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Interrelationships among depression, anxiety, flourishing, and cannabis use in youth

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**Abstract**

**Aims:** The objective of the study was to examine if depression or anxiety was associated with youth cannabis use; and investigate whether flourishing moderates these associations.

**Methods:** Students (N=8179) were recruited from 10 secondary schools (grade 9-12) in Ontario and British Columbia, Canada Self-report questionnaires were used to assess symptoms of depression [CESD-R-10], anxiety [GAD-7], flourishing [Deiner's Flourishing Scale] and cannabis consumption using measures that assess cannabis ever use and frequency of use. Logistic regression and product-term

interactions were used to examine the associations between mental health and youth cannabis use, and the potential moderating effect(s) of flourishing.

**Results:** In our sample, 33% of participants had ever used cannabis, 51% and 38% reported elevated depressive and anxiety symptoms, respectively. Associations between depression, anxiety, and cannabis use were no longer significant when flourishing was added to the models. In addition, there was no evidence suggesting a moderating effect of flourishing as all interactions were not statistically significant. Instead, robust associations were found between flourishing and cannabis use : mental health and cannabis ever use, mental health and cannabis use frequency.

**Conclusions:** Indicators of mental wellbeing, such as flourishing, appear to be associated with a lower likelihood of cannabis use, even after controlling for depression and anxiety. Results suggest prevention strategies for youth cannabis use should aim to foster mental wellbeing among all youth, rather than exclusively targeting those experiencing mental health problems. Future longitudinal studies should test the sequential relationship between cannabis use and changes in both positive and negative mental health.

**Keywords:** Cannabis; Youth; Mental health; Flourishing; Anxiety; Depression

## INTRODUCTION

Nearly 1 in 4 Canadian youth aged 15 and 17 years have experimented with cannabis at least once in their lifetime, making cannabis the most widely used illicit drug by young Canadians (1). The Government of Canada has initiated the process to legalize cannabis leading many to express concerns pertaining to new regulations and the impact this may have on youth development (2). Despite the minimum age to purchase cannabis under the federal law has been determined as 18 years, research has demonstrated that a temporary increase in use among youth populations is probable (3–5).

While negative repercussions associated with cannabis can occur at any age, youth are at an increased risk as the brain is exceptionally susceptible to adverse effects during this stage of development (6–9). Youth are at a disproportionate risk for addiction (10), developing a cannabis use disorder (11), and impaired reckless driving with fatal outcomes (12–14). One of the leading concerns has been the association between cannabis use and mental health. Research shows that the risk of developing substance use disorders is doubled in people with mental illnesses compared to the general population, and at least 20% of people with a mental illness have a co-existing substance use problem (15). Moreover, frequent cannabis exposure at a young age is correlated with an increased risk and earlier onset of mental illness (16–19). Patton and colleagues (16) identified a dose-response relationship where frequency of cannabis use predicted later depression and anxiety in adolescent girls, with daily use presenting the highest risk. Prior to the legislation surrounding cannabis being enacted, important questions remain about current cannabis use among Canadian youth and the correlation to other common health-related concerns. Of particular concern to public health professionals, is the link between cannabis use and mental illnesses, specifically depression and anxiety.

Available literature has highlighted a presumable association where cannabis users have been found to experience poorer mental health (16,20–23), however, there is limited knowledge related to the patterns and frequency of youth cannabis use and possible factors associated with initial uptake. Moreover, critical research gaps remain in how positive aspects of wellbeing, such as flourishing or resilience, may co-exist and serve as a protective measure against the use of cannabis in high-risk populations. Flourishing is defined as the presence of positive mental health inclusive of emotional, psychological and social prosperity and is a good indicator overall wellbeing (24–26). A greater understanding of how mental health and aspects of wellbeing are correlated with youth cannabis use is warranted to inform future prevention strategies, and in turn, minimize latent health consequences that may accompany the legalization of cannabis in Canada. While there is currently limited research examining the association between mental health and cannabis use in youth, this has been identified more recently as a leading public health concern made evident by new federal investments providing the *Mental Health Commission of Canada* and the *Canadian Centre on Substance Use and Addition* with funding budgets to explore this relationship.

Developing a more robust understanding of the associations between youth cannabis use and mental health would be valuable in helping to inform the pending legalization of cannabis in Canada. This manuscript will examine the association between mental health and cannabis use among youth using the pilot data from the Mental Health Module (MH-M) of the COMPASS study. Specifically, we aim to examine if depression or anxiety symptoms are associated with cannabis use among secondary school students, and whether flourishing acts as a protective factor to moderate this correlation.

## METHODS
### Design

The COMPASS Study (COMPASS) is a longitudinal, prospective cohort study (2012-2021) that collects data from students in grades 9 to 12 attending participating secondary schools across Canada (27). During the COMPASS year 5 (Y₅[2016-2017]) data collection, a new module was included to measure student mental health, given that schools participating in the earlier waves of COMPASS identified this as a priority area that was missing from the survey tools. As such, this paper uses the new student-level data collected from students attending 10 COMPASS schools who participated in the MH-M pilot. In this pilot, the only change to the study protocol was that the student questionnaire included eight new additional subsections about youth mental health as a supplement within the original student questionnaire (27). A complete description of COMPASS methods is available in print (27) or online (www.compass.uwaterloo.ca). Researchers may access COMPASS data by completing an online application form (https://uwaterloo.ca/compass-system/information-researchers). COMPASS received ethics approval from the University of Waterloo Human Research Ethics Committee and all participating school boards.

**Sample**
Data were collected from 8,179 students attending selected secondary schools in British Columbia (N=5) and Ontario (N=9), Canada. Specific schools were recruited to participate in the pilot stage of the mental health module during year 5 of the COMPASS data collection based on expressed interests in the mental health data. This recruiting strategy allowed for a diversified population and comparisons across jurisdictions. Students were recruited using an active-information passive-consent protocol (27), a strategy shown to be important for collecting robust data on self-reported risk behaviours such as substance use among youth (28–31). A complete-case analysis was used for this manuscript and a total of 8,040 students were included in the analysis.

**Measures**
*Outcome variable - Cannabis use*
Consistent with previous research (32), cannabis use was assessed by asking students "In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash)". Binary outcome responses were recoded into "never users" if the student had never used cannabis, and all other responses were coded as "ever users". For ordinal responses, cannabis use frequency was recoded into "never," if students had never used cannabis, "rare/sporadic" if respondents used cannabis less than once a month, "monthly" if reported use was once to 3 times per month, "weekly" if use ranged from 1 to 3 times a week, "habitual" if reported use was 4 to 6 times a week, and "daily".

*Explanatory variable - Depressive and anxiety symptoms*
Youth depressive symptoms were assessed using *the Center for Epidemiologic Studies Depression Scale (Revised)-10 (CESD-R10*; (33)). This scale was designed to assess self-reported symptoms of depression by asking respondents about feelings of sadness, loss of interest, and difficulties sleeping, making decisions and concentrating over a 1-week period, and has been validated in both adolescent and adult populations (33–35). Internal consistency of the CESD-R-10 scale was high ($\alpha = 0.983$). Symptoms of anxiety were measured using the *Generalized Anxiety Disorder 7-item Scale (GAD-7;* (36)). The GAD-7 reports on self-perceived feelings of worry, fear, and irritability over a 2-week period of time and has been validated for youth populations. The GAD-7 had an alpha coefficient of 0.986. The CESD-R-10 and GAD-7 scales were fit as categorical variables for each model. Consistent with other research, this study used scores ≥10 for both depression (35) and anxiety (36) to establish the presence of mental health

problems and applied a binary coding system to categorize students with and without clinically relevant symptoms (control=0, depression and/or anxiety=1).

*Moderating variable- Flourishing*
Levels of psychosocial prosperity and wellbeing among students was measured using *Diener's Flourishing Scale (FS;* (25)). This scale assessed how respondents perceived their relationships, life purpose and satisfaction, engagement and interest with daily activities, self-esteem and competence, and optimism to provide a score that represents overall psychological wellbeing, or flourishing. To maintain suitability for large school-based studies among youth and consistency with other questions in the COMPASS MH-M (37), the original 7-point Likert scale was reduced to a 5-point response option with total scores ranging from 8 to 40. The FS measures wellbeing on a flourishing-languishing continuum and all item statements are positively framed (25). To remain consistent with the other mental health measures used in this study, where higher scores indicated greater symptoms of mental health problems, the FS was reverse coded and high scores represent languishing (poor wellbeing).

*Covariates*
Covariates were included to reduce potential confounding and are as follows: Grade (9, 10, 11, 12); sex (female, male); ethnicity (White, Black, Asian, Aboriginal [First Nations, Métis, Inuit], Latin American or Hispanic, Mixed/Other); weekly spending money ($0, $1-$20, $21-$100, more than $100, I don't know); truancy (no skipped classes, 1 or more missed classes per week), binge drinking (non-current binge drinker, current binge drinker [reported consuming 5 or more alcoholic beverages in the past month]) and smoking status (non-smoker, current smoker [reported smoking one or more cigarettes in the past month]).

**Analysis**
All analyses were conducted in SAS 9.4. *Ever use* of cannabis (dichotomous dependent variable) was fit using logistic models and cannabis use frequency (ordinal dependent variable) was fit using ordinal logistic regression models. The explanatory variables were fit as dichotomous variables using the predetermined thresholds that are used to classify clinically relevant symptoms of depression and anxiety. To help with the interpretation of the results, we used a stepwise modeling approach: 1) the main effects of depression and anxiety were tested, 2) flourishing was added and main effects tested, and 3) inclusion of 2-way and 3-way interactions among depression, anxiety, and flourishing to test for moderation. Using a stepwise modeling approach, we were able to demonstrate and evaluate significant changes and interactions after including each variable. In addition to the 6 logistic models reported on, depression and anxiety variables were separately fit as continuous variables in these models to triangulate our results.

**RESULTS**
*Sample Characteristics*
Demographic characteristics for the total sample (n=8,040) can be found in Table 1. Among participating students, 33% reported ever using cannabis, and 7% were daily users. Depression and anxiety (scores ≥ 10) was reported by 51% and 38% of students, respectively, and showed increased prevalence in older grades. As shown in Figure 1 and Figure 2, the same trend was demonstrated for continuous measures of depression and anxiety for grade level. Consistent with available literature (38), co-occurring mental health problems were common, as 86% of students reporting depression also reported having anxiety. The mean flourishing score was 16.6 (SD 5.87) and similarly, declined with grade level (Figure 3). The

majority of the sample reported their ethnicity as White (71.0%), and 50.8% were female. Descriptive results stratified by sex (Table 1) demonstrate female cannabis use was more likely to be sporadic and monthly, while male cannabis use was more likely to be weekly, habitual or daily. Additionally, females were more apt to report depression, anxiety, and lower flourishing levels compared to males.

As shown in Table 2, cannabis ever use was lowest among grade 9 students (14.4%), and the prevalence nearly doubled in grade 10 students (27.9%). A similar trend was observed for all frequency levels (Table 3). Compared to never users, cannabis ever users were more likely to smoke (29.4% vs 1.8%), binge drink (75.5% vs 18.1%), be depressed (61.0% vs 46.2%), be anxious (46.1% vs 34.1%), and report lower flourishing scores (17.9 vs 16.0). The frequency of clinically relevant symptoms of depression and anxiety, current smoking, and current binge drinking, was higher with more frequent cannabis use. Moreover, daily users had the highest frequency of depressive (72.9%) and anxiety (60.4%) symptoms, current smoking (65.9%), current binge drinking (87.3%), and reported the poorest flourishing scores (20.8).

*Main Effects and Interactions*
Results for the comprehensive models that included all interaction terms (model 3 and model 6) are shown in Table 4 and Table 5. For all comprehensive models, flourishing was the only variable associated with cannabis ever use and frequency of use, whereby increases on the flourishing-languishing continuum (higher scores reflect languishing) were associated with more frequent cannabis use. As seen in Table 4, for every one-unit increase on the flourishing scale, the likelihood of cannabis ever use increases B=0.040, SE=0.012, *p≤0.01*. Whereas depression was found to be associated with cannabis ever use (B=0.281, SE=0.078, *p≤0.01*) in model 1, neither depression nor anxiety were significantly associated with cannabis ever use after including flourishing in model 2 and 3. Table 5 demonstrates that for that for every unit increase on the flourishing scale, the likelihood of cannabis use frequency increases B=0.042, SE=0.010, p<0.001. While depression (B=0.287, SE=0.068, p<0.001) and anxiety (B=0.239, SE=0.068, p≤0.01) were found to be associated with cannabis ever use in model 4, neither were associated with the frequency of cannabis use after including flourishing in model 5 and 6. Moreover, after including flourishing in the final models, there were no significant 2-way or 3-way interactions identified in our complete analysis. The 6 models yielded concordance statistic ranging between 0.852-0.881, suggesting all models within our analysis were a good fit. As expected, binge drinking, smoking and truancy were significantly associated with an increased risk of cannabis use in all models. Triangulation of the models, using continuous depression and anxiety explanatory variables, confirmed our expectations and results were consistent with the binary models in that depression and anxiety were no longer significantly associated after including flourishing in the models and there were no significant interactions. As these results were primarily used to validate our results, they are not presented throughout this manuscript.

**DISCUSSION**
*Cannabis use and mental health in Canadian youth*
This study examined the association between mental health and cannabis use within secondary school students in Ontario and British Columbia, Canada. Overall, cannabis use and depressive and anxiety symptoms were common among youth. Half of the students in our study scored above the accepted threshold for depression and over one third for anxiety. Results demonstrate that depression, anxiety, and languishing all increase with grade level. Consistent with previous research, females were more

likely to experience depression and anxiety (39), and the majority of youth with depression had co-occurring anxiety (40,41). Co-occurring depression and anxiety have been identified to be highly prevalent in adolescent substance users and are typically more severe and problematic (40,42,43). Additionally, one third of the students in our study had tried cannabis at least once and nearly 10% indicated using cannabis at least once a week. Consistent with previous research, youth who use cannabis were substantially more likely to engage in alcohol and tobacco use (44). On average, cannabis users in our study were upwards of 10 times more likely to smoke and 7 times more likely to binge drink. The frequency of cannabis use was directly related to these risk factors, by which daily cannabis users were the most likely report smoking and/or binge drinking compared to all other levels of frequencies measured. Our findings align with other research (43) that suggests adolescence is the peak age for cannabis uptake as we observed a significant increase in cannabis ever use between grade 9 and grade 12 and found that older students used cannabis at higher frequencies. Descriptive analysis identified the largest increase in depression, anxiety and cannabis use within grade 10 students, suggesting this may be critical period for interventions and prevention strategies.

*Research Implications*
Findings of this study are particularly novel in which it identified that flourishing appears to mitigate potential negative associations between depression and/or anxiety and youth cannabis use. This has not yet been demonstrated previously in the literature, and most evidence suggests there is a link between depression, anxiety and cannabis use (16,45–47). Although we did find depression and anxiety to be significantly correlated with cannabis use in some of our analyses, our stepwise modelling approach helped illustrate that these associations were no longer significant after including flourishing within our models. Our results suggest that higher flourishing may result in lower cannabis use regardless of having high depression or anxiety symptoms. While findings from this study are preliminary, they fill a crucial knowledge gap within research, practice, and clinical domains and may present significant implications for innovative and universal prevention approaches using indicators of mental wellbeing to reduce youth substance use.

This study focused on exploring flourishing as a moderator. While this was not evident, our results suggest that flourishing acts as a dominant confounding variable in the association between depression and anxiety, and cannabis use. We are unaware of any research that has controlled for mental wellbeing when exploring this association, and therefore, available evidence may not represent accurate findings between cannabis use and depression and anxiety. Future research and large surveillance tools should aim to measure and control for positive mental health given its large confounding effects. Lastly, longitudinal research is required to inform the temporal sequence and the direction of effect between mental health and cannabis use. Considering COMPASS has now incorporated the MH-M in all data collections in wave 6 ($Y_6$[2017-2018]), it will soon be possible for future COMPASS studies to examine the relationship between depression, anxiety, and cannabis use and the role of flourishing over time once longitudinal mental health data become available. Consistent with this study, additional analysis will also be conducted to see if flourishing has a similar effect in other substance use domains including tobacco and alcohol. As cannabis use has been found to increase with age (3,48), reproducing this study in young adults may also provide valuable insight for prevention and intervention programs that are targeted at an older population, such as university and college students.

*Practice and School-based Implications*

Flourishing appears to be protective against substance use for all youth regardless of depression or anxiety symptoms. Consistent with more recent literature (49–51) this suggests that a universal approach to fostering mental wellbeing and building resilience among all youth in schools should be a leading priority and may be more effective at reducing substance use rather than intervention strategies targeting individuals with mental illness. A systematic review of universal, school-based substance use interventions, demonstrated that intervention type and approach as well as setting is important for long-term effects (52). Interventions were most effective when programs addressed resilient-protective factors as part of a multidimensional intervention approach that targeted broader individual resilience factors (e.g., social, emotional and cognitive competencies, self efficacy and regulation, academic achievement) as well as environmental resilience factors (e.g., school connectedness, community participation and support, parent support and involvement) (52). The same long-term effects were seen in universal-only approaches as well as interventions that were implemented within a school setting (52).  As abstinence-focused interventions targeting substance use have been shown to be ineffective (53,54), it is crucial to consider prevention programs that do not inherently target substance use, rather upstream factors such as flourishing and resilience, that contribute to overall wellbeing.  Researchers expect cannabis uptake in Canadian youth to follow a similar trajectory to what has been observed in other jurisdictions (e.g. Colorado, Washington State) that have legalized cannabis (3–5). Longitudinal research examining how flourishing is related to different substance use trajectories will produce valuable prevention planning insight moving forward.


*Clinical Implications*

Our results demonstrate the importance of fostering good mental wellbeing to mitigate the use and misuse of cannabis in secondary school students. There would be great value in replicating this study on other substance use outcomes, and using clinical-based data that uses true diagnostic criteria for mental disorders. Personality-targeted interventions have also shown to be effective at reducing cannabis use within high-risk adolescents (55). A study conducted in the UK secondary schools found that targeted-interventions that provide personality-specific coping skills relative to the individual, resulted in significant reductions of cannabis use in high-risk youth after a 2-year follow-up (55). Prevention-intervention approaches used within this study included sessions that promoted positive coping behaviours and goal-setting, as well as evaluating cognitive-behavioural components. Given the resources and training that were required for school staff, this approach may be more appropriately implemented at the clinical level. Research should continue to reference previous studies that have explored domains similar to flourishing such as resilience, coping, and other domains of psychosocial wellbeing to inform future substance use prevention strategies.


*Strengths and Limitations*

This study is not without limitations. Foremost, our results were cross-sectional, and as such, causality and temporality of our findings cannot be inferred. However, given the nature of the pilot study, an initial cross-sectional analysis was warranted to evaluate the prevalence of mental health problems and inform future longitudinal studies using data from the COMPASS MH-M. Secondly, all measures included in our analyses were self-reported and are subject to social desirability bias and recall bias. The biases mentioned allow for potential misclassification of both the exposure and outcome and could lead to our results underestimating the association between depression, anxiety, flourishing and cannabis use in youth. Moreover, by employing a complete-case analysis, our results may underestimate the true association as unreported/missing data may be more likely among students with mental health problems and who use cannabis. It is important to note that mental health data were measured using

scales and not diagnostic criteria. While self-reported data does come with limitations, COMPASS ensures confidentiality of data through autotomized student surveys and utilizes a passive consent protocol to reduce the effects of information bias (social desirability and recall bias) and missing data. If available, future analyses might consider including additional measures such as parental factors, risk seeking behaviours and sexual health, as well as exploring this relationship longitudinally.

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**FIGURES/TABLES**

Table 1. Sample Descriptive by Sex*

| | | Female (n=4083) | Male (n=3957) | |
|---|---|---|---|---|
| | | % (n) | % (n) | Test Statistic, P-value |
| Grade | 9 | 27.6 (1127) | 29.4 (1163) | 8.57, 0.036 |
| | 10 | 30.4 (1240) | 28.6 (1131) | |
| | 11 | 23.4 (957) | 24.9 (985) | |
| | 12 | 18.6 (759) | 17.1 (678) | |
| Ethnicity | White | 70.5 (2742) | 71.4 (2680) | 30.60, <0.001 |
| | Black | 2.0 (79) | 3.3 (122) | |
| | Asian | 10.8 (421) | 9.8 (367) | |
| | Aboriginal | 2.0 (77) | 2.3 (86) | |
| | Latin American/Hispanic | 2.4 (95) | 3.4 (129) | |
| | Mixed/Other | 12.3 (476) | 9.8 (368) | |
| Province | Ontario | 55.8 (2279) | 57.5 (2277) | 2.44, , 0.12 |
| | British Columbia | 44.2 (1804) | 42.5 (1680) | |
| Weekly spending money | $0 | 13.2 (537) | 17.1 (692) | 64.18, <0.001 |
| | $1-$20 | 28.0 (1138) | 26.4 (1038) | |
| | $21-$100 | 26.8 (1091) | 23.3 (917) | |
| | >$100 | 17.9 (726) | 21.6 (847) | |
| | I don't know | 14.1 (571) | 11.1 (437) | |
| Truancy | No skipped class | 58.3 (2349) | 61.2 (2377) | 7.27, 0.007 |
| | 1 or more | 41.7 (1682) | 38.8 (1504) | |
| Smoking Status | Non-smoker | 89.7 (3648) | 88.7 (3498) | 1.92, 0.17 |
| | Current Smoker | 10.3 (420) | 11.3 (445) | |
| Binge Drinking | Non-binge drinker | 62.7 (2554) | 63.9 (2520) | 1.16, 0.28 |
| | Current Binge drinker | 37.3 (1518) | 36.1 (1425) | |
| Depression (CESD-R-10) | No Depression | 41.1 (1679) | 57.1 (2261) | 206.31, <0.001 |
| | Depression (≥0) | 58.9 (2404) | 42.9 (1696) | |
| Anxiety (GAD-7) | No Anxiety | 52.3 (2137) | 71.9 (2846) | 327.06, <0.001 |
| | Anxiety (≥10) | 47.7 (1946) | 28.1 (1111) | |
| Flourishing (FS) ** | Mean Score (SD) | 17.2 (5.97) | 16.0 (5.70) | 8.70, <0.001 |
| Cannabis Ever Use | Never Use | 67.5 (2758) | 67.3 (2664) | 0.05, 0.83 |
| | Ever Used | 32.5 (1325) | 32.7 (1293) | |
| Cannabis Use *** | Never Use | 67.6 (2578) | 67.3 (2664) | 62.93, <0.001 |
| | Sporadic/Rare Use | 18.0 (736) | 14.9 (589) | |
| | Monthly Use | 7.7 (315) | 6.7 (267) | |
| | Weekly Use | 3.0 (124) | 4.2 (167) | |
| | Habitual use | 1.1 (45) | 2.6 (102) | |
| | Daily use | 2.6 (105) | 4.3 (168) | |

*Complete case analysis only. Students with missing data for sex, grade and cannabis use were removed from analysis

** Higher scores are indicative of higher languishing/lower flourishing (FS scores range from 8-40)

***Numbers may not add to total sample due to missing data

Table 2. Sample Descriptive by Cannabis Ever Use

| | | Full sample (N=8040) | Never Users (N=5422) | Ever Users (N=2618) | |
|---|---|---|---|---|---|
| | | % (n) | % (n) | % (n) | Test Statistic, P-value |
| Sex | Female | 50.8 (4083) | 50.8 (2758) | 50.6 (1325) | 0.05, 0.83 |
| | Male | 49.2 (3957) | 49.2 (2664) | 49.4 (1293) | |
| Grade | 9 | 28.5 (2290) | 35.3 (1913) | 14.4 (377) | 520.22, |
| | 10 | 29.5 (2371) | 30.3 (1642) | 27.9 (729) | <0.001 |
| | 11 | 24.1 (1942) | 20.8 (1130) | 31.0 (812) | |
| | 12 | 17.9 (1437) | 13.6 (737) | 26.7 (700) | |
| Ethnicity | White | 71.0 (5422) | 69.3 (3562) | 74.3 (1860) | 206.22, <0.001 |
| | Black | 2.6 (201) | 2.1 (111) | 3.6 (90) | |
| | Asian | 10.3 (788) | 13.4 (688) | 4.0 (100) | |
| | Aboriginal | 2.1 (163) | 1.4 (71) | 3.7 (92) | |
| | Latin American/Hispanic | 2.9 (224) | 3.0 (155) | 2.8 (69) | |
| | Mixed/Other | 11.1 (844) | 10.8 (553) | 11.6 (291) | |
| Province | Ontario | 56.7 (4556) | 56.5 (3062) | 57.1 (1494) | 0.25, 0.62 |
| | British Columbia | 43.3 (3484) | 43.5 (2360) | 42.9 (1124) | |
| Weekly spending money | $0 | 15.3 (1229) | 18.8 (1012) | 8.3 (217) | 506.15, <0.001 |
| | $1-$20 | 27.2 (2176) | 30.5 (1642) | 20.5 (534) | |
| | $21-$100 | 25.1 (2008) | 22.9 (1237) | 29.6 (771) | |
| | >$100 | 19.8 (1573) | 14.0 (756) | 31.4 (817) | |
| | I don't know | 12.6 (1008) | 13.8 (743) | 10.2 (265) | |
| Truancy | No skipped class | 59.7 (4726) | 73.4 (3920) | 31.3 (806) | 1277.38, |
| | 1 or more | 40.3 (3186) | 26.6 (1420) | 68.7 (1766) | <0.001 |
| Smoking Status | Non-smoker | 89.2 (7146) | 98.2 (5307) | 70.6 (1839) | 1387.65, |
| | Current Smoker | 10.8 (865) | 1.8 (99) | 29.4 (766) | <0.001 |
| Binge Drinking | Non-binge drinker | 63.3 (5074) | 81.9 (4436) | 24.5 (638) | 2495.02, |
| | Current Binge drinker | 36.7 (2943) | 18.1 (978) | 75.5 (1965) | <0.001 |
| Depression (CESD-R-10) | No Depression | 49.0 (3940) | 53.8 (2919) | 39.0 (1021) | 155.52, <0.001 |
| | Depression (≥10) | 51.0 (4100) | 46.2 (2503) | 61.0 (1597) | |
| Anxiety (GAD-7) | No Anxiety | 62.0 (4983) | 65.9 (3571) | 53.9 (1412) | 106.58, <0.001 |
| | Anxiety (≥10) | 38.0 (3057) | 34.1 (1851) | 46.1 (1206) | |
| Flourishing (FS) (8-40) | Mean Score (SD) | 16.6 (5.87) | 16.0 (5.55) | 17.9 (6.29) | -13.57, <0.001 |

Table 3. Sample Descriptive by Frequency of Cannabis Use

| | | Never (N=5422) | Sporadic (N=1325) | Monthly (N=582) | Weekly (N=291) | Habitual (N=147) | Daily (N=273) | |
|---|---|---|---|---|---|---|---|---|
| | | % (n) | % (n) | % (n) | % (n) | % (n) | % (n) | Test Statistic, P-value |
| Sex | Female | 50.9(2758) | 55.6(736) | 54.1(315) | 42.6(124) | 30.6(45) | 38.5(105) | 62.93, <0.001 |
| | Male | 49.1(2664) | 44.4(589) | 45.9(267) | 57.4(167) | 69.4(102) | 61.5(168) | |
| Grade | 9 | 35.3(1913) | 14.6(193) | 14.4(84) | 15.1(44) | 12.9(19) | 13.6(37) | 541.92, <0.001 |
| | 10 | 30.3(1642) | 27.7(367) | 24.6(143) | 31.6(92) | 34.7(51) | 27.8(76) | |
| | 11 | 20.8(1130) | 29.4(390) | 36.1(210) | 29.2(85) | 31.3(46) | 29.7(81) | |
| | 12 | 13.6(737) | 28.3(375) | 24.9(145) | 24.1(70) | 21.1(31) | 28.9(79) | |
| Ethnicity | White | 69.3(3562) | 76.0(965) | 77.4(435) | 68.9(191) | 75.7(109) | 64.3(160) | 296.08, <0.001 |
| | Black | 2.2(111) | 2.0(25) | 3.6(20) | 4.0(11) | 7.6(11) | 9.2(23) | |
| | Asian | 13.4(688) | 4.4(54) | 3.9(22) | 2.9(8) | 2.1(3) | 5.2(13) | |
| | Aboriginal | 1.4(71) | 3.4(43) | 2.9(16) | 5.0(14) | 6.9(10) | 3.6(9) | |
| | Hispanic | 3.0(155) | 2.5(36) | 3.0(17) | 2.2(6) | 0.0(0.0) | 4.0(10) | |
| | Mixed/Other | 10.7(553) | 11.7(147) | 9.2(52) | 17.0(47) | 7.7(11) | 13.7(34) | |
| Province | Ontario | 56.5(3062) | 54.4(721) | 60.0(349) | 59.5(173) | 59.9(88) | 59.7(163) | 7.96, 0.16 |
| | British Columbia | 43.5(2360) | 45.6(604) | 40.0(233) | 40.5(118) | 40.1(59) | 40.3(110) | |
| Weekly spending money | $0 | 18.8(1012) | 8.6(114) | 8.1(47) | 7.9(23) | 4.9(7) | 9.6(26) | 532.96, <0.001 |
| | $1-$20 | 30.4(1642) | 23.1(305) | 18.2(105) | 18.3(27) | 18.6(27) | 16.2(44) | |
| | $21-$100 | 23.0(1237) | 28.4(375) | 33.8(195) | 31.0(90) | 26.9(39) | 26.6(72) | |
| | >$100 | 14.0(756) | 29.4(388) | 31.1(180) | 32.1(93) | 37.9(55) | 37.3(101) | |
| | I don't know | 13.8(743) | 10.5(138) | 8.8(51) | 10.7(31) | 11.7(17) | 10.3(28) | |
| Truancy | No skipped class | 73.4(3920) | 37.5(492) | 29.3(169) | 23.1(66) | 17.4(24) | 21.2(55) | 1329.76, <0.001 |
| | 1 or more | 26.6(1420) | 62.5(819) | 70.7(408) | 76.9(220) | 82.6(114) | 78.8(205) | |
| Smoking Status | Non-smoker | 98.2(5307) | 85.0(1124) | 69.6(403) | 55.2(160) | 41.8(61) | 34.1(91) | 2238.66, <0.001 |
| | Current Smoker | 1.8(99) | 15.0(199) | 30.4(176) | 44.8(130) | 58.2(85) | 65.9(176) | |
| Binge Drinking | Non-binge drinker | 81.9(4436) | 32.5(429) | 18.9(109) | 15.5(45) | 14.3(21) | 12.7(34) | 2571.77, <0.001 |
| | Current Binge drinker | 18.1(978) | 67.5(892) | 81.1(468) | 84.5(245) | 85.7(126) | 87.3(234) | |
| Depression (CESD-R-10) | No Depression | 53.8(2919) | 43.3(575) | 37.8(220) | 36.8(107) | 30.6(45) | 27.1(74) | 186.28, <0.001 |
| | Depression (≥10) | 46.2(2503) | 56.5(750) | 62.2(362) | 63.2(184) | 69.4(102) | 72.9(199) | |
| Anxiety (GAD-7) | No Anxiety | 65.9(3571) | 58.0(768) | 52.1(303) | 54.3(158) | 51.0(75) | 39.6(108) | 141.05, <0.001 |
| | Anxiety (≥10) | 34.1(1851) | 42.0(557) | 47.9(279) | 45.7(133) | 49.0(72) | 60.4(165) | |
| Flourishing (FS) (8-40) | ANOVA Mean (SD) | 16.0 (5.55) | 17.2 (5.75) | 17.6 (5.75) | 18.7 (6.20) | 19.4 (7.20) | 20.8 (8.46) | 56.43, <0.001 |

Table 4. Cannabis Ever Use for grade 9-12 students in year 5 of the mental health pilot of COMPASS (using depression and anxiety threshold measures)

| | | Model 1 Depression and Anxiety | Model 2 Depression, Anxiety and Flourishing | Model 3 2-way and 3-way interactions (final model) |
|---|---|---|---|---|
| | | OR (95%CI) | OR (95%CI) | OR (95%CI) |
| Sex | Female | | | |
| | Male | 1.12 (0.98-1.28) | 1.13 (0.99-1.30) | 1.12 (0.98-1.29) |
| Grade | 9 | | | |
| | 10 | 0.65 (0.54-0.79)** | 0.63 (0.52-0.76)** | 0.63 (0.52-0.76)** |
| | 11 | 0.53 (0.44-0.65)** | 0.52 (0.43-0.64)** | 0.52 (0.43-0.64)** |
| | 12 | 0.52 (0.42-0.64)** | 0.50 (0.41-0.62)** | 0.50 (0.41-0.62)** |
| Ethnicity | White | | | |
| | Black | 1.78 (1.20-2.65)* | 1.89 (1.26-2.85)* | 1.90 (1.26-2.86)* |
| | Asian | 0.33 (0.25-0.43)** | 0.34 (0.25-0.45)** | 0.33 (0.25-0.44)** |
| | Aboriginal | 2.04 (1.34-3.12)* | 2.03 (1.29-3.18)* | 2.02 (1.29-3.16)* |
| | Latin American/Hispanic | 0.88 (0.59-1.30) | 0.91 (0.61-1.36) | 0.91 (0.61-1.36) |
| | Mixed/Other | 1.01 (0.82-1.24) | 1.03 (0.83-1.27) | 1.03 (0.84-1.27) |
| Weekly spending money | $0 | | | |
| | $1-$20 | 1.25 (0.99-1.57) | 1.30 (1.03-1.65) | 1.30 (1.03-1.65) |
| | $21-$100 | 1.44 (1.15-1.81)* | 1.54 (1.22-1.94)* | 1.54 (1.22-1.95)* |
| | >$100 | 1.77 (1.40-2.24)** | 1.79 (1.41-2.29)** | 1.79 (1.41-2.29)** |
| | I don't know | 1.22 (0.94-1.59) | 1.23 (0.93-1.62) | 1.23 (0.94-1.62) |
| Truancy | No skipped class | | | |
| | 1 or more | 2.71 (2.38-3.10)** | 2.61 (2.28-2.99)** | 2.61 (2.28-2.99)** |
| Smoking Status | Non-smoker | | | |
| | Current Smoker | 9.61(7.43-12.42)** | 9.82 (7.48-12.88)** | 9.83 (7.49-12.91)** |
| Binge Drinking | Non-binge drinker | | | |
| | Current Binge drinker | 7.29 (6.38-8.32)** | 7.28 (6.35-8.35)** | 7.34 (6.40-8.42)** |
| **Main Effects** | | B(SE) | B(SE) | B(SE) |
| Depression (Dep) | No Depression | | | |
| | Depression (≥10) | 0.281 (0.078)* | 0.181 (0.083) | -0.050 (0.322) |
| Anxiety (Anx) | No Anxiety | | | |
| | Anxiety (≥10) | 0.167 (0.080) | 0.074 (0.084) | -0.533 (0.529) |
| Flourishing (Flourish) | | | 0.033 (0.007)** | 0.040 (0.012)* |
| **Interactions** | | | | B(SE) |
| Dep*Anx | | | | 1.297 (0.628) |
| Dep*Flourish | | | | 0.009 (0.019) |
| Anx*Flourish | | | | 0.031 (0.033) |
| Dep*Anx*Flourish | | | | -0.065 (0.038) |
| | Concordance statistic | 0.881 | 0.880 | 0.881 |

* p≤0.01, **p<0.001

Table 5. Frequency of Cannabis Use for grade 9-12 students in year 5 of the mental health pilot of COMPASS (using depressive and anxiety threshold measures)

| | | Model 4 Depression and Anxiety | Model 5 Depression, Anxiety and Flourishing | Model 6 2-way and 3-way interactions (final model) |
|---|---|---|---|---|
| | | OR (95%CI) | OR (95%CI) | OR (95%CI) |
| Sex | Female | | | |
| | Male | 1.33 (1.19-1.49)** | 1.33 (1.18-1.50)** | 1.35 (1.18-1.49)** |
| Grade | 9 | | | |
| | 10 | 0.67 (0.57-0.79)** | 0.64 (0.54-0.76)** | 0.64 (0.54-0.76)** |
| | 11 | 0.63 (0.53-0.75)** | 0.61 (0.51-0.73)** | 0.61 (0.51-0.73)** |
| | 12 | 0.61 (0.51-0.73)** | 0.58 (0.48-0.70)** | 0.58 (0.48-0.70)** |
| Ethnicity | White | | | |
| | Black | 2.41 (1.78-3.26)** | 2.53 (1.84-3.47)** | 2.53 (1.85-3.48)** |
| | Asian | 0.39 (0.31-0.51)** | 0.41 (0.31-0.52)** | 0.40 (0.31-0.52)** |
| | Aboriginal | 1.59 (1.15-2.21)* | 1.52 (1.07-2.14)* | 1.51 (1.07-2.13) |
| | Latin American/Hispanic | 0.90 (0.642-1.26) | 0.85 (0.60-1.22) | 0.86 (0.60-1.22) |
| | Mixed/Other | 1.05 (0.88-1.25) | 1.05 (0.88-1.25) | 1.05 (0.88-1.25) |
| Weekly spending money | $0 | | | |
| | $1-$20 | 1.12 (0.91-1.37) | 1.18 (0.95-1.45) | 1.18 (0.95-1.45) |
| | $21-$100 | 1.29 (1.06-1.57)* | 1.41 (1.15-1.73)* | 1.41 (1.15-1.74)* |
| | >$100 | 1.51 (1.23-1.85)** | 1.55 (1.26-1.92)** | 1.56 (1.26-1.92)** |
| | I don't know | 1.17 (0.93-1.48) | 1.19 ()0.94-1.52 | 1.20 (0.94-1.52) |
| Truancy | No skipped class | | | |
| | 1 or more | 2.55 (2.27-2.88)** | 2.45 (2.16-2.76)** | 2.44 (2.16-2.76)** |
| Smoking Status | Non-smoker | | | |
| | Current Smoker | 7.39 (6.32-8.64)** | 7.32 (6.22-9.61)** | 7.32 (6.22-8.62)** |
| Binge Drinking | Non-binge drinker | | | |
| | Current Binge drinker | 6.88 (6.07-7.79)** | 6.93 (6.10-7.89)** | 6.94 (6.11-7.90)** |
| **Main Effects** | | B(SE) | B(SE) | B(SE) |
| Depression (Dep) | No Depression | | | |
| | Depression (≥10) | 0.287(0.068)** | 0.155 (0.072) | 0.181 (0.278) |
| Anxiety (Anx) | No Anxiety | | | -0.401 (0.455) |
| | Anxiety (≥10) | 0.239(0.068)* | 0.130 (0.072) | |
| Flourishing (Flourish) | | | 0.039 (0.005)** | 0.042 (0.010)** |
| **Interactions** | | | | B(SE) |
| Dep*Anx | | | | 0.649 (0.536) |
| Dep*Flourish | | | | -0.004 (0.016) |
| Anx*Flourish | | | | 0.028 (0.028) |
| Dep*Anx*Flourish | | | | -0.032 (0.032) |
| | Concordance statistic | 0.852 | 0.853 | 0.854 |

* p≤0.01, **p<0.001

Figure 1: Depression scores for Grade

**Despression levels among grade 9-12 students year 5 of the mental health pilot of COMPASS**



Figure 2: Anxiety scores for Grade

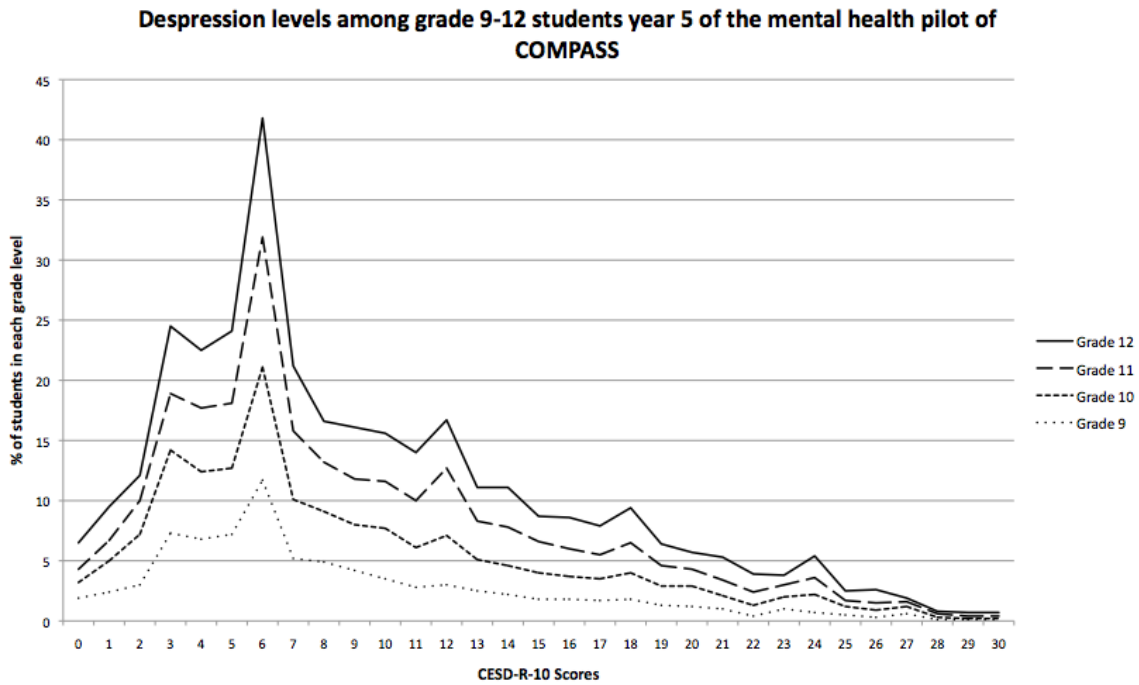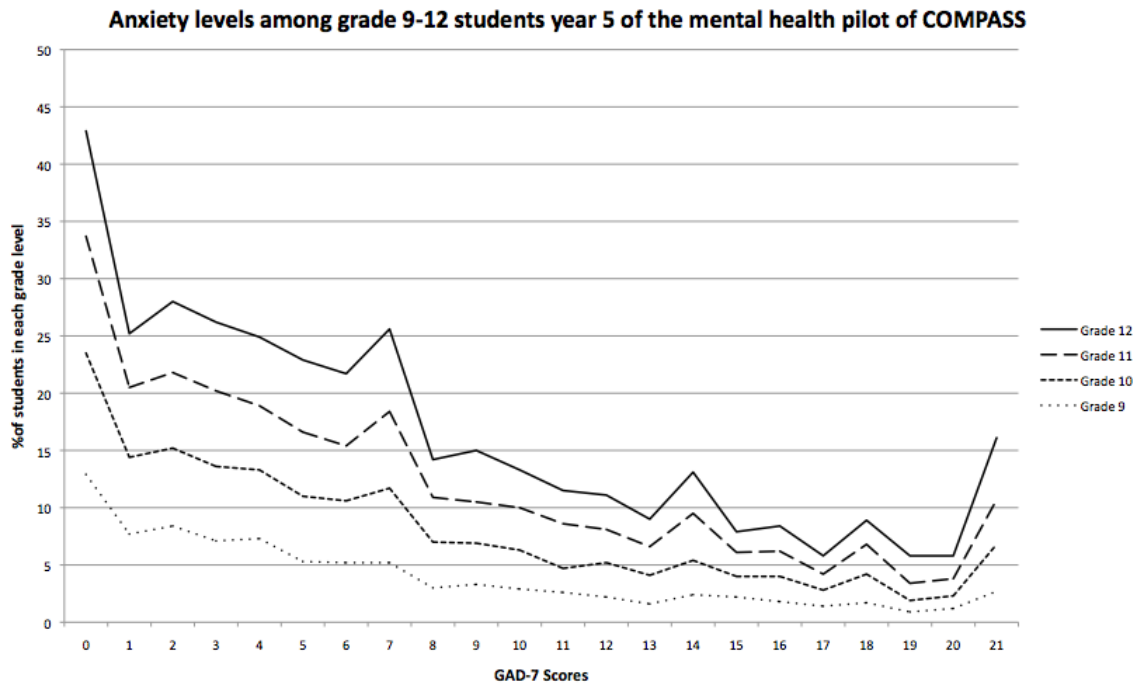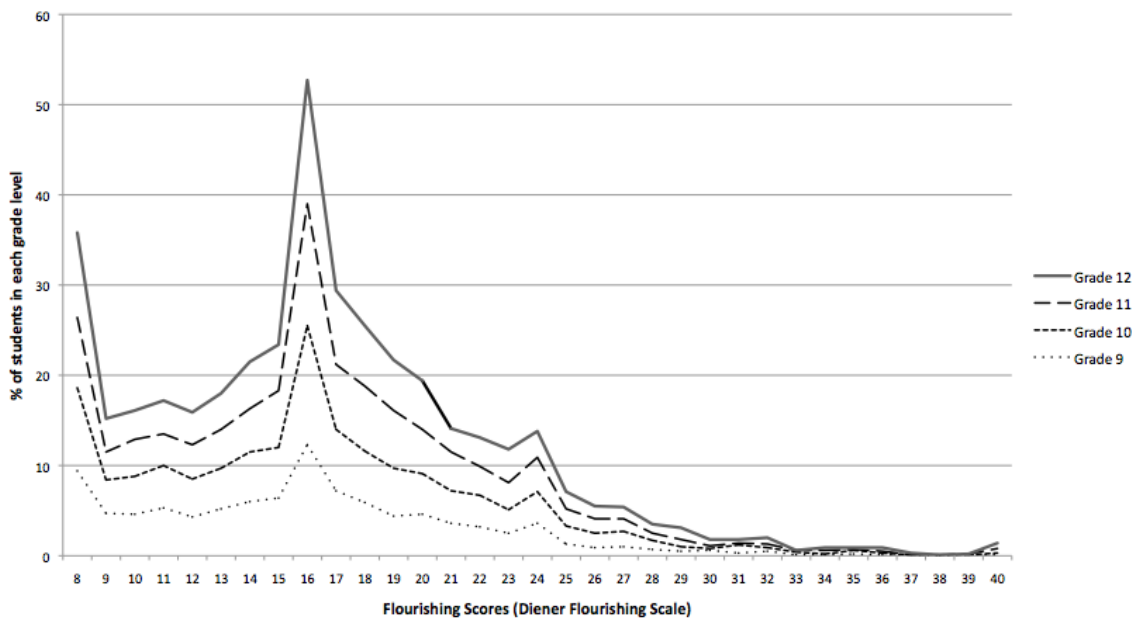**Anxiety levels among grade 9-12 students year 5 of the mental health pilot of COMPASS**



Figure 3: Flourishing scores for Grade

**Flourishing Scores among grade 9-12 students year 5 of the mental health pilot of COMPASS**

**Highlights**

- Youth cannabis users commonly indicated mental health problems
- Depression and anxiety were not associated with cannabis use
- Flourishing was associated with a lower likelihood of overall youth cannabis use