.⁸³ While these authors found a greater association between climate worry and depression and anxiety than the association expected to be found in

this study, the congruency in these results lends merit to the findings of this thesis and their replicability.

5.5.2 Risk Factors for Psychological Distress

Certain modes of screen use have been revealed to be protective factors or risk factors for increasing scores of psychological distress with differences across gender identities as seen in the results provided in Table 4. For cis-boys, social media use, internet surfing, and texting were revealed to be risk factors for increasing scores of psychological distress with modest minute-by-minute increases. For cis-girls, social media use, internet surfing, texting and video game play were all revealed to be risk factors for increasing scores of psychological distress. The minute-by-minute increases for these modes of screen use are modest, but more meaningful when viewed as hourly increases. Current literature pertaining to social media use in adolescents (aged 11-17 years)⁸⁷ and teens (grades 7-12)⁸⁸ describes use of social media as being associated with anxiety and depression, which is consistent with the above findings. For gender diverse individuals, only texting was revealed to be a risk factor for increasing scores of psychological distress with a modest minute-by-minute increase. Additional modes of screen use (social media, TV, internet surfing, and video gaming) did not display significant associations for gender diverse individuals. There is a literature gap for the association between psychological distress and texting for gender diverse individuals.

Grade is associated with an increased risk of experiencing psychological distress for cis-gendered participants, with grade 9 students as the reference category in Table 4. For cis-boys, being in 10th grade was not a significant predictor, however those in grades 11 and 12 were at a greater risk of experiencing psychological distress symptoms. For cis-girls, as grade increased, so did the risk of experiencing psychological distress symptoms with a minor increase between grades 10 and 11, and a greater increase in grade 12. For gender diverse participants, grade was not significantly associated with psychological distress. The experiences of higher levels of psychological distress in relation to an increase in grade is consistent with existing literature.⁵⁷

For cis-boys, identifying as Middle Eastern or Southeast Asian was a risk factor which is supported by existing literature that describes racialized youth as having a higher likelihood of experiencing symptoms of mental illnesses⁶⁴ which may include psychological distress. They are also less likely to receive treatment for symptoms associated with mental illnesses which may exacerbate this issue⁶⁶

Cannabis use was determined to be a risk factor for psychological distress in cis-girls and cis-boys at higher rates than climate worry, but not for gender diverse individuals as seen in the results of Table 4. This reflects existing literature on youth cannabis use wherein youth who engage in cannabis use are more likely to experience symptoms of psychological distress.⁸⁹ As such, it may be suggested that cannabis control efforts among youth should be prioritized due to this larger effect size, however over 75% of participants in this study responded as having never used cannabis. The relatively low percentage of students who have ever used cannabis provides reasoning for the assertion that psychological distress mitigation efforts should focus on other covariates with both a large effect size, and large population of students experiencing these factors.

For cis-girls, as seen in Table 4, binge drinking was found to be a moderate risk factor for psychological distress outcomes, while cis-boys did not experience significant interactions from binge drinking. Current literature on youth binge drinking posits that youth engaging in such

behaviours are more likely to experience mental distress,⁹⁰ as seen in the results of this study for cis-girls.

Another risk factor for psychological distress is perceived affluence, included in Table 4. For gender diverse individuals, compared to feeling more affluent than peers, feeling as affluent or less affluent than peers was a risk factor. For cis-girls and cis-boys, compared to feeling more affluent than peers, only feeling less affluent than peers was a risk factor. These risk factors were higher than climate worry across all gender identities denoting a stronger association with psychological distress. This is supported by existing literature which posits that schoolmate income is associated with mental health outcomes, with higher associations to symptoms of anxiety and depression.⁹¹

The strongest effect sizes were seen in the home lives of participants when using a happy home life as the reference category for Table 4. For cis-boys, experiencing a neutral ($\beta = 6.4$) or unhappy ($\beta = 10.6$) home life was quite strongly associated with psychological distress. This strong association was also noted in cis-girls to a slightly lesser degree with minimally lower values for neutral ($\beta = 5.4$) and unhappy ($\beta = 9.3$) home lives. Gender diverse individuals also had similar risk factor values for these covariates with neutral ($\beta = 6.5$) and unhappy ($\beta = 10.3$) home life values. Existing literature supports this data, as a poor family environment (lack of support, presence of conflict, etc.) is associated with depressive symptoms.⁹² Additional existing literature further supports the position that a negative emotional family climate is predictive of youth anxiety and depressive symptoms.⁹³ Of the covariates included in the modelling for this thesis, home life has the strongest effect size, suggesting future initiatives should focus on improving the home environment to promote resilience against psychological distress.

5.5.3 Protective Factors for Psychological Distress

As shown in Table 2, over half of all cis-gendered boys (58.9%) and girls (58.7%) met the sleep attainment guidelines set by the 24-Hr Movement Guidelines, while less than half of all gender diverse individuals (49.0%) met sleep attainment guidelines. This discrepancy denotes that gender diverse individuals within the 2022/2023 COMPASS study population may be more likely to experience sleep issues than their cis-gendered counterparts despite being a very small population within the overall sample.

Sleep disturbances are important to scores of psychological distress as the models revealed sleep to be a protective factor for all gender identities wherein greater sleep attainment would act as a protective factor for outcomes of psychological distress. While the minute-by-minute protective effects of sleep seen in Table 4 are modest across all gender identities, these effects increase as sleep attainment increases (hourly rates: $\beta = -0.6$ per hour for cis-boys and gender diverse individuals, $\beta = -1.2$ for cis-girls). A 25-country cross-sectional study on negative emotions about climate change and their relationship to sleep disturbances found that negative climate-related emotions were positively associated with symptoms of insomnia.⁸⁴ While this thesis did not seek to study insomnia, lower sleep attainment was found to be associated with higher scores of psychological distress, which is consistent with the cross-sectional study's findings.

Racial identity provided an interesting protective factor for students when compared to their white counterparts in Table 4. For gender diverse individuals, identifying as Multiethnic or Black was protective against psychological distress, while all other racial identities held no significant association with psychological distress. For cis-girls, there were a greater number of protective racial identities, with those identifying as Black, East Asian, Southeast Asian, and Latino seeing

protective effects against psychological distress associated with their racial identity. For cis-boys, only identifying as Black had a protective effect. These results provide interesting insights into the interaction between racial identity and youth mental health which revealed that across all gender identities, a Black racial identity was protective against psychological distress. Results from existing studies which posit that non-white youth are more likely to experience poor mental health^{64,65} is not consistent with the findings from this thesis regarding racialized youth.

School connectedness was found to be a protective factor against increasing scores of psychological distress for all gender identities. School connectedness was protective against psychological distress at higher rates than the risk provided by climate worry for all genders. Existing literature supports the protective effects of school connectedness wherein a lack of school connectedness can contribute to negative mental health outcomes, suggesting the inverse (elevated school connectedness) would promote resilience against negative mental health outcomes.⁸⁵

Binge drinking was found to be the most surprising protective factor (results in Table 4), specifically for gender diverse individuals. This finding is surprising as existing literature often shows that binge drinking is linked with negative mental health outcomes for youth⁸⁶ while this study provides a conflicting result. An element of gender diverse individuals' binge drinking behaviours that does align with existing research⁸⁶ is that they are more likely to engage in this behaviour than their cis-gendered peers. This is seen in Table app5 where gender diverse individuals are more likely to drink 2-5 times per week (1.4%) or daily/almost daily (2.9%) compared to their cis-gendered peers' habits of drinking 2-5 times per week (0.5% for cis-girls and 1.1% for cis-boys) and daily/almost daily (0.2% for cis-girls and 0.6% for cis-boys).

5.5.4 Additional Gender Differences

Compared to cis-identifying students, results for gender diverse students displayed a lower number of significant covariates suggesting that these individuals may experience different, more gender-specific contributing factors or that they are more resilient to the impact of included factors. This suggestion of increased resilience is supported by the adjusted R-squared values for all genders (Table 4) wherein cis-gendered girls (35.5%) and boys (32.6%) had lower R-squared values than gender diverse individuals (37.1%). These R-squared values show that there are more external factors for cis-gendered participants than gender diverse participants by a small margin.

Table app2 shows that cis-gendered boys/men view their home lives as happier compared with cis-gendered girls/women and gender diverse individuals. Table app3 shows that gender diverse individuals have the highest perceived household affluence compared with their cis-gendered counterparts. Table app4 displays results that show gender diverse individuals as having higher rates of daily cannabis use by approximately double the rate of their cis-gendered counterparts. Table app5 displays results that show gender diverse individuals as having higher rates of daily or almost daily binge drinking by over double the rate of their cis-gendered counterparts. (Tables app2-app5 may be found in the appendix).

5.5.5 Directions for Future Research

Future studies should aim to uncover additional external factors influencing the association between climate worry and psychological distress and to determine the degree to which these factors modify the association. Additional research should be conducted on the association between climate worry and specified anxiety disorders as well as depression to build connections

between pervasive clinical diagnoses and climate worry in youth and even older age groups. Researchers may also desire to investigate the impact of ecological and social determinants of health on youth mental health as an effect of climate change.

For future research conducted within the COMPASS Study, an argument could be made for the expansion of the climate worry section of the COMPASS questionnaire (Cq) to include more robust measures of climate worry. This could be undertaken by referencing the study by Clayton and Karazsia⁷⁵ which was used as a tool for creating the current version of the climate worry section in the Cq. Clayton and Karazsia included a 22-item scale to collect climate worry data, and while COMPASS likely does not need to/cannot include all 22 questions, it could seek to add several of them for a more robust measure. Alternative studies could also be referenced to expand this section of the Cq such as the recently published study by Man and colleagues on experiences of climate worry and eco-depression among youth.³⁶

5.5.6 Implications for Public Health

The implications of these results being that the relatively novel topic of climate worry, while modestly associated with psychological distress in this study, may further increase scores of psychological distress, especially for individuals with high climate worry scores. These increases in climate worry and psychological distress scores should be a warning to mental health researchers and professionals that while the concept of climate worry may be new to research spheres, it is a moderate predictor of poor mental health outcomes and may be experienced by any gender identity to varying degrees.

Efforts to mitigate the effects of climate worry may include education programs and social initiatives to provide palatable information to youth regarding the ongoing climate crisis. Schools may benefit from adding climate change-related content to their curriculum to facilitate non-frightening discussions regarding the ways in which students may be both physically and mentally affected by climate change.⁸³ This mitigation initiative could also be implemented through the formation of climate-focused clubs/extracurriculars to promote resilience through informal peer-to-peer interactions. This provision of relevant information may foster empowerment and resilience in youth to mitigate an increase in the prevalence of further negative emotions/feelings associated with climate worry.

5.6 Limitations

A potential limitation of this thesis lies in the novelty of the climate worry dataset. As this paper is among the first (outside of Quebec) to utilize climate worry data in any COMPASS research, no previous data-coding method has been established. This limitation has potentially been mitigated by assessing existing climate worry literature for externally consistent measures that have been used to supplement the coding of this dataset. Further mitigation of this limitations is seen through the climate worry measurement tool by Clayton and Karazsia, which was used to develop the COMPASS questionnaires' climate worry section.⁷⁵ However, the study by Clayton and Karazsia also presents another limitation in that this study contained 22 total questions,⁷⁵ of which the Cq adapted four questions for our own study. To provide a more comprehensive approach to evaluating climate worry, the Cq could be expanded to include all 22 questions and use the original author's scoring methods.

Selection bias may be present in this study as participating schools are selected from a convenient sample of those wishing to participate and therefore may not be representative of the Canadian youth population as a whole. The self-report nature of COMPASS's dataset is another

potential limitation as it allows for misrepresentation or underreporting of answers. Due to the sensitive nature of some of the questions within the questionnaire, it is plausible that some students may downplay or fail to report accurate answers to one or more questions. Students may also fail to fully understand the scope or rationale of each question presented and provide incorrect or inconsistent answers through misunderstanding.

While numerous covariates were included in the modelling of the association between climate worry and psychological distress, the r-squared values for all the above models fell below 50 denoting that there are further external factors impacting this association that have not been accounted for in this modelling, which serves as a limitation. A further limitation is the amount of missing data within this dataset. As a result, the dataset, while still significantly large, was reduced during the data analysis to remove these missing values.

5.7 Conclusion

This study has established climate worry as an important and novel research topic, further underscoring the importance of youth mental health. The ability to evaluate associated mental health outcomes, such as psychological distress, with climate worry may assist in the formation of mitigation strategies to combat future development or worsening of such conditions. Future studies should aim to explore potential causal pathways for the inception of climate worry (e.g., media literacy and climate worry rooted in media use), and outcomes of climate worry (e.g., psychological distress, anxiety, or depression). Future studies may also desire to continue monitoring symptoms of climate worry to see if there is a trend towards increasing or decreasing values as grade level increases or as the years pass if the climate crisis continues to worsen. The results of this paper will contribute to the limited but expanding body of evidence pertaining to climate worry and promote awareness of emerging effects of climate change on youth mental health. While the identified research provides the foundation for the topic of climate worry in youth, many research gaps remain as directions for future research.

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Appendix A

6.1 COMPASS Student Questionnaire (Partial)

The following are the Compass questionnaire (Cq) student questions used in this thesis. The questions are numbered as they are shown within the Cq.

About You

1. What grade are you in?

- Grade 7
- Grade 8
- Grade 9
- Grade 10
- Grade 11
- Grade 12

5. Which gender do you most identify with?

- Girl/Woman
- Non-binary person
- Two-Spirit
- Boy/Man
- I describe my gender differently
- I prefer not to say

6. Which race Category best describes you?

- Black
- East Asian
- Indigenous (First Nations (status or non-status), Metis, Inuk/Inuit)
- Latino
- Middle Eastern
- South Asian
- Southeast Asian
- White
- Another category
- I do not know
- I prefer not to answer

12. would you say that you and your family are more or less financially comfortable than the average student in your class?

- More comfortable
- As comfortable
- Less comfortable

Screen Time and Sleep

20. How much time per day do you usually spend doing the following activities?

For example: if you spend about 3 and a half hours watching TV each day, you will need to enter '3' in the hour box and '30' in the minute box.

	Hours												Minutes				
a) Watching/ streaming TV shows or movies	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45
b) Playing video/ computer games	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45
c) Doing homework	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45
d) Surfing the internet	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45
e) Browsing/ scrolling social media (e.g., Instagram, TikTok)	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45
f) Texting, messaging, emailing (note: 50	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45

texts = 30 minutes)																	
g) Video calling (e.g., FaceTime, Skype, Zoom)	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45

Alcohol and Drug Use

50. In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?

- I have never done this
- I did not have 5 or more drinks on one occasion in the last 12 months
- Less than once a month
- Once a month
- 2 to 3 times a month
- Once a week
- 2 to 5 times a week
- Daily or almost daily

53. in the last 12 months, how often did you use marijuana or cannabis? (*a joint, pot, weed, hash*)

- I have never used marijuana
- I have used marijuana but not in the last 12 months
- Less than once a month
- Once a month
- 2 or 3 times a month
- Once a week
- 2 or 3 times a week
- 4 to 6 times a week
- Every day

Mental Health

66. Over the last two weeks, how often have you been bothered by the following problems?

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a) Feeling nervous, anxious, or on edge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b) Not being able to stop or control worrying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c) Worrying too much about different things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d) Trouble relaxing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e) Being so restless that it is hard to sit still	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f) Becoming easily annoyed or irritable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g) Feeling afraid as if something awful might happen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

68. On how many of the last 7 days did you feel the following ways?

	None or less than 1 day	1 to 2 days	3 to 4 days	5 to 7 days
a) I was bothered by things that usually don't bother me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b) I had trouble keeping my mind on what I was doing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c) I felt depressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d) I felt that everything I did was an effort	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e) I felt hopeful about the future	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f) I felt fearful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g) My sleep was restless	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h) I was happy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
i) I felt lonely	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
j) I could not get "going"	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

69. Please rate how often the following statements are true for you.

	Never	Rarely	Sometimes	Often	Almost always
a) Thinking about climate change makes it difficult for me to sleep	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b) My concerns about climate change interfere with my ability to get work or school assignments done	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c) I try to reduce my behaviors that contribute to climate change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d) I believe I can do something to help address the problem of climate change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Your School and You

71. How strongly do you agree or disagree with each of the following statements?

	Strongly agree	Agree	Disagree	Strongly disagree
a) I feel close to people at my school	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b) I feel I am part of my school	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c) I am happy to be at my school	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d) I feel the teachers at my school treat me fairly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e) I feel safe in my school	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f) Getting good grades is important to me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix B

7.1 Tables

Table app1: Cross table for Depression and Climate Worry Measures on Sleep in the COMPASS Study in the 2022/2023 Cohort

“My sleep was restless”	“Thinking about climate change makes it difficult for me to sleep”									
	Never		Rarely		Sometimes		Often		Almost Always	
	Count	col %	Count	col %	Count	col %	Count	col %	Count	col %
None or less than 1 day	12919	47.4%	1905	35.0%	882	30.2%	223	25.0%	247	31.9%
1-2 days	7156	26.2%	1678	30.8%	882	30.2%	248	27.7%	141	18.2%
3-4 days	3933	14.4%	1020	18.7%	616	21.1%	192	21.5%	114	14.7%
5-7 days	3281	12.0%	840	15.4%	540	18.5%	231	25.8%	272	35.2%

Table app2: Home Life Counts and Percentages by Gender in the COMPASS Study in the 2022/2023 Cohort

Variable of Interest	Cis-Gendered Girl/Woman (n=15,851)		Cis-Gendered Boy/Man (n=14,020)		Gender Diverse (n=1,171)	
	Count	Table %	Count	Table %	Count	Table %
Happy Home Life Strongly Agree	4509	28.5%	6506	43.3%	192	15.4%
Happy Home Life Agree	6118	38.6%	5896	39.0%	382	30.3%
Happy Home Life Neither Agree nor Disagree	3473	21.9%	1868	12.4%	350	27.7%
Happy Home Life Disagree	1303	8.2%	570	3.7%	225	17.8%
Happy Home Life Strongly Disagree	448	2.8%	248	1.6%	114	8.8%

Table app3: Affluence Perceptions by Gender in the COMPASS Study in the 2022/2023 Cohort

Variable of Interest	Cis-Gendered Girl/Woman (n=15,851)		Cis-Gendered Boy/Man (n=14,020)		Gender Diverse (n=1,171)	
	Count	Column %	Count	Column %	Count	Column %
More Affluent than Peers	4153	26.2%	4534	32.3%	238	20.3%
As Affluent as Peers	10124	63.9%	8286	59.1%	676	57.7%
Less Affluent than Peers	1574	9.9%	1200	8.6%	257	22.0%

Table app4: Cannabis Use by Gender in the COMPASS Study in the 2022/2023 Cohort

Frequency of Cannabis Use:	Cis-Gendered Girl/Woman (n=15,851)		Cis-Gendered Boy/Man (n=14,020)		Gender Diverse (n=1,171)	
	Count	Column %	Count	Column %	Count	Column %
I have never used marijuana	11884	75.0%	11027	78.7%	783	66.9%
I have used marijuana but not in the last 12 months	745	4.7%	559	4.0%	71	6.1%
Less than once a month	1355	8.6%	923	6.6%	98	8.4%
Once a month	351	2.2%	244	1.7%	37	3.2%
2 or 3 times a month	465	2.9%	305	2.2%	40	3.4%
Once a week	158	1.0%	130	0.9%	11	0.9%
2 or 3 times a week	256	1.6%	227	1.6%	27	2.3%

4 to 6 times a week	244	1.5%	193	1.4%	30	2.5%
Every day	393	2.5%	412	2.9%	74	6.3%

Table app5: Binge Drinking by Gender in the COMPASS Study in the 2022/2023 Cohort

Frequency of Alcohol Use:	Cis-Gendered Girl/Woman (n=15,851)		Cis-Gendered Boy/Man (n=14,020)		Gender Diverse (n=1,171)	
	Count	Column %	Count	Column %	Count	Column %
I have never done this	9025	56.9%	9066	64.7%	856	67.6%
I did not have 5 or more drinks on one occasion in the last 12 months	1276	8.1%	731	5.2%	90	7.2%
Less than once a month	2858	18.0%	1985	14.1%	153	12.5%
Once a month	1257	7.9%	926	6.6%	54	4.3%
2 or 3 times a month	1070	6.8%	783	5.6%	41	3.3%
Once a week	258	1.6%	292	2.1%	11	0.9%
2 to 5 times a week	84	0.5%	152	1.1%	17	1.4%
Daily or almost daily	23	0.2%	85	0.6%	41	2.9%

Table app6: Model 1 Psychological Distress and Climate Worry Base Regression Model Output in the COMPASS Study in the 2022/2023 Cohort Without Covariates

	Estimate	Std. Error	Pr(> t)
(Intercept)	5.09	0.33	<0.05
Climate Worry	1.48	0.04	<0.05
Adjusted R-squared:	0.05098		

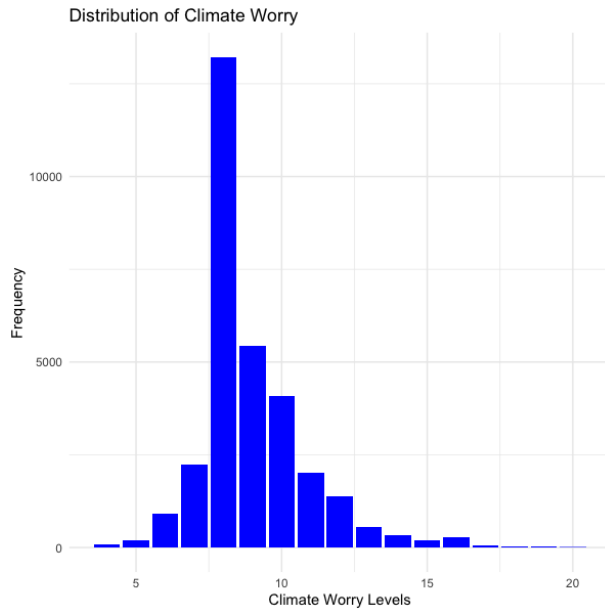
Table app7: Models 3, 5, 7 Psychological Distress and Climate Worry Base Regression Model Output in the COMPASS Study in the 2022/2023 Cohort for Cis-Gendered Boys, Cis-Gendered Girls, and Gender Diverse Individuals

	Model 3: Cis-Gendered Boys			Model 5: Cis-Gendered Girls			Model 7: Gender Diverse		
	Estimate	Std. Error	Pr(> t)	Estimate	Std. Error	Pr(> t)	Estimate	Std. Error	Pr(> t)
Intercept	4.6	0.4	<0.05	11.9	0.5	<0.05	15.4	1.5	<0.05
Climate Worry	1.0	0.05	<0.05	1.1	0.05	<0.05	1.3	0.1	<0.05
Adjusted R-Squared	0.03			0.03			0.07		

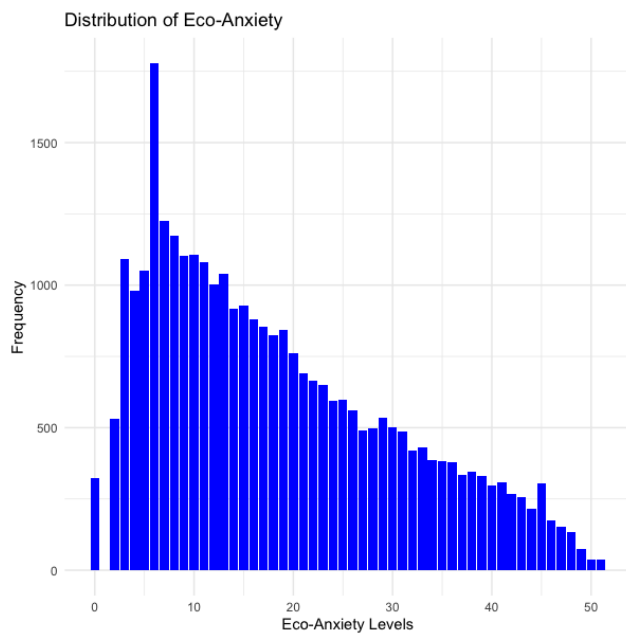
Appendix C

8.1 Figures

8.1.1 Figure 3: Distribution of Climate Worry in the COMPASS Study in the 2022/2023 Cohort



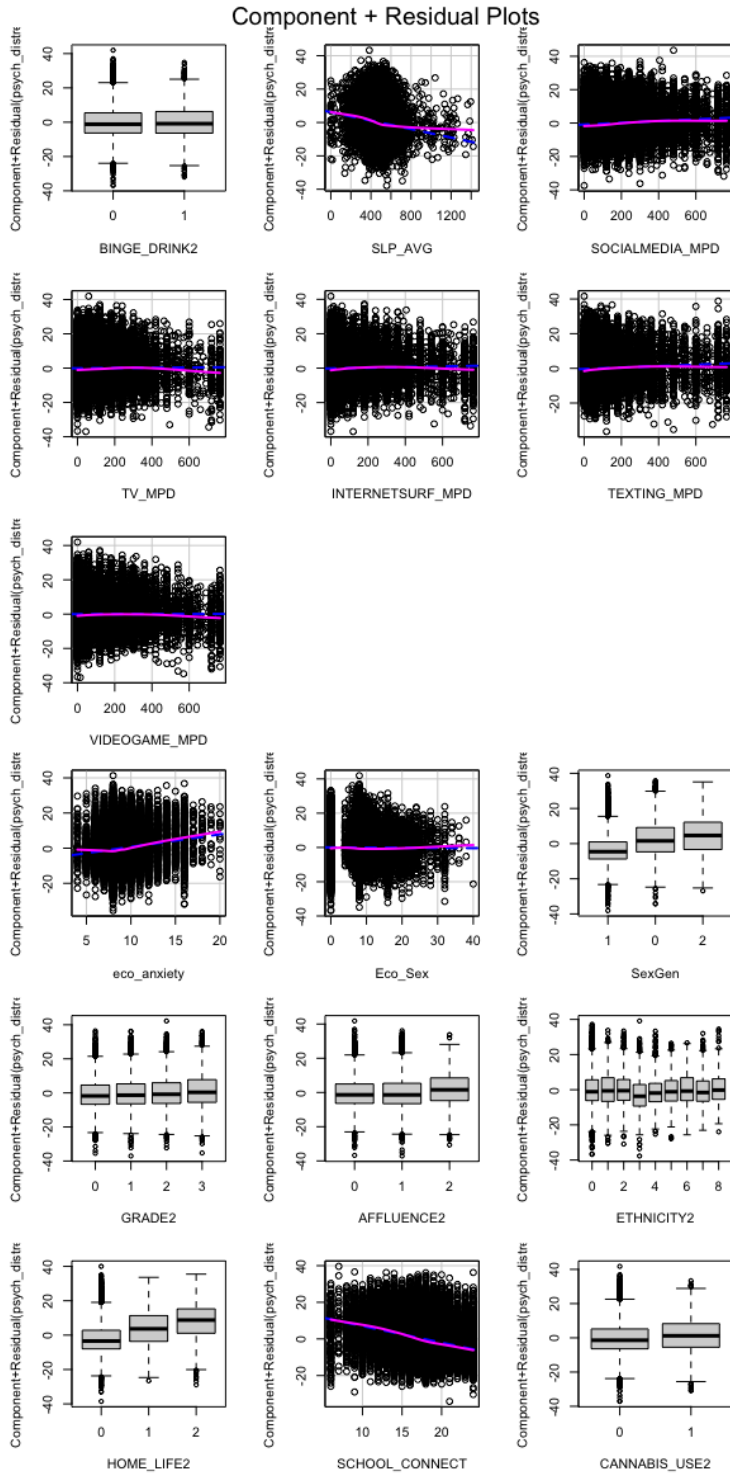
8.1.2 Figure 4: Distribution of Psychological Distress in the COMPASS Study in the 2022/2023 Cohort



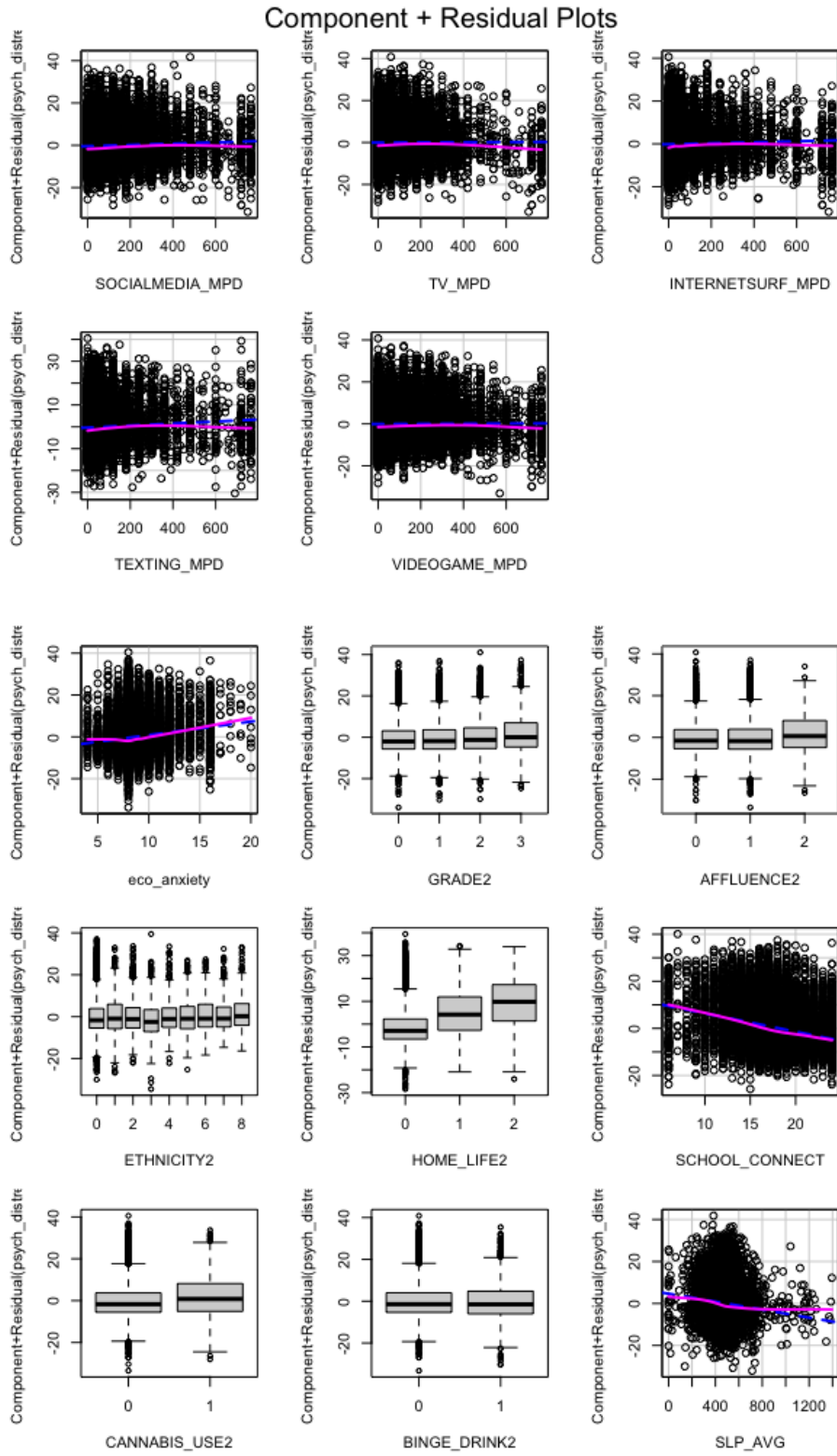
Appendix D

9.1 Residuals for Model Results Tables 3 and 4

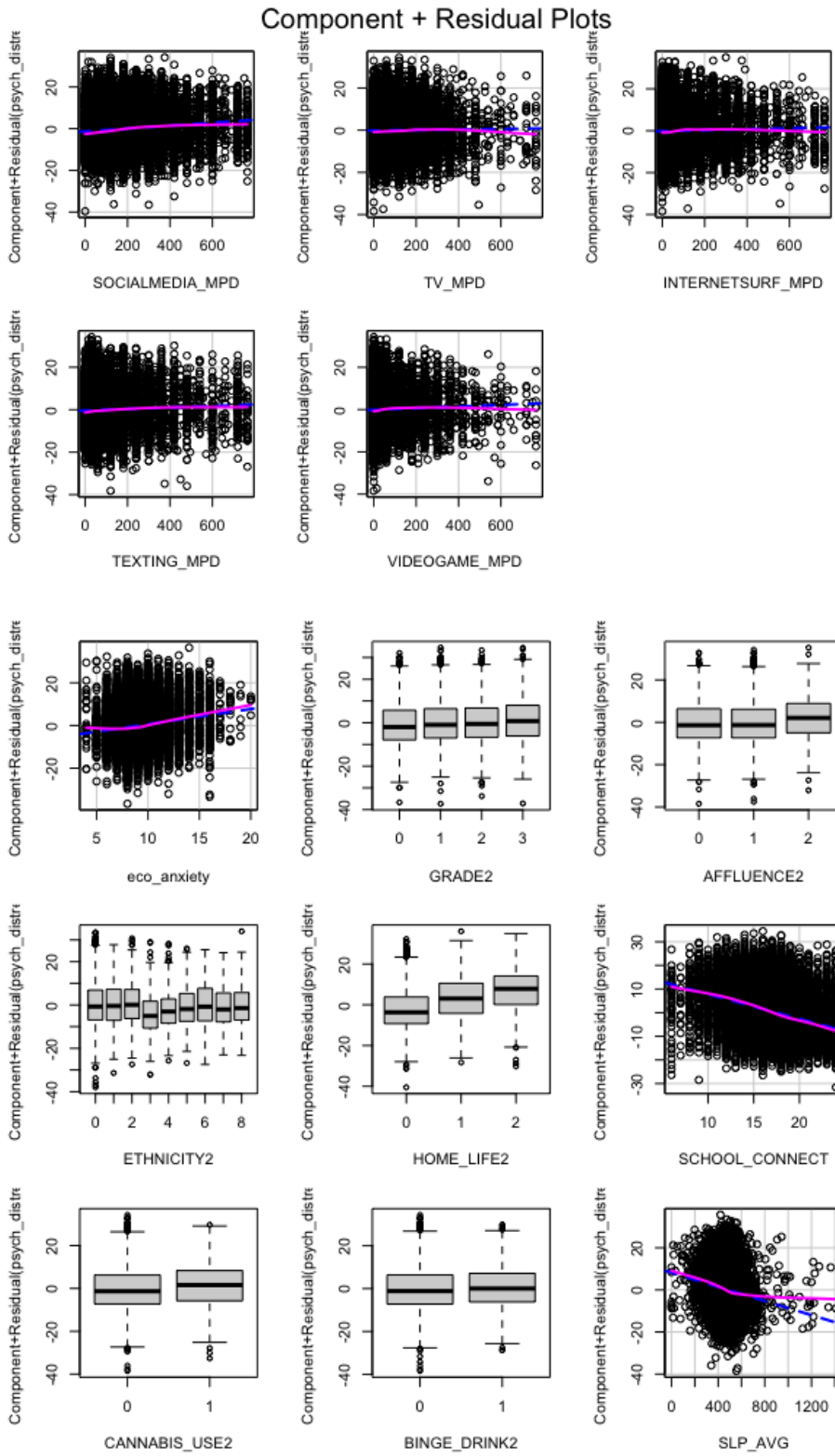
9.1.1 Figure 5: Table 3 Model 2



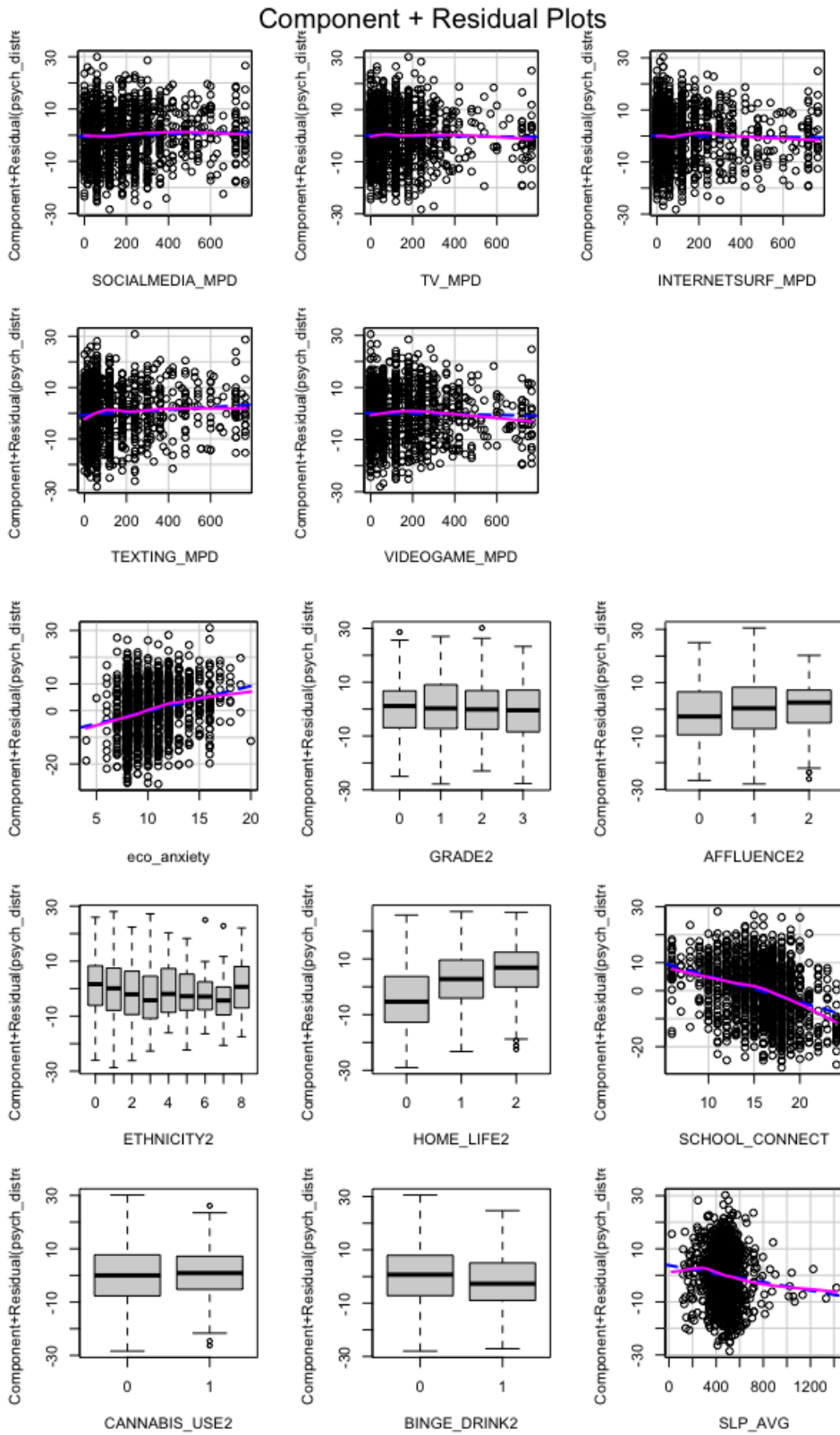
9.1.2 Figure 6: Table 4 Model 4



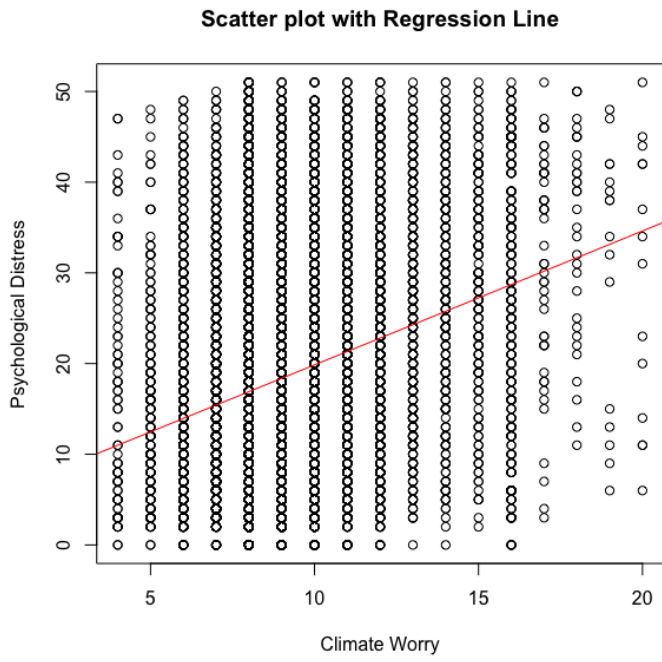
9.1.3 Figure 7: Table 4 Model 6



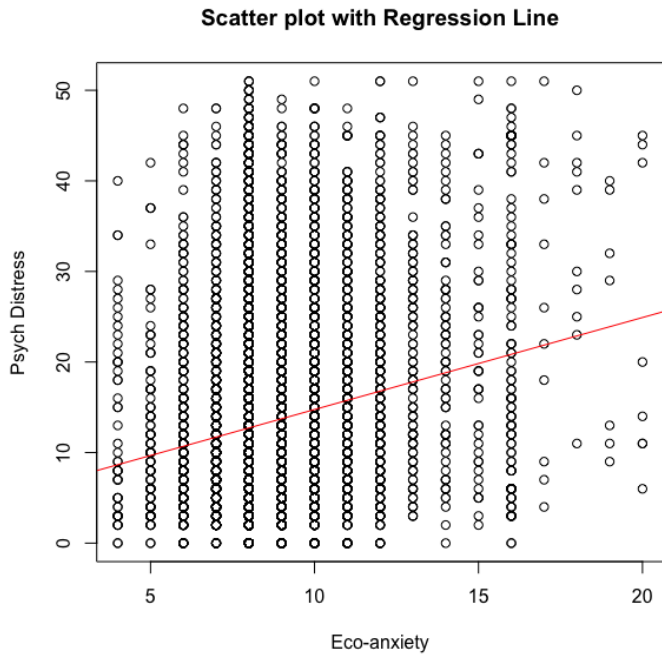
9.1.4 Figure 8: Table 4 Model 8



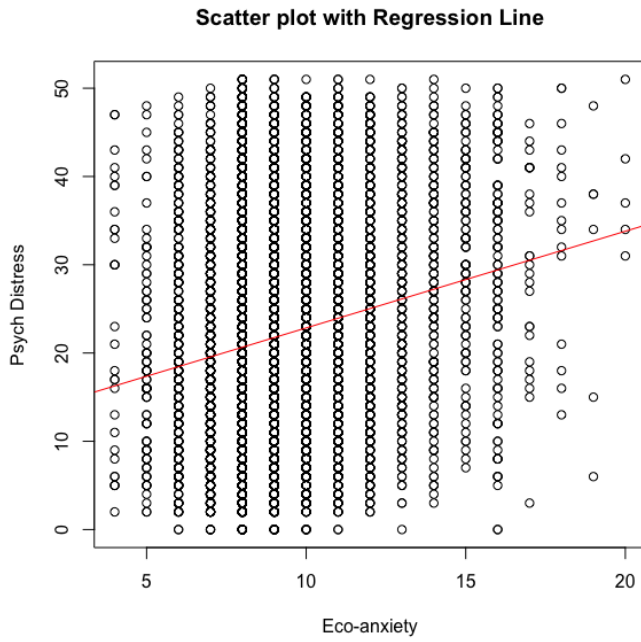
9.1.5 Figure 9: Table app6 Model 2



9.1.6 Figure 10: Table app7 Model 3



9.1.7 Figure 11: Table app7 Model 5



9.1.8 Figure 21: Table app7 Model 7

