A longitudinal examination of the associations between cannabis use, physical activity, and CSEP guideline achievement among youth in the COMPASS study

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

Background

There is a lack of conclusive longitudinal literature regarding cannabis use frequency and physical activity in Canadian youth. While it is documented that rates of physical activity are decreasing and cannabis use in Canadian youth is among the highest in the world, the strength and direction of this longitudinal association is contradictory.

Objectives

This thesis will examine the relationship between cannabis use and physical activity through two main objectives: 1) Are the changes in cannabis use frequency over time associated with the relative change in MVPA? 2) Are the changes in cannabis use frequency over time associated with the likelihood of meeting the CSEP PA guidelines at two-year follow-up?

Methods

Data from years 5 (2016-17), 6 (2017-18), and 7 (2018-19) of the COMPASS study were used. Overall, 7400 Grade 9 to 12 students attending 75 schools were included in the analyses. Linear mixed regression models and generalized estimating equations were used to longitudinally examine the associations between student-level characteristics and cannabis use on the relative change in MVPA and the likelihood of meeting the CSEP guidelines, respectively.

Results

Less than a third (28%) of youth reported achieving the CSEP guidelines at baseline, with the average MVPA decreasing by approximately 12% from baseline to two-year follow-up. Cannabis use in youth also increased from approximately 8% to approximately 31% by two-year follow-up. However, it was found that neither the increase nor the decrease in cannabis use was associated with either relative changes in MVPA or CSEP guideline achievement at two-year follow-up. A decrease in relative MVPA was seen for students who reported being underweight (β= -14.4 (SE=6.48)), and had met the CSEP guidelines at baseline (β= -56.6 (SE=4.65)), where an increase in relative MVPA was seen for those who were in grade 11 (β= 47.7 (SE=17.81)). Youth who were males (aOR=2.07, 95% CI = 1.83, 2.34), current binge drinkers (aOR=1.35, 95% CI = 1.09, 1.69), and met the guidelines at baseline (aOR=3.59, 95% CI = 3.16, 4.09) had higher odds of meeting the CSEP guidelines at two-year follow-up. Students who were non-white (aOR=0.86, 95% CI = 0.75, 0.98), were underweight (aOR = 0.82, 95% CI = 0.68, 0.98) or had not stated weight status (aOR = 0.63, 95% CI = 0.55, 0.72) were of lower odds of meeting the CSEP guidelines at two-year follow-up. The interaction between cannabis use and CSEP achievement at baseline was not significantly associated with CSEP achievement at two-year follow-up.

Conclusion

Few student-level characteristics were associated with CSEP guideline achievement and relative MVPA in youth. However, this research provides a valuable understanding to this longitudinal association with cannabis use and other student-level characteristics. Using this research, future initiatives can better prioritize the needs of at-risk student populations. Future research should continue to investigate this complex relationship longitudinally in attempt to promote youth health and mitigate harmful health behaviours.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

COMPASS	Cannabis, Obesity, Mental Health, Physical Activity, Alcohol, Smoking, Sedentary Behaviour
Cq	COMPASS Student Questionnaire
PA	Physical Activity
MPA	Moderate Physical Activity
VPA	Vigorous Physical Activity
MVPA	Moderate-to-Vigorous Physical Activity
RT	Resistance Training
CSEP	Canadian Society for Exercise Physiology
BMI	Body Mass Index
SES	Socioeconomic Status
GEE	Generalized Estimating Equation
LMM	Linear Mixed Model
GLMM	Generalized Linear Mixed Model
ICC	Intraclass Correlation Coefficient
SE	Standard Error
OR	Odds Ratio
aOR	Adjusted Odds Ratio
CI	Confidence Interval

1. Background

1.1. Youth Physical Activity

Physical activity is an important contributor to overall health and wellbeing. There are recognised health benefits related to engaging in physical activity including reducing the risk of cardiovascular diseases, obesity, diabetes, and numerous other acute and chronic conditions (9). These health behaviours are important to instill in childhood to maximize their benefits over the life course, as it has been demonstrated that these behaviours are developed in youth and are maintained into adulthood (10,11). Youth, defined as individuals aged 12-17, often begin spending less time engaging in physical activity, with the largest declines in physical activity engagement occurring during these formative years (10–14). These declines in physical activity can be associated with an increasingly sedentary population (11,12). It is crucial to identify factors which can maximize physical activity rates in youth to improve the health of the population in the future.

1.1.1. Recommendations for Youth Physical Activity in a Canadian Context

While recommendations for youth physical activity are defined by the World Health Organization as greater than 60 minutes of moderate-to-vigorous physical activity (MVPA) per day, an additional comprehensive set of guidelines have been made available by the Canadian Society for Exercise Physiology (CSEP) (3,4). Both sets of guidelines indicate whether youth are meeting physical activity recommendations which are beneficial to their health (4). The 24-hour movement guidelines outlined by CSEP recommend that youth engage in light physical activities, achieve 8-10 hours of uninterrupted sleep, and have no more than 2 hours of screen time per day, along with a set of physical activity guidelines (15). The CSEP guidelines for physical activity measure the pre-defined 60 minutes of MVPA per day, but also include three or more days of both resistance training activities and vigorous physical activities per week (4). The measures of the MVPA and CSEP physical activity guidelines assist in gaining an understanding of physical activity rates in youth and their associated factors. This understanding can be helpful to optimize the health benefits received from physical activity for youth.

1.1.2. The Dose Response of Physical Activity

An important point to consider in terms of physical activity is the dose-response relationship between physical activity and its health benefits. In this relationship, as minutes of physical activity increase, the benefits to health exponentially increase (16). Any amount of physical activity is better than the absence of physical activity, where the benefits for increasing low levels of physical activity are high and the returns begin diminishing at higher levels of MVPA (17). For highly trained or active individuals there is an attenuation of effect with respect to the benefits received from increased physical activity; the largest benefits come to those who are inactive (16). With a minor increase in physical activity for an inactive individual, risk reductions for chronic diseases and mortality can decrease by up to 30% (16). Therefore, it is prudent to account for this relationship when investigating physical activity rates.

1.1.3. Physical Activity Trends in Youth

When considering the total minutes of MVPA, the majority of youth are not meeting the defined daily MVPA guidelines; on average, about one third of youth are meeting the 60 minutes per day recommendation for physical activity (18). In a large Canadian cohort study, it was observed that in self-report questionnaires about 50% of youth had met the WHO daily recommendation of 60 minutes of physical activity (19,20). In another Canadian cohort study, it was seen that 53% of Ontario youth were deemed physically inactive; students had failed to meet the 60 minutes of daily MVPA or 3 or more days of VPA per week threshold as defined by the study (21). According to the objectively measured Canadian Health Measures Survey (CHMS), just over 10% of Canadian children and youth are meeting the CSEP physical activity guidelines (22). Within youth alone, the proportion of those not meeting the CSEP physical activity guidelines climbs to 96% (13). Furthermore, within self-reported cross-sectional literature, the prevalence of youth CSEP guideline achievement has been consistently reported to be around a third of youth (23,24). While there has not been a conclusive trend on the CSEP guidelines over time, data available from the CHMS show that the proportion of those meeting the CSEP guidelines has been steadily decreasing (13).

When examining the trends of physical activity over time, a systematic review and meta analysis investigated absolute and relative changes in minutes of MVPA in children and youth over their development. It was found that in girls, absolute MVPA began to fall starting as early as age 5 and declined by up to 65% by age 17; a similar trajectory was found in boys from age 8 to 17, with declines in absolute MVPA of up to 54% (25). This decline in absolute minutes of MVPA was observed to linearly decrease over time (25). Results from this study also considered annual relative changes in MVPA. In girls, there was an average decrease of 5.3% in relative MVPA per year, where in boys, decreases were closer to 3.5% per year (25). Significant declines in relative MVPA were observed in both sexes, with peak declines at ages 9 and 13 (25). Declines in relative MVPA also spiked within high school, though the values were not significant, potentially due to the already low rates of physical activity in this age group (25). It was consistently found that youth decrease both their absolute and relative changes in MVPA over time (25,26).

Absolute and relative changes in MVPA are useful measures in examining physical activity over time. Absolute changes provide insight into the overall amount that youth change their physical activity, whereas relative changes provide context to the percentage that MVPA changes between time points. However, it should be noted that youth tend to overestimate their self-reported physical activity. Interestingly, youth often consistently and reliably overestimate their physical activity minutes, leading to consistent estimates of changes in physical activity longitudinally (27). Due to the over-reporting bias of self-reported MVPA, the use of relative change in MVPA can account for this consistent over-reporting in attempt to mitigate some of this bias longitudinally. Alternatively, accelerometry is an option to obtain more valid objective measures of physical activity. However, accelerometry is not always possible due to the time investment and cost intensiveness of this method, along with its difficulty to apply to larger epidemiological settings (28). The use of self-report may be employed as a low-cost alternative to accelerometry, which is more practical and less burdensome to participants (28). Irrespective

of the self-reported or objective measure of physical activity used in youth, it is apparent that youth are not meeting physical activity recommendations.

1.2 Cannabis Use in Canadian Youth

Cannabis has been noted as one of the most commonly used substances amongst Canadian youth, and the substance has been legalized as of October 2018 (5–7). The federal legal age of purchase, possession, and sale is 18 years of age, though most provinces and territories have set their own age restrictions on the substance (6). When considering youth populations in Canada, the use, purchase, and possession of cannabis remains illegal (6).

Several nationally representative surveys have been conducted within Canadian populations which portray cannabis use prevalence and trends in youth and school-aged children. According to the 2010 Health Behaviour in School-Aged Children (HBSC) survey, about 40% of school-aged males and 37% of school-aged females had reported ever trying cannabis; a rate which has increased roughly 14% in both sexes since 1990 (29). More recent reports from the Canadian Tobacco Alcohol and Drugs Survey (CTADS) describe cannabis use patterns in those aged 15 years or older which has found that the estimated past-year cannabis use in Canadian youth was approximately 12% in 2017, a prevalence which has statistically significantly risen from 11% in 2013 (30). In terms of the prevalence of higher frequency users, in 2015, of those who reported using cannabis, 72% claimed to have used cannabis within the past 90-days, and 34% of these students had used cannabis once or more per week (30–32). Furthermore, self-reported longitudinal research has found that roughly 5% of youth used cannabis in the last year; other studies have reported longitudinal cannabis use frequencies of up to 15% within the past year (33–35).

When observing the trajectory of cannabis use in Canadian youth, use has been seen to have increased over time (5). Existing literature regarding the trends of cannabis use prior to legalization have demonstrated a U-shaped curve, where from 2012 to 2015 the rates of cannabis gradually decreased, but exponentially increased in the following years (5). Trends prior to legalization show that youth had already begun increasing their use due to acceptance of social norms surrounding cannabis use along with pro-cannabis messaging, though trends following legalization have not been widely documented in Canada (5). Nonetheless, though legalization itself may not be of major concern regarding cannabis use patterns, this change in legislation is an important event to consider. In this large prospective Canadian cohort study, the overall rate of cannabis use increased where the proportion of never-users decreased, indicating that more youth have begun using cannabis in the last few years (5). The rates of lifetime and past year cannabis use in this self-report cross-sectional study reached a low of approximately 29% and 24% respectively in 2015, though as of 2017, lifetime use has surpassed 30% while past-year use has been approaching the 30% mark (5). When considering monthly use versus weekly or more frequent use, about 10% of students have reported weekly use, while about 18% of students reported monthly use (5). Alongside the increase in overall cannabis use, these rates of more frequent use have also been increasing, signifying that more youth are also regularly using cannabis.

A difference in the varying frequencies of cannabis use have demonstrated differential impacts on youth health. Differences of increased frequency of use are often compared relative to

never users; it has been seen that increased cannabis use frequency in youth are generally associated with worse health outcomes (36). Evidence suggests that psychosocial health in youth is significantly associated with increased cannabis use, where the level of risk for depression and anxiety increases with more frequent use (36). Other health behaviours that are associated with increased cannabis use frequency in youth include a higher likelihood of reporting smoking and binge drinking behaviours (36). When looking at cannabis use change over time, it has been seen that in a cohort of Canadian high school students, about 66% of students either maintained or increased their cannabis use behaviours, whereas 34% of students reported that they reduced or ceased their use (37). This study suggests that the majority of youth either maintain or increase their cannabis use behaviours over time (37). While there have not been conclusive studies on the association between the change in cannabis use related to physical activity in Canadian youth, the evidence from this study warrants future observation of changing cannabis use categories in terms of increased, decreased, or maintained use patterns and their impacts on youth health outcomes.

1.2.1 Cannabis Use Related to Physical Activity

The relationship between cannabis use as a function of physical activity has been explored within the literature. It has been documented that engaging in increased amounts of physical activity have largely been associated with decreased use of cannabis (38,39). Additionally, in a study of European youth, it has been seen that in boys, a greater degree of physical activity was associated with lower rates of cannabis use (40). However, when examining the association between physical activity as a function of cannabis use, the relationship is less conclusive.

A study using the National Health and Nutrition Examination Survey (NHANES) questionnaire observed patterns of use in a sample of 20-to-59-year old recreational marijuana users; it was found that marijuana users had lower rates of MVPA than those who had never used marijuana (41). Overall, the relationship was that as cannabis use increased, the total minutes spent in MVPA decreased (41). When investigating this cross-sectional association in low-to-middle income countries of Africa, Southeastern Asia, and South America, past and current cannabis users had significantly lower odds of meeting the physical activity recommendations, though the relationship is less clear in developed countries (42). Conversely, a recent study observed that individuals who concurrently use cannabis while exercising had higher average weekly minutes of physical activity than those who did not concurrently use cannabis (43). Similarly, in a sample of emerging adults, it was concluded that relative to those who did not use cannabis, frequent users had a higher probability of meeting physical activity recommendations (44). On the other hand, an international study conducted in Europe found that there were no associations found between low levels of physical activity and an increased use in psychoactive substances, which included cannabis (45). Other studies have found no clear association between minutes of MVPA and cannabis use frequency (46,47). In the few studies which consider the CSEP guidelines, one Canadian cross-sectional study found that cannabis use was not significantly associated with CSEP guideline achievement (48). Due to these conflicting results, no clear consensus has been established on these cross-sectional associations in the literature.

Moreover, the lack of longitudinal literature makes the association between cannabis use frequency and physical activity largely inconclusive. Longitudinal studies regarding the CSEP guidelines and cannabis use are not well established within the literature. However, a Canadian longitudinal study had analyzed the change in cannabis use trajectories over time where findings demonstrated that those who increased their cannabis use frequency experienced worse health outcomes than those who decreased their use (49). Furthermore, this group of increased users were seen to have greater odds of engaging in physical activity relative to never users, though the value was not significant (49). This study found that neither the increase nor decrease in cannabis use frequency was associated with MVPA (49). It should be noted that the measure of physical activity used is dated when compared to current youth MVPA guidelines and may be difficult to translate to current Canadian youth. In contrast, a longitudinal study of the trends of the determinants of physical activity from adolescence to adulthood found that over a five-year follow-up period, the use of cannabis and other substances were seen to be negatively associated with MVPA in females (50). Overall, much of the research on this topic has been cross-sectional in nature; there exists a paucity in the literature with respect to longitudinal studies as well as between the respective relationships between youth cannabis use and relative MVPA and CSEP guideline achievement.

1.2.2 Cannabis Use and Physical Activity – Potential Mechanisms

The underpinnings of this relationship are not well understood, though some evidence points to the endocannabinoid system and its association with both cannabis use and physical activity (51). Cannabis acts on the endocannabinoid system, which produces similar physiological effects as engaging in physical activity (51). These feelings enhance euphoria and reduce anxiety, while also increasing positive motivations towards exercise (51,52). For youth who use cannabis, evidence has suggested that these individuals may increase their physical activity rates to prolong this feeling, but may also use cannabis to alleviate pain, improve physical performance, and promote recovery from exercise (52). On the other hand, youth who use cannabis may also find exercise challenging due to the neurocognitive, respiratory, and psychomotor impairments that often accompany the use of cannabis (53).

Aside from this system, physically active youth may be protected against use of cannabis due to the immediate detriments of cannabis on athletics and their experience of physical activity (54). Active youth tend to adhere to healthier lifestyles, are less likely to engage in risky behaviours, and have greater positive social influences (55). As a result, there may be a reduced likelihood in engaging in cannabis use through an increased emphasis on their physical activity. Youth are also highly susceptible to peer influence; networks encompass similar individuals and the change in peer networks have been associated with habit adoption (56). For example, a higher degree of physical activity in peers has been associated with higher individual physical activity (55). However, social settings are also a means to introduce peers to substances (57). Both positive and negative health behaviours may be reinforced through peer networks, which can include the use or aversion to substance use (56). Additionally, evidence has pointed to an association between sports participation and cannabis use. These physically active youth may be more likely to binge drink which has been associated with cannabis use (58,59). Depending on the method of physical activity engagement, there is potential that specific type of sport and the competitive level of sport

5

may have differential associations with cannabis use based on these engagements (47,60,61). While there may not be a singular mechanism which is responsible for the covariance between physical activity and cannabis use, there is evidence which supports this complex relationship. As cannabis use increases and physical activity decreases throughout youth, it is important to identify the reasoning behind the relationship between these health behaviours.

1.3. Correlates of Youth Physical Activity

Sociodemographic characteristics have demonstrated an association with physical activity rates including grade, ethnicity, binge drinking status, biological sex, weekly spending money, sleep and sedentary behaviours, and weight status as indicated through Body Mass Index (BMI). When accounting for grade related to physical activity guidelines, there are increased odds of meeting physical activity guidelines with a lower grade (48,62,63). It is also recognised that males are more active and more likely to meet physical activity guidelines than females at all age groups (12,48,64). However in youth, the decline of physical activity over time is more significant within males than in females, which illustrates the importance of sex related differences when measuring physical activity rates (11). However, where MVPA is cross-sectionally related to sex, some literature suggests that the longitudinal relative changes in MVPA are not significantly different between males and females (25).

In a large Canadian prospective cohort study, it has been seen that ethnicity has been associated with meeting physical activity guidelines (62,63). Being Caucasian is associated with higher odds of meeting the MVPA and CSEP guidelines when compared to other ethnicities (Black, Asian, and Latin American) but lower odds than Aboriginal youth (48,62,63). This study also found that the association between socioeconomic status and physical activity in youth have found positive associations, where those who have higher socioeconomic status tend to engage in more physical activity and are more likely to meet the CSEP guidelines (48,63). The measure of weekly spending money is often used as a proxy for youth socioeconomic status as it is more accessible than household income for this age demographic (65).

Physical activity is often mentioned alongside weight status, which is commonly described through BMI. BMI is an anthropometric measure which uses height and weight characteristics to define a categorical weight status (2). As classified by the World Health Organization (WHO), a BMI of less than $18kg/m^2$ is defined as Underweight, $18-25kg/m^2$ is defined as Normal Weight, $25-30kg/m^2$ is defined as Overweight, and a BMI greater than $30kg/m^2$ is defined as obese (66). BMI has consistently been associated with MVPA, where a higher rate of physical activity is related to both lower BMI and prevalence of obesity (67). In addition, a large Canadian cohort study found that cross-sectionally, underweight, obese, and missing weight statuses were associated with lower odds of meeting the CSEP guidelines (48). Physical inactivity is especially concerning when considering youth overweight and obesity in Canada; according to a 2017 report by the Public Health Agency of Canada, approximately 30% of youth aged 5-17 are overweight or obese, with about 14% of these youth being obese (68,69). Childhood overweight and obesity prevalence has been increasing over time, as these rates have risen from 23.3% to 31.4% since 1978 (69). It should be noted that BMI tends to be under-reported in youth populations when self-reporting height and weight measurements (70). For this reason, it is imperative to recognize the importance of BMI when considering physical activity interventions.

The recommendations for 24-hour movement guidelines have been established by CSEP, include criteria involving uninterrupted sleep per night as well as recreational screen time per day (15). It has been observed that in Canadian youth, those who went to bed at a later hour and had less overall sleep and were less physically active than youth who went to sleep earlier (71). These youth were also more likely to lead a more sedentary lifestyle with more hours of daily screen time (71). It has been seen that about 65% of youth report watching 2 or more hours of television per day; the inclusion of other measures of screen time may increase this proportion even higher (72). In a Canadian study, youth aged 12-17 were measured on screen time, physical activity, and sleep; it was found that only 5.5% of youth were meeting all three of these guidelines, where only 28.1% met the screen time recommendation and 68% met the sleep recommendation (73). Many youth fail to meet the screen time and sleep recommendations and it is crucial to account for these behaviours as they have been related to physical activity (73).

Binge drinking has become common among youth as well. Based on a Canadian longitudinal study from 2012 to 2015, about 15% of students had participated in binge drinking (1). When considering the association between binge drinking and physical activity, binge drinking has been positively associated with physical activity (1). In Canadian youth, those who were more likely to meet the CSEP guidelines were also 29% more likely to use alcohol and 35% more likely to be binge drinkers (58). Cross-sectionally, current binge drinkers were also at increased odds of meeting the MVPA and CSEP recommendations (48). However, the respective longitudinal associations between binge drinking and changes in MVPA and changes in CSEP guideline achievement are not well established within literature. While the cross-sectional results are seemingly counterintuitive, evidence suggests that those who are more physically active are often involved in the school athletic culture and sports participation, which may influence alcohol and binge drinking behaviours (58,59).

1.4. Study Rationale

In a Canadian context, very little is known about the relationship between cannabis use frequency and youth physical activity rates. Much of the information available on this topic is cross-sectional; currently, there is a lack of longitudinal literature on the respective relationships of both the relative change in MVPA and meeting the CSEP guidelines as a function of the change in cannabis use frequency.

Studies assessing physical activity primarily account for minutes of MVPA, though the comprehensive CSEP guidelines may be more explanatory of youth physical activity rates in Canada. Furthermore, in the observation of the change in minutes of physical activity, the absolute minutes of MVPA are often used as a measure of physical activity, though the application of relative change can instead be used help identify those who are most impacted by changing their physical activity over time and can mitigate the bias of overreporting MVPA.

Evidence suggests that youth are some of the highest users of cannabis. Additionally, many youth are not meeting physical activity guidelines which have been seen to decrease throughout adolescence (25). Intuitively, those who independently increase their cannabis use or decrease their physical activity over time have seen worse health outcomes (9,74,75). Canadian youth often tend to escalate or decrease their use of cannabis, making it worthwhile to investigate how the change in use impacts physical activity rates over time (37). By conducting a longitudinal analysis, the

understanding of the association between the change in cannabis use and physical activity can help in the assessment of the effects on youth health over time. As such, the primary objective of this thesis was to explore the independent associations between relative change in MVPA and CSEP guideline achievement as a function of changing cannabis use frequency over time within a large sample of Canadian youth.

2. Study Aims & Objectives

The overall goal of this thesis is to further our understanding between the changes in physical activity recommendations and overall minutes as a function of the changes in cannabis use frequency. The specific aims of this thesis are:

- to examine the association between the change in cannabis use frequency and the relative change in MVPA over time
- to examine the association between the change in cannabis use frequency and the likelihood of meeting the CSEP guidelines over time

2.1. Research Questions

Research Question 1: To examine if the changes in cannabis use frequency (defined as an increase, decrease, or no change in use) are associated with the relative change in MVPA while controlling for weight status, binge drinking, ethnicity, grade, sex, sleep time, screen time, and spending money in the 2016-2017 year (Year 5), 2017-2018 year (Year 6), and 2018-2019 year (Year 7) waves of the COMPASS study.

Research Question 2: To examine if the changes in cannabis use frequency (defined as an increase, decrease, or no change in use) are associated with the likelihood of meeting the CSEP physical activity guidelines at two-year follow-up, while controlling for weight status, binge drinking, ethnicity, grade, sex, sleep time, screen time, CSEP status at baseline, weekly spending money, and the interaction between CSEP at baseline and the changes in cannabis use in the 2016-2017 year (Year 5), 2017-2018 year (Year 6), and 2018-2019 year (Year 7) waves of the COMPASS study.

2.1.2. Hypotheses

Research Question 1 Hypotheses:

a) I hypothesize that the relative change in MVPA will significantly decrease on average when comparing the escalation of cannabis use to those who did not change their use from Year 5 to Year 7.
b) I hypothesize that the relative change in MVPA will significantly increase on average when comparing the reduction of cannabis use to those who did not change their use from Year 5 to Year 7.

Research Question 2 Hypotheses:

a) I hypothesize that the likelihood of achieving the CSEP physical activity guidelines will significantly decrease on average when comparing the escalation of cannabis use to those who did not change their use from Year 5 to Year 7.
b) I hypothesize that the likelihood of achieving the CSEP physical activity will significantly increase on average when comparing the reduction of cannabis use to those who did not change their use from Year 5 to Year 7.

3. Methods

This chapter describes the proposed methodology to answer the aforementioned research questions. All research questions will be answered using data from the COMPASS host study.

3.1. COMPASS Host Study

The COMPASS host study is an ongoing nine-year prospective cohort study (2012-2021) conducted within a convenience sample of schools in four provinces (Alberta, British Columbia, Ontario, and Quebec) collecting self-reported data annually from grade 9 to 12 students, or their equivalents, and the secondary schools they attend (76). The purpose of the COMPASS study is to evaluate how the changes in the school environment, built environment, policies, and programs influence youth health behaviours (76). COMPASS collects student and school level data on information related to Cannabis use, Obesity, Mental health, Physical activity, Alcohol use, Smoking, and Sedentary behaviour, amongst other health behaviours. The COMPASS Study was approved by the University of Waterloo Office of Research Ethics (ORE 30118).

3.1.1. Sampling and Recruitment

The COMPASS study uses purposeful sampling in their recruitment process based on active-information, passive-consent parental permission protocols. The use of passive-consent permission protocols were chosen to achieve higher response rates and to mitigate selection bias, while maintaining student confidentiality (77). School boards which used passive consent protocols and met ethics approval were recruited by the COMPASS recruitment coordinator; the school boards must have met the eligibility criteria outlined by the COMPASS host study (78). Following the board recruitment, individual schools were recruited from the school boards by COMPASS recruitment coordinators (79).

In this recruitment process, an information letter was distributed to parent(s) or guardian(s) of the student in which they could call or email the COMPASS recruitment coordinator to decline participation (76). Eligible students were recruited using active-information, passive-consent permission protocols in which students were eligible to participate given they agreed to participate or parents and guardians did not inform the COMPASS recruitment team that they did not want to participate (76). An eligible student could also decline or withdraw consent to participate at any time (76). The recruitment and sampling process, and additional details about the COMPASS host study are available in further detail online (https://uwaterloo.ca/compass-system) (78–81).

3.1.2. Design

For the purposes of this thesis, data were collected from four Canadian provinces (Alberta, British Columbia, Ontario, and Quebec). The current study uses student-level data from the COMPASS 2016-17 (Year 5; Y5), 2017-18 (Year 6; Y6), and 2018-19 (Year 7; Y7) data collection years. The 2016-17 sample consisted of 46862 students from 93 schools in Ontario (68 schools), Alberta (9 schools), British Columbia (5 schools), and Quebec (11 schools). The participation rate for 2016-17 was 77.5%. The 2017-18 sample consisted of 66434 students from 122 schools in

Ontario (61 schools), Alberta (8 schools), British Columbia (16 schools), and Quebec (37 schools). The participation rate for 2017-18 was 81.9%. The 2018-19 sample consisted of 74501 students from 136 schools in Ontario (61 schools), Alberta (8 schools), British Columbia (15 schools), and Quebec (52 schools). The participation rate for 2018-19 was 84.2%.

This study compared changes in outcomes longitudinally as a part of a linked sample. Research questions 1 and 2 were explored using data from the 2016-17 (Year 5; Y5), 2017-18 (Year 6; Y6), and 2018-19 (Year 7; Y7) data collection years. For the purposes of this thesis, Y5 corresponded to Time 1 (baseline), Y6 corresponded to Time 2, and Y7 corresponded to Time 3 (two-year follow-up). For this thesis, the interest surrounded how cannabis use change was associated with physical activity from baseline to the final two-year follow-up; therefore, Y5 and Y7 were used as analytic years, and Y6 was used descriptively as well as for linkage purposes. In the creation of a longitudinal sample, a unique code was generated by each student which allowed for the linkage of student-level data over these waves. Respondent data were linked between any two consecutive years of responses on a series of questions intended for linkage (82,83). A series of two-year links were then combined to allow for a multi-year link which was used in this thesis (83). Eligible students were not expected to have their data linked due to spares and absenteeism, being newly admitted or graduating, transferring or dropping out of school, or student or parental refusal (82). The linkage process is further described in detail online (https://uwaterloo.ca/compass-system) (82,83). Data were linked from Alberta, British Columbia, Ontario, and Quebec based on consecutive responses from Y5, Y6, and Y7. Using these collection years, data from 9137 students from 75 schools were successfully linked, allowing for the longitudinal sample.

3.2. Data Sources and Measures

The research questions will be explored using the following measures from the COMPASS student questionnaire.

3.2.1. The COMPASS Student Questionnaire

The COMPASS student questionnaire (Cq) is a 16-page paper-based questionnaire which is administered and completed on the scheduled day of data collection within eligible schools. The Cq collects student-level data related to cannabis use, obesity, mental health, physical activity, alcohol use, smoking behaviours, and sedentary behaviours, as well as other demographic and school-level characteristics (76). The questionnaire was purposefully created to be short and inexpensive (i.e. machine-readable forms), allowing for the completion of the survey during a 30-40 minute class period (76). The questionnaire is administered primarily in English, but a French version is available, mainly completed by students residing in Quebec. The questionnaire administration procedures are available in detail online (https://uwaterloo.ca/compass-system) (84). The current research questions were investigated using cannabis use, physical activity measures, and demographic characteristics. A copy of the Cq can be found in Appendix C.

3.2.2. Dependent Variables

Relative Change in Moderate-to-Vigorous Physical Activity

Physical activity can be defined as the expenditure of energy resulting from bodily movement (85). The measures of physical activity on the Cq are derived from the School Health Action Planning and Evaluation System (SHAPES), which have been demonstrated to be reliable and valid (86). These measures have further demonstrated validity and reliability through the Cq. The test-retest reliability for the individual items of self-reported measures of physical activity including VPA (ICC=0.68), MPA (ICC=0.71), and MVPA (ICC=0.75) are considered moderate (27). The criterion validity of the PA measures of VPA (ICC=0.18), MPA (ICC=0.22), and MVPA (ICC=0.25) on the Cq for are considered slight, however, the validity and reliability results are consistent with previous literature on validation of self-reported measures of physical activity (27). Though the validity is considered slight, youth have been seen to consistently overestimate their MVPA longitudinally (27). Using these previously validated measures from the Cq students were asked to indicate the number of hours and minutes spent engaging in both moderate and hard physical activity on each of the last 7 days (27,86).

The options for response on the Cq were: "Mark how many minutes of HARD physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time" and "Mark how many minutes of MODERATE physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time. Do not include time spent doing hard physical activities". Examples of moderate and hard physical activity were provided to assist in the reporting of physical activity. These were defined as follows: "HARD physical activities include jogging, team sports, fast dancing, jump-rope, and any other physical activities that increase your heart rate and make you breathe hard and sweat", and "MODERATE physical activities include lower intensity activities such as walking, biking to school, and recreational swimming". Responses were recorded in hours (0-4) and minutes (0, 15, 30, 45) for days of the week. These two measures were added and averaged over the seven days to calculate mean total minutes of daily MVPA. This measurement of MVPA remains consistent with existing literature (87).

This definition of minutes of MVPA was used to quantify the time spent in physical activity for respondents which are recorded cross-sectionally at baseline and at two-year follow-up. The interest is in the relative changes of MVPA, which indicates the percentage of change between baseline and two-year follow-up values of MVPA minutes for a respondent. In this context, the outcome was defined through the following equation:

$$\text{Relative MVPA} = \frac{Minutes\ of\ MVPA\ (two-year\ follow\ up) - Minutes\ of\ MVPA\ (baseline)}{Minutes\ of\ MVPA\ (baseline)} \text{ x } 100$$

Canadian Society for Exercise Physiology (CSEP) Guidelines

The CSEP guidelines were measured using the CSEP physical activity guideline criteria. This measure includes engaging in resistance training for three or more days per week, engaging in more than 60 minutes of MVPA daily, and engaging in VPA for three or more days per week (4). Engaging in more than 60 minutes of MVPA daily was determined through the measure of

total minutes of MVPA. A variable was created to operationalize this achievement of 60 minutes of MVPA daily which dichotomizes respondents into achieving or not achieving the daily 60 minutes of MVPA recommendation. The Cq also includes self-reported student responses on number of days of VPA, from which engagement in VPA for three or more days per week was determined. Should the response of days of VPA be equal to or exceed 3 days, then this recommendation was met. The Cq includes items on resistance and strength training. Resistance Training (RT) was measured by asking, "On how many days in the last 7 days did you do exercises to strengthen or tone your muscles?". Using this self-reported response, number of days engaging in RT was determined. Should the response of days of RT be equal to or exceed 3 days, then this recommendation is met. The meeting of CSEP guidelines were assessed as a binary outcome of whether students met this recommendation through meeting the each of the previously defined variables, which was used to quantify the physical activity guideline achievement for respondents. For the description of the likelihood of meeting the CSEP guidelines over time, this measure was analyzed in terms of meeting the CSEP guidelines at the two-year follow-up.

3.2.3. Independent Variable

Change in Cannabis Use Frequency

The measure of cannabis use frequency on the Cq is consistent with national surveillance measures used by Health Canada, as derived from the National Youth Smoking Survey (YSS) (88,89). On the Cq students were asked, "In the last 12 months, how often did you use marijuana or cannabis?" and selected 1 of nine options: "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," and "Every day".

To identify frequency of cannabis use, the responses were re-coded into groups of current users, non-current users, and non-users. Respondents who selected "I have never used marijuana", or "I have used marijuana but not in the last 12 months" were classified as non-users. Respondents were classified as non-current users if they indicated marijuana use of "less than once a month". Respondents who indicated marijuana use of "at least once a month", "2 or 3 times a month", "Once a week", "2 or 3 times a week", "4 to 6 times a week", or "Every day" were classified as current users. Currently, data regarding the reliability and validity of cannabis use frequency measures are not available. However, the coding of cannabis use frequencies in this convention are consistent with the existing body of literature (36,59).

Using this measure of cannabis use frequency, the change in cannabis use frequency was an independent variable for the longitudinal analysis using the linked longitudinal sample. Change in cannabis use was defined as a difference in responses from baseline to two-year follow-up indicated through an increase, decrease, or no change in cannabis use. The increase in cannabis use frequency was described as a change from non-users to non-current or current users, as well as the change from non-current to current users. The decrease in cannabis use frequency was described as a change from current users to non-current users or non-users, and a change from non-current users to non-users. If a respondent has not changed their cannabis use frequency between time points, then this indicated no change in cannabis use frequency.

Sociodemographic Covariates

To control for observable covariates, this study included student-level correlate measures from the Cq. These measures were self-reported on the Cq, including the grade of the student during which the assessment was completed (grade 9, grade 10, grade 11, grade 12, grade 8 (Quebec only)), the amount of weekly spending money students had available in dollars (zero, $1-20, $21-100, $100 or more), the ethnicity of the student, the sex of the student (Female, Male), sleep time, screen time, binge drinking status, and weight status (Under weight, Normal Weight, Over weight, Not Stated, and Obese). The use of the school grade variable was used over age due to the high degree of collinearity between the variables. Spending money was used as an approximation of SES for youth as students are often unaware of their parental income; spending money has also demonstrated a positive association with substance use (90,91). The categories of weekly spending money were collapsed from the Cq into 4 categories (zero, $1-20, $21-100, $100+). To assess ethnicity, students were asked, "How would you describe yourself?" Responses were then grouped as White and Non-White. Respondents were defined as Non-white following the indication of a response of any of Black, Asian, Aboriginal, Latin American/Hispanic, or Mixed/Other.

To assess sleep duration, students were asked to indicate the number of hours and minutes they spent sleeping. If their total daily average sleep was within the CSEP sleep recommendation of 8-to-10 hours of daily average sleep, then the respondent had met the CSEP sleep guideline, otherwise the respondent had not met the sleep guidelines. To measure screen time, students were asked "How much time per day do you usually spend on the following activities?" using a previously validated questionnaire item (27). Students were then asked to indicate the number of hours and minutes they spent in recreational screen time behaviours including watching/streaming TV shows and/or movies, playing video games, surfing the internet, as well as texting/messaging/emailing. Students were also asked about the number of hours spent doing homework, which was not included in the calculation of screen time. The time spent in these categories were then summed and averaged to represent daily screen time behaviours. If students reported less than 2 hours per day of screen time then they had met the CSEP screen time guideline, otherwise they had not met the CSEP screen time guidelines. These methods of measuring sleep and screen time have been successfully conducted in other studies (92,93).

Current binge drinking is a measure often associated with increased physical activity. Though the measure for binge drinking has not been previously validated, the measure on the Cq is consistent with national surveillance as well as with previous research (1,58,94). On the Cq students were asked, "In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?" and selected 1 of eight options: "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 or 3 times a month", "Once a week", "2 to 5 times a week", and "daily or almost daily". To identify frequency of current binge drinkers, the responses were re-coded into groups of current users, non-current users, and never-users. Respondents who selected "I have never done this" were classified as never users. Respondents who selected "I did not have 5 or more drinks on one occasion in the last 12 months", or "less than once a month" were classified as non-current users. Respondents who indicated binge drinking frequency of "at least once a month", "2 or 3 times a month", "Once a week", "2 to 5 times a week", or "daily or almost daily" were classified as current users.

14

Weight status was calculated for each student based on their self-reported height (m) and weight (kg) to calculate a Body Mass Index (BMI) score (BMI=kg/m^2). Weight status was coded the using World Health Organization defined cut-points for BMI classification (66). A BMI of less than 18kg/m^2 was defined as an underweight status, 18-25kg/m^2 was defined as normal weight status, 25-30kg/m^2 was defined as an overweight status, and a BMI greater than 30kg/m^2 was defined as an obese weight status (66). However, when youth self-report height and weight measurements, values are often underreported. Due to the high degree of non-response for height and weight measures amongst youth, this missingness may be a predictive category in itself due to motivations behind non-response, designated as a "Not Stated" status (70). Overall, these correlates have been found to impact amount of physical activity as well as cannabis use frequency.

4. Analysis

4.1. Descriptive Statistics

For this thesis the longitudinal descriptive statistics are relevant to research questions 1 and 2. All analyses will be conducted using the statistical package SAS 9.4.

4.1.2. Longitudinal Descriptive Statistics

To determine the characteristics of the independent and dependent variables, categorical and continuous variables were assessed using SAS PROC FREQ and PROC UNIVARIATE respectively. The use of PROC FREQ, PROC MEANS, and PROC ANOVA were then used to determine whether a potential relationship existed between the independent and dependent variables of interest. Chi-squared estimates, t-tests, and F-tests were used to assess the potential for a significant relationship between variables descriptively. Statistical significance was set at $p < 0.05$.

Additionally, frequency tables using PROC FREQ were used to assess the baseline (Y5) characteristics of the linked sample. For any continuous variables, the mean and standard deviation were reported. All categorical variables were reported as a proportion of the total sample (n, %). In addition to reporting the overall sample, the sample was stratified by cannabis use frequency and CSEP guideline achievement at baseline to examine the proportions and differences between respective stratified groups. Following this, using PROC FREQ, a two-way frequency table was created using cannabis use frequency in the baseline year and at two-year follow-up. This table allowed for the direct observation of the proportion of baseline and follow-up cannabis use frequencies, while also observing the proportion of youth who had changed their cannabis use frequencies between time points.

Only complete cases were used in all analyses. As such, any participants with missing responses on the variables of interest in the analytic years of Y5 and Y7 were excluded from the overall analysis (95). In cases where the proportion of missing responses were below 5%, the impact of missing data was seen as negligible and was excluded from analysis (95). For variables that had a higher proportion of missing responses, the categories themselves may be predictive and were included within the appropriate models. In our study, missing BMI data were included due to the high volume of missing BMI data. All other missing data had been excluded to allow for a complete case analysis. It should be noted that the variable level of grade 12 in 2016 was also removed from analysis due special cases and false matches. Of the overall 9137 students in the linked sample, a total of 1737 (19.0%) students with missing responses were identified, which were then excluded from analysis resulting in a final sample of 7400 students.

4.2. Research Question 1

A linear mixed model (LMM) was used to estimate the relative change in MVPA from baseline to follow-up as a function of the change in cannabis use frequency, while adjusting for ethnicity, binge drinking status, spending money, sex, weight status, sleep time, screen time, and grade.

The MIXED procedure was selected to create the linear mixed model which allowed for the observation of change of cannabis use from baseline to two-year follow-up for individuals. This model was additionally used to account for the clustering of students within schools (nested nature of the data), as students within the same school are more similar than students from different schools (96). To assess whether clustering was necessary, the intraclass correlation coefficient (ICC) was calculated; the larger the ICC the greater the need for clustering by schools due to the inherent differences in responses between schools. However, if the ICC was objectively low (e.g. below 5%) then there was sufficient evidence to not cluster by school.

The ICC was calculated for the continuous outcome of relative MVPA as follows:

$$\text{ICC} = \frac{\hat{\sigma}^2{}_0}{\hat{\sigma}^2{}_0 + \sigma}$$

Hierarchical LMM's (I, II) were tested for this research question. First, an unconditional model (null model) was tested where none of the predictors or covariates were entered within the model. The null model is an empty model which tests to see the amount of variation in the outcome explained by the respondents. Through the null model, we calculated the ICC to assess the variation in the outcome explained by the respondents (Appendix B.2). Next, model I was a crude model which tested for the relationship between the predictor, change in cannabis use frequency, and the relative change in MVPA at follow-up. Finally, model II tested the complete model including the covariates of interest along with the predictor variable to assess how variables in the model were associated with the outcome. Other similar longitudinal studies have successfully used related models for continuous outcomes (87,96).

4.3. Research Question 2

For research question 2, a generalized estimating equation (GEE) was selected to estimate the change in meeting the CSEP physical activity guidelines from baseline to two-year follow up as a function of the change in cannabis use frequency, while adjusting for ethnicity, binge drinking, spending money, sex, weight status, sleep time, screen time, baseline CSEP guideline achievement, grade, and the interaction between baseline CSEP guideline achievement and cannabis use change.

The GENMOD procedure was selected to create the generalized estimating equation models. Multi-level GEE models (Model III, IV, V) were tested for this research question. First, using PROC GLIMMIX, a null model with none of the predictors or covariates entered within the model was tested to calculate the ICC and determine the clustered nature of the data and the variation in the response variable (Appendix B.2). For the binary outcome of CSEP guideline achievement, the following calculation of the ICC was used:

$$\text{ICC} = \frac{\hat{\sigma}^2{}_0}{\hat{\sigma}^2{}_0 + \left(\frac{\pi^2}{3}\right)}$$

where $\dfrac{\pi^2}{3} = 3.2898681337$

Next, model III tested for the relationship between the predictor, change in cannabis use frequency, and the likelihood of meeting the CSEP guidelines at follow-up. Model IV tested the moderation effect of CSEP guideline achievement at baseline by cannabis use change while adjusting for the covariates of interest and the predictor variable to assess how variables in the model were associated with CSEP guideline achievement at follow-up. Model V then tested the full model without the interaction term while adjusting for the covariates of interest and the predictor variable to assess how the variables in the model were associated with CSEP guideline achievement at follow-up. Similar longitudinal studies have successfully used GEE's when modelling dichotomous outcomes (33,59,62).

5. Results

5.1. Longitudinal Study Sample Participant Characteristics

5.1.1. Preliminary Univariate Analyses at Baseline

Participant Characteristics

The present study examined complete data from 7400 students with linked baseline (year 5) to two-year follow-up (year 7) responses in the COMPASS study. Among students in this linked sample, 55.1% self-identified as female and 44.9% self-identified as male and most self-identified as White (74.6%) as opposed to Non-White (25.4%). At baseline, as shown in Table 1, the vast majority of students were non-users of cannabis (91.7%), with a small prevalence of non-current (4.3%) and current (4.0%) users. Among respondents at baseline, most were not meeting the CSEP physical activity guidelines (71.4%), with respondents reporting an average of 121.1 minutes of MVPA per day.

Table 1: Sample descriptive statistics of student-level characteristics of students participating in the longitudinal linked sample at baseline [year 5 (2016-2017)] of the COMPASS Study, Canada (n=7400).

Variable	n	%	χ^2 df p-value
Cannabis Use Frequency			
Non-Use *(ref.)*	6785	91.7	χ^2= 11340.11
Non-Current Use	319	4.3	df=2
Current Use	296	4.0	p<0.0001
Binge Drinking			
Never Binge Drinker *(ref.)*	5538	74.8	χ^2=5871.31
Non-Current Binge Drinker	1339	18.1	df=2
Current Binge Drinker	523	7.1	p<0.0001
Grade			
9 *(ref.)*	3689	49.8	
10	2479	33.5	χ^2=3973.76
11	102	1.4	df=3
8 (Quebec Only)	1130	15.3	p<0.0001
Sex			
Female *(ref.)*	4079	55.1	χ^2=77.64
Male	3321	44.9	df=1
			p<0.0001
Spending Money			
$0	1477	20.0	
$1-20 *(ref.)*	2688	36.3	χ^2=1714.61

$21-100	1533	20.7	df=4
$100 or more	474	6.4	p<0.0001
Do not know	1228	16.6	
Race			
White *(ref.)*	5519	74.6	χ^2=1788.52
Non-White	1881	25.4	df=1
			p<0.0001
Weight Status			
Under Weight	942	12.7	
Normal Weight *(ref.)*	3908	52.8	χ^2=5925.62
Over-Weight	566	7.7	df=4
Obese	194	2.6	p<0.0001
Not Stated	1790	24.2	
CSEP			
Doesn't Meet Guidelines *(ref.)*	5287	71.4	χ^2=1361.39
Meets Guidelines	2113	28.6	df=1
			p<0.0001
Sleep			
< 8 hours *(ref.)*	3528	47.7	χ^2=15.99
8-10 hours	3872	52.3	df=1
			p<0.0001
Screen Time			
2+ hours *(ref.)*	6998	94.6	χ^2=5879.35
< 2 hours	402	5.4	df=1
			p<0.0001
			Pr > |t|
Daily MVPA (mean)	**121.2 (±79.2)**		**t=131.5**
			p<0.0001

Note: Students in Grade 8 pertain to the Quebec Sample only. Students in Grade 11 were linked across three years indicating that they enrolled in an additional year of school following Grade 12.
X^2=chi-square value
df= degrees of freedom

5.1.2. Stratified Analyses at Baseline

Student-Level Characteristics by Cannabis Use Frequency at Baseline

As shown in Table 2, at baseline, those who were current users had greater self-reported minutes of MVPA (139.5 min/day) than both non-current (124.0 min/day) and non-users (120.2 min/day) at baseline. Interestingly, non-users of cannabis self-reported lower CSEP guideline achievement (27.9%) than both non-current (32.0%) and current cannabis users (39.9%). These results indicate that at baseline, current users had greater physical activity rates and were more apt to meet the guidelines than non-current cannabis users and cannabis non-users.

At baseline, when considering cannabis use frequency, current users had the highest proportions of being current binge drinkers (49.3%) compared to never (4.3%) and non-current (27.3%) binge drinkers. Similarly, non-current cannabis users were most often non-current binge drinkers (48.3%) compared cannabis non-users (15.8%) and cannabis current users (37.5%). In observing spending money at baseline, current users had a higher proportion of respondents with a weekly disposable income of $100 or more (17.9%) than non-users (5.6%) and non-current users (11.9%). Other related information regarding baseline student-level characteristics by cannabis use frequency can be found in table 2.

Table 2: Sample descriptive statistics of student-level characteristics of students participating in the longitudinal linked sample at baseline [year 5 (2016-2017)] of the COMPASS Study, Canada, stratified by cannabis use frequency (n=7400).

Variable	Non-User n=6785	Non-Current Use n=319	Current Use n=296	Chi-Square (χ^2) df p-value
Sex				
Female *(ref.)*	3744 (55.2)	174 (54.6)	161 (54.4)	χ^2=0.12
Male	3041 (44.8)	145 (45.4)	135 (45.6)	df=2
				p=0.94
Binge Drinking				
Never Binge Drinker *(ref.)*	5421 (79.9)	78 (24.4)	39 (13.2)	χ^2=1530.27
Non-Current Binge Drinker	1074 (15.8)	154 (48.3)	111 (37.5)	df=4
Current Binge Drinker	290 (4.3)	87 (27.3)	146 (49.3)	p<0.0001
Grade				
9 *(ref.)*	3461 (51.0)	123 (38.5)	105 (35.5)	χ^2=177.19
10	2315 (31.5)	170 (53.3)	174 (58.8)	df=6
11	89 (1.3)	5 (1.6)	8 (2.7)	p<0.0001
8 (Quebec Only)	1100 (16.2)	21 (6.6)	9 (3.0)	
Spending Money				
$0	1413 (20.8)	32 (10.0)	32 (10.8)	χ^2=129.84
$1-20 *(ref.)*	2478 (36.6)	111 (34.9)	99 (33.4)	df=8
$21-100	1373 (20.2)	83 (26.0)	79 (26.7)	p<0.0001
$100 or more	383 (5.6)	38 (11.9)	53 (17.9)	
Do not know	1140 (16.8)	55 (17.2)	33 (11.2)	
Race				
White *(ref.)*	5073 (74.8)	250 (78.4)	196 (66.2)	χ^2=13.46
Non-White	1712 (25.2)	69 (21.6)	100 (33.8)	df=2
				p=0.0012
Weight Status				
Under Weight	908 (13.4)	20 (6.3)	14 (4.7)	χ^2=66.20
Normal Weight *(ref.)*	3534 (52.1)	203 (63.6)	171 (57.8)	df=8
Over-Weight	496 (7.3)	31 (9.7)	39 (13.2)	p<0.0001

Obese	170 (2.5)	13 (4.1)	11 (3.7)	
Not Stated	1677 (24.7)	52 (16.3)	61 (20.6)	
CSEP				
Doesn't Meet Guidelines *(ref.)*	4892 (72.1)	217 (68.0)	178 (60.1)	χ^2=21.82
Meets Guidelines	1893 (27.9)	102 (32.0)	118 (39.9)	df=2
				p<0.0001
Sleep				
< 8 hours *(ref.)*	3180 (46.9)	177 (55.5)	171 (57.8)	χ^2=21.66
8-10 hours	3605 (53.1)	142 (44.5)	125 (42.2)	df=2
				p<0.0001
Screen Time				
2+ hours *(ref.)*	6393 (94.2)	313 (98.1)	292 (98.6)	χ^2=19.00
< 2 hours	392 (5.8)	6 (1.9)	4 (1.4)	df=2
				p<0.0001
				F-test Pr > F
MVPA (mean)	**120.2 (±78.8)**	**124.0 (±76.8)**	**139.5 (±89.8)**	**F= 8.59 p=0.0002**

Note: Students in Grade 8 pertain to the Quebec Sample only. Students in Grade 11 were linked across three years indicating that they enrolled in an additional year of school following Grade 12.

Student-Level Characteristics by CSEP Guideline Achievement at Baseline

As shown in Table 3, at baseline, non-current and current cannabis users were slightly more likely to meet the CSEP guidelines (4.8% and 5.6% respectively) than those who did not meet the CSEP guidelines (4.1% and 3.4% respectively). Unsurprisingly, there were greater reported average minutes of MVPA for those who met the guidelines (189.1 min/day) than those who did not meet the guidelines (94.0 min/day). In addition, students meeting the CSEP guidelines had greater than double the minutes of MVPA relative to an individual not meeting the CSEP guidelines at baseline.

A large proportion of respondents reported a normal weight status (60.0%) when achieving the CSEP guidelines, but 49.9% reported a normal weight status when not meeting the guidelines. Curiously, many more students were reluctant to state their weight status, indicating a Not Stated status, when not meeting the guidelines (27.1%) when compared to those who do meet the CSEP guidelines (17.0%). There were more non-current (19.7%) and current binge drinkers (9.4%) in those who met the CSEP guidelines when compared to those who had not met the guidelines (17.4% and 6.1% respectively). Other related information regarding baseline student-level characteristics by cannabis use frequency can be found in table 3.

Table 3: Sample descriptive statistics of student-level characteristics of students participating in the longitudinal linked sample at baseline [year 5 (2016-2017)] of the COMPASS Study, Canada, stratified by the Canadian Society for Exercise Physiology (CSEP) physical activity guideline achievement (n=7400).

Variable	Doesn't Meet Guideline n=5287	Meets Guideline n=2113	Chi-Square (χ^2) df p-value
Cannabis Use Frequency			
Non-Use *(ref.)*	4892 (92.5)	1893 (89.6)	χ^2=21.82
Non-Current Use	217 (4.1)	102 (4.8)	df=2
Current Use	178 (3.4)	118 (5.6)	p<0.0001
Sex			
Female *(ref.)*	3119 (59.0)	960 (45.4)	χ^2=112.22
Male	2168 (41.0)	1153 (54.6)	df=1
			p<0.0001
Binge Drinking			
Never Binge Drinker *(ref.)*	4041 (76.5)	1497 (70.9)	χ^2=33.81
Non-Current Binge Drinker	922 (17.4)	417 (19.7)	df=2
Current Binge Drinker	324 (6.1)	199 (9.4)	p<0.0001
Grade			
9 *(ref.)*	2558 (48.4)	1131 (53.5)	χ^2=71.79
10	1729 (32.7)	750 (35.5)	df=3
11	75 (1.4)	27 (1.3)	p<0.0001
8 (Quebec Only)	925 (17.5)	205 (9.7)	
Spending Money			
$0	1160 (21.9)	317 (15.0)	χ^2=115.45
$1-20 *(ref.)*	1943 (36.8)	745 (35.3)	df=4
$21-100	981 (18.5)	552 (26.1)	p<0.0001
$100 or more	285 (5.4)	189 (8.9)	
Do not know	918 (17.4)	310 (14.7)	
Race			
White *(ref.)*	3912 (74.0)	1609 (76.0)	χ^2=3.38
Non-White	1375 (26.0)	506 (24.0)	df=1
			p=0.07
Weight Status			
Under Weight	689 (13.0)	253 (12.0)	χ^2=96.15
Normal Weight *(ref.)*	2639 (49.9)	1269 (60.0)	df=4
Over-Weight	389 (7.4)	177 (8.4)	p<0.0001
Obese	139 (2.6)	55 (2.6)	
Not Stated	1431 (27.1)	359 (17.0)	
Sleep			

< 8 hours *(ref.)*	2553 (48.3)	975 (46.1)	χ^2=2.79
8-10 hours	2734 (51.7)	1138 (53.9)	df=1
			p=0.095
Screen Time			
2+ hours *(ref.)*	4986 (94.3)	2012 (95.2)	χ^2=2.45
< 2 hours	301 (5.7)	101 (4.8)	df=1
			p=0.12
			t-test
			Pr > |t|
MVPA (mean)	**94.0 ($\pm$60.2)**	**189.1 ($\pm$80.3)**	**t= -49.19**
			<0.0001

Note: Students in Grade 8 pertain to the Quebec Sample only. Students in Grade 11 were linked across three years indicating that they enrolled in an additional year of school following Grade 12.

5.2. Cannabis Use Frequency Changes from Baseline to Two-year Follow-up

As shown in Table 4, 11.9% of respondents who were non-users of cannabis at baseline transitioned to being current cannabis users at follow-up, whereas 67.2% of current cannabis users at baseline remained as current cannabis users at follow-up. Additionally, 14.4% of respondents who were non-users of cannabis at baseline transitioned to being non-current cannabis users at follow-up, whereas 32.0% of non-current cannabis users at baseline remained as non-current cannabis users at follow-up. Interestingly, although non-current users only made up 4.3% of baseline cases, among non-current users at follow-up, 48.9% of these respondents increased their cannabis use to current use. In contrast, 19.1% of non-current users at baseline decreased their cannabis use to non-use at follow-up. Other decreases were observed amongst current users at baseline, where 17.2% of respondents decreased their use to non-current use at follow-up and 15.6% decreased to non-use at follow-up. Among non-users at baseline, the majority (73.7%) remained as non-users at follow-up.

Table 4: Frequency table of self-reported student cannabis use frequency at baseline [year 5 (2016-20170] and two-year follow-up [year 7 (2018-2019)] of the longitudinal linked sample of the COMPASS study, Canada (n=7400).

		Cannabis Frequency 2018 (two-year follow-up)			
		Non-User	Non-Current User	Current User	Total[3]
Cannabis Frequency 2016 (baseline)	Non-User	4998 73.7%[1]	977 14.4%	810 11.9%	6785 91.7%
	Non-Current User	61 19.1%	102 32.0%	156 48.9%	319 4.3%
	Current User	46 15.6%	51 17.2%	199 67.2%	296 4.0%
	Total[2]	5105 69.0%	1130 15.3%	1165 15.7%	7400 100.0%

[1] This is the row percentage to depict change from baseline to follow-up.
[2] This is the percentage describing the total distribution of each category at baseline.
[3] This is the percentage describing the total distribution of each category at follow-up.

5.3. Research Question 1

As shown in Table 5, for an individual who decreased their cannabis use from baseline to two-year follow-up, there was a 1.22 (SE=14.51) unit increase in relative MVPA from baseline to follow-up. Furthermore, for an increase in cannabis use from baseline to two-year follow-up a 0.99 (SE=4.87) unit decrease in relative MVPA from baseline to follow-up was observed. However, regardless of the direction of the cannabis use change, neither change was found to significantly predict relative changes in MVPA and overall, cannabis change was not associated with relative MVPA at follow-up.

Results from Model II suggested that meeting the CSEP guidelines at baseline were associated with a 56.61 (SE= 4.65) unit decrease in relative MVPA at follow-up when compared to those who did not meet the CSEP guidelines at baseline. In other words, those who met the guidelines at baseline were more likely to decrease their minutes of MVPA at the two-year follow-up by approximately 57%. The model also suggested that there was a 14.44 (SE= 6.48) unit decrease in relative MVPA at follow-up for those who were underweight at baseline relative to a normal weight status at baseline. Other related information regarding the relative minutes of MVPA can be found in table 5.

Table 5: Adjusted beta estimates for the relative change in moderate-to-vigorous physical activity (MVPA) minutes at two-year follow-up [year 7 (2018-2019)] for students at baseline [year 5 (2016-2017)] of the longitudinal linked sample of the COMPASS Study, Canada, using linear mixed models.

	Model I	Model II	p-value
	β (SE)	β (SE)	
Intercept	26.82 (2.93)	44.59 (5.98)	<0.0001
Cannabis Use Change			
Cannabis Decrease	-6.63 (14.33)	1.22 (14.54)	0.93
No Change (*ref.*)	-	-	-
Cannabis Increase	-5.91 (4.72)	-0.99 (4.87)	0.84
Sex			
Female (*ref.*)		-	-
Male		0.70 (4.18)	0.87
Binge Drinking Status at Baseline			
Never Binge Drinker (*ref.*)		-	-
Non-Current Binge Drinker		-6.43 (5.64)	0.25
Current Binge Drinker		-10.78 (8.46)	0.20
Grade at Baseline			
9 (*ref.*)		-	-
10		6.77 (4.74)	0.15
11		47.72 (17.81)	0.0074
8 (Quebec Only)		-1.82 (6.95)	0.79
Spending Money at Baseline			
$0		9.41 (5.73)	0.10
$1-20 (*ref.*)		-	-
$21-100		-5.48 (5.67)	0.33
$100+		-1.62 (8.98)	0.86
Do not Know		-2.51 (6.06)	0.68
Race			
White (*ref.*)		-	-
Non-White		-3.02 (4.84)	0.53
Weight Status at Baseline			
Underweight		-14.44 (6.48)	0.03
Normal Weight (*ref.*)		-	-
Overweight		-1.26 (7.92)	0.99
Obese		11.38 (12.94)	0.38
Not Stated		9.30 (5.14)	0.07
Sleep at Baseline			
< 8 hours (*ref.*)		-	-
8-10 hours		-6.73 (4.24)	0.11
Screen Time at Baseline			
2+ hours (*ref.*)		-	-

<2 hours	-12.33 (9.14)	0.18
CSEP Guideline Achievement at Baseline		
Doesn't Meet Guidelines *(ref.)*	-	-
Met Guidelines	-56.61 (4.65)	<0.0001

Note: Students in Grade 8 pertain to the Quebec Sample only. Students in Grade 11 were linked across three years indicating that they enrolled in an additional year of school following Grade 12. β= the beta estimate. (SE)= the standard error of the beta estimate.

5.4. Research Question 2

Findings from Table 6 provide information which predict the achievement of the CSEP guidelines at two-year follow-up within the longitudinal linked sample. The model first examined whether the interaction between CSEP at baseline and cannabis change was significant. As the effect of moderation was not significant, the interaction term was dropped from the model for parsimony. The following results are presented as the full adjusted model (Model V). As shown in Table 6, results suggest that the odds of meeting the CSEP guidelines at follow-up were not significantly different when a respondent decreased (aOR=1.30, 95% CI=0.93, 1.83) or increased (aOR=1.02, 95% CI=0.91, 1.14) their cannabis use frequency relative to those not changing their cannabis use frequency from baseline to follow-up. A male respondent had significantly higher odds (aOR=2.07, 95% CI=1.83, 2.34) of meeting the CSEP guidelines at two-year follow-up relative to a female respondent. Results suggest that for an individual in this longitudinal linked sample, current binge drinkers were at higher odds (aOR=1.35, 95% CI= 1.09, 1.69) of meeting the CSEP guidelines at two-year follow-up than those who were never binge drinkers. Non-current users were not significantly different than never binge drinkers at meeting the CSEP guidelines at two-year follow-up. Model V also suggests that those who were both underweight (aOR=0.82, 95% CI=0.68, 0.98) or had a not stated weight status (aOR=0.63, 95% CI=0.55, 0.72) relative to a normal weight status had significantly lower odds of meeting the CSEP guidelines at two-year follow-up. For a respondent who had met the CSEP physical activity guidelines at baseline, the odds of meeting the CSEP guidelines at two-year follow-up were significantly higher (aOR=3.59, 95% CI= 3.16, 4.09) relative to those who did not meet the CSEP guidelines at baseline. Other related information regarding the meeting of the CSEP guidelines at follow up for those who did not meet the CSEP guidelines at baseline can be found in table 6.

Table 6: Adjusted odds ratios for meeting the Canadian Society for Exercise Physiology (CSEP) physical activity guidelines at two-year follow-up [year 7 (2018-2019)] for students at baseline [year 5 (2016-2017)] of the longitudinal linked sample of the COMPASS study, Canada, using generalized estimating equation models.

	Model III (adjusted model)	Model IV (adjusted with interaction)	Model V (adjusted w/o interaction)	p-value
	OR (95% CI)	OR (95% CI)	OR (95% CI)	
Intercept	0.28 (0.25, 0.31)	0.14 (0.12, 0.17)	0.14 (0.12, 0.17)	<0.0001
Cannabis Use Change				
Cannabis Decrease	1.59 (1.18, 2.14)	1.59 (1.04, 2.40)	1.30 (0.93, 1.83)	0.13
No Change	-	-	-	-
Cannabis Increase	1.19 (1.07, 1.32)	1.09 (0.94, 1.27)	1.02 (0.91, 1.14)	0.73
Sex				
Female *(ref.)*		-	-	-
Male		2.07 (1.83, 2.34)	2.07 (1.83, 2.34)	<0.0001
Binge Drinking Status at Baseline				
Never Binge Drinker *(ref.)*		-	-	-
Non-Current Binge Drinker		1.09 (0.94, 1.27)	1.09 (0.94, 1.27)	0.25
Current Binge Drinker		1.35 (1.09, 1.68)	1.35 (1.09, 1.69)	0.01
Grade at Baseline				
9 *(ref.)*		-	-	-
10		0.81 (0.70, 0.95)	0.81 (0.70, 0.95)	0.01
11		0.65 (0.36, 1.16)	0.65 (0.37, 1.16)	0.15
8 (Quebec Only)		0.79 (0.59, 1.05)	0.79 (0.59, 1.05)	0.11
Spending Money at Baseline				
$0		0.93 (0.79, 1.08)	0.93 (0.79, 1.09)	0.35
$1-20 *(ref.)*		-	-	-
$21-100		1.28 (1.10, 1.48)	1.28 (1.10, 1.48)	0.001
$100+		1.14 (0.93, 1.40)	1.14 (0.93, 1.40)	0.22
Do not Know		1.06 (0.88, 1.28)	1.06 (0.88, 1.28)	0.56
Race				
White *(ref.)*		-	-	-
Non-White		0.86 (0.75, 0.98)	0.86 (0.75, 0.98)	0.03
Weight Status at Baseline				
Underweight		0.82 (0.68, 0.98)	0.82 (0.68, 0.98)	0.03
Normal Weight *(ref.)*		-	-	-
Overweight		0.93 (0.74, 1.17)	0.93 (0.74, 1.16)	0.52
Obese		0.77 (0.53, 1.12)	0.78 (0.54, 1.12)	0.18
Not Stated		0.63 (0.55, 0.72)	0.63 (0.55, 0.72)	<0.0001
Sleep at Baseline				
<8 hours *(ref.)*		-	-	-
8-10 hours		1.03 (0.90, 1.18)	1.03 (0.90, 1.18)	0.68

Screen Time at Baseline			
2+ hours *(ref.)*	-	-	-
<2 hours	1.25 (0.96, 1.64)	1.25 (0.95, 1.63)	0.11
CSEP Guidelines at Baseline			
Did not meet guidelines *(ref.)*	-	-	-
Met guidelines	3.80 (3.28, 4.40)	3.59 (3.16, 4.09)	<0.0001
CSEP Guidelines x Cannabis Decrease	0.66 (0.37, 1.20)	-	0.17
CSEP Guidelines x Cannabis No Change	-	-	-
CSEP Guidelines x Cannabis Increase	0.86 (0.67, 1.11)	-	0.24

Note: Students in Grade 8 pertain to the Quebec Sample only. Students in Grade 11 were linked across three years indicating that they enrolled in an additional year of school following Grade 12. OR is the non-adjusted odds ratio. 95% CI is the 95% confidence interval.

6. Discussion

6.1. Proportions of cannabis use and changes in cannabis use over time

Our data suggest that among this large sample of Canadian youth, cannabis use is common and remains as an important public health issue. As such, my study quantified youth cannabis use prevalence at baseline, as well as over time among COMPASS participants. At baseline, about 1 in 10 youth had used cannabis within the past year or more frequently; at two-year follow-up, the prevalence of those who used cannabis within the past year or more frequently increased to approximately 1 in 3 youth. This is consistent with longitudinal literature, where research shows that at baseline approximately 1 in 10 youth have self-reported past year cannabis use (33–35,97). Other longitudinal literature has described that youth past year cannabis use prevalence was approximately 1 in 5 youth at baseline but later increased to about 1 in 3 youth at two-year follow-up (98). This thesis is consistent with current literature regarding the prevalence of cannabis use frequency.

In general, when examining the changes in cannabis use, we identified that large proportions of students either maintained or escalated their use relative to decreasing their use. Findings demonstrate that approximately three quarters of non-users, a third of non-current users, and about two thirds of current users remained within the same cannabis use category at follow-up. The escalation and maintenance of use both seemed to be more common than the cessation of use within this study. This is consistent with research previously showing that as youth progress through high-school, cannabis use generally increases by grade (99). Moreover, these results are not surprising, as the pre-legalization trends found in a Canadian repeated cross-sectional study reported similar findings. Researchers found that the amount of never users of cannabis decreased where cannabis use frequency increased gradually over time; the majority of students either maintain or increase their use, with a smaller proportion ceasing their cannabis use (37). This thesis confirms the literature on the changes and trends in cannabis use. These results are particularly novel as well, in that they examine the longitudinal changes in cannabis, rather than examining them in a repeated cross-sectional or cross-sectional design. This methodology allows for a more direct observation of the changes in cannabis use patterns between time points, providing a deeper understanding of the factors which may play a role in changing cannabis use behaviours within students.

Though these results are unsurprising, they are concerning, as results from our study suggest that the frequency of cannabis use has been increasing, with more youth initiating use. With the rising proportion of youth cannabis users, these youth may be at a greater risk of being subject to the health implications of altering their cannabis use frequency. However, it is of importance to public health and school-based interventions to target at risk youth to prioritize methods in which cannabis use uptake and overall use can be reduced over time.

6.2. Physical activity rates and the Canadian Society for Exercise Physiology physical activity guidelines amongst youth

In terms of the relative change in MVPA, this study found that on average, youth had decreased their daily MVPA by roughly 12% from baseline to follow up (Appendix B.1). Our

results are consistent with other research on relative changes in MVPA, which has found that on average, youth decrease both their absolute and relative MVPA over time (25,26,100). Similar to our results, a systematic review assessing youth relative MVPA found that on average children and youth decrease their MVPA annually by 3.4% (25). When isolating the results from this study to youth aged 13 and upwards, relative changes in MVPA decreased by an average of 8.4%, and by age 15 relative MVPA annually decreased by up to 15% (25). In our sample, we found that youth decreased their physical activity rates over time, which seems to be typical with regards to current literature. As such, interventions must work to promote physical activity and attenuate the percentage decrease in MVPA over time. Those with little to no physical activity will benefit greatly from small increases in MVPA; those who are highly trained continue to benefit from physical activity despite the average decrease in MVPA over time.

In the present study, close to a third of respondents met the CSEP physical activity guidelines at baseline. This prevalence is consistent with other prevalence literature, where cross-sectional findings indicate approximately two-thirds of respondents had not met the CSEP physical activity guidelines (24). In addition, the 2018 ParticipACTION report card for Canadian youth reported that 36% of children and youth aged 5-17 had met the CSEP physical activity guidelines (23). Though these results are unsurprising, they consistently demonstrate that roughly a third of youth are meeting the CSEP physical activity guidelines; however, the majority of youth remain inactive by guideline standards. There is room for improvement in supporting youth to meet the CSEP physical activity guidelines and in those who are at the lowest levels of physical activity. A greater emphasis could be directed towards interventions which promote overall physical activity across the school day in an attempt to increase CSEP physical activity guideline achievement.

6.3. Student characteristics associated with physical activity rates and guideline achievement

6.3.1. Cannabis use and physical activity rates

In our sample at baseline, we identified that current cannabis users reported almost 20 additional minutes of MVPA per day (139.5 min/day) than non-users (120.2 min/day), and that approximately 40% of current users met the CSEP guidelines, which suggests that cannabis users appeared to be more active than non-cannabis users in our baseline sample. This was unexpected; although results are inconclusive, previous literature has suggested potential inverse relationships between cannabis and daily physical activity (38). However, research suggests that this relationship may be in part due to social norms and peer pressure, sex differences, the co-occurrence of binge drinking, and specific sport participation, which require further investigation to observe moderating effects (38,58,59,101). Other reasoning includes the perception of cannabis use in youth, where some respondents may consider the substance to be safe or less harmful (58,59,101). Literature has found that youth are more likely to use substances if their perception of the substance is not considered harmful (101). Further research has found that youth are often unaware or misinformed about the harms of cannabis use when compared to awareness of the harms of other substances such as tobacco and alcohol (101). Within previous literature respondents described cannabis to not be harmful to health, whereas tobacco and other substances were described with negative perceptions and were seen as more harmful (101). Some literature has also alluded to the perception that cannabis has a positive influence on physical activity

31

performance (102). As such, there may be underlying independent associations related to cannabis use and cannabis perception with physical activity that were beyond the scope of our study.

In this study, I hypothesized that the change in youth cannabis use would be associated with relative MVPA, where the increase in cannabis use over time would be associated decreased relative MVPA and the decrease in cannabis use over time would be associated with increased relative MVPA. Similarly, I hypothesized that the increase in cannabis use over time would be associated with a decreased likelihood in meeting the CSEP physical activity guidelines at follow-up and the decrease in cannabis use over time would be associated with an increased likelihood in meeting the CSEP physical activity guidelines at follow-up. However, results demonstrate that students who had decreased their cannabis use frequency at follow-up had no significant difference in changing their relative MVPA compared to students who did not change their cannabis use frequency. In addition, students who had increased their cannabis use frequency had no significant difference in changing their relative MVPA when compared to students who did not change their cannabis use frequency. It was also found that neither the increase nor decrease in use were significantly associated with meeting the CSEP physical activity guidelines at two-year follow-up. Previous research on MVPA and changes in cannabis use suggests similar results; past research has found that neither increased nor decreased cannabis users were significantly associated with changes in MVPA (49). Though longitudinal literature on CSEP guideline achievement is scarce, the results from this thesis are consistent with cross-sectional literature which has found that cannabis use was not associated with CSEP guideline achievement (24,48). The present study did not identify statistically significant results for the association between cannabis use, relative MVPA, and CSEP guidelines. A plausible explanation could be due to increasing obligations in school which reduce the time to participate in physical activity, which is independent of cannabis use. Additionally, specific program changes in certain schools surrounding physical activity or cannabis use may influence the independent changes in both of these health behaviours; the evaluation of initiative changes were not possible, however. It should be mentioned that the general acceptance of cannabis in recent years could further play a role in changing cannabis use. These assumptions would warrant additional investigation.

This study also accounted for the interaction between CSEP guideline achievement at baseline and cannabis use on CSEP guideline achievement at follow-up. The result was not significant however, which indicates that the association between cannabis increase or decrease and CSEP guideline achievement at follow up is not moderated by CSEP guidelines at baseline. Given the lack of research on youth CSEP achievement, it was necessary to investigate the interactions between cannabis change and baseline CSEP achievement to determine any moderating effects on CSEP achievement in a follow-up year. Results suggest that regardless of the level of CSEP achievement at baseline, the associations between cannabis use change and CSEP at follow-up were not significant and were not due to the moderating effect of CSEP baseline achievement.

To the author's knowledge, this is one of the first studies to longitudinally measure the relative changes in MVPA and calculate a percentage change in MVPA in a Canadian youth cohort. Our study is also amongst the first to have examined the longitudinal association between cannabis use changes and its association with CSEP guideline achievement over time. This study shows how various modifiable and demographic characteristics have been associated with the changes in physical activity in a youth context. The results indicate that cannabis use may not have as large of an association on physical activity and guideline achievement as presumed. This may

highlight the need for further investigation to other facets of youth behaviour which may be associated with the relative changes in MVPA and CSEP achievement over time respectively.

6.3.2. Correlates associated with physical activity rates and CSEP guideline achievement

Consistent with other research, the respective associations between student-level characteristics and MVPA and CSEP guideline achievement were as expected. In our study those who had $21-100 of weekly spending money had greater odds of CSEP guideline achievement, which is consistent with spending money literature, where those with greater spending money are more likely to meet the physical activity guidelines (48). Furthermore, males were twice as likely to meet the CSEP guidelines than females, which is as expected, where males have higher rates of activity than females at all observed age groups (12,24,103). In our study, males also reported more than 20 minutes more of MVPA per day on average than females at baseline. On the other hand, when examining sex-specific relative changes in MVPA, our study found no significant differences in changing relative MVPA over time between males and females in youth. Inconsistent with other literature, it has been found that the relative change in MVPA in females significantly decreases at a greater rate than in males in children and youth (25). However, it is also seen that the changes in relative MVPA are not significant, which validate the results in our study (25). This suggests that the relative MVPA differences by sex are likely established well before entering secondary school, as from grade 9 onwards, there were no differences in changes in relative MVPA. As such, further efforts should be made to promote physical activity amongst young females prior to entering grade 9.

Consistent with weight status research, those who are underweight had both significantly decreased their relative MVPA over time and were at lower odds of CSEP guideline achievement at follow-up. For example, literature suggests that underweight youth engage in lower rates of physical activity and are less likely to meet physical activity guidelines (24,104). When examining a Not Stated weight status at baseline, over a quarter of respondents with a Not Stated weight status had not met the CSEP guidelines and were at half the odds of meeting the CSEP guidelines at follow-up. However, this is expected, as previous research has reported similar findings (24). A large Canadian cohort study indicated that there are inherent reasons and motivations as to why respondents may be reluctant to state their weight status; a common reason surrounds body image concerns (70). In these cases, we may be underestimating the amount of overweight or obese respondents, which align with results that these respondents may not be meeting physical activity recommendations (70,104).

Current binge drinkers at baseline had significantly higher odds of meeting the CSEP guidelines at follow up than non-current and never binge drinkers. Consistent with previous research on the topic, those who are more physically active often report a higher frequency of binge drinking (58,59). Our results validate these findings as current binge drinkers are almost 30% more likely to meet the CSEP guidelines at two-year follow-up. While these results may seem counterintuitive, there is evidence which suggests that there is also an association between team sports and alcohol (58,59). Binge drinking has been deemed to be associated with sports participation and school sports culture, where these individuals are more likely to engage in social settings where alcohol is common (58,59). While team sports and sports participation should still be promoted alongside the reduction of binge drinking, there may be opportunity for intervention

within these contexts of sports participation and athletics to reduce the risks of binge drinking while maintaining physical activity rates which should be investigated.

In our study, it should also be noted that roughly half of current cannabis users were also current binge drinkers. Binge drinking research shows that the co-occurrence of cannabis use and binge drinking is common, and that drinking is common amongst active youth, which may be associated with higher cannabis use in active youth (58,59). While this moderating effect was beyond the scope of this study, future research should be keen to further explore the co-occurrence of binge drinking and cannabis use with physical activity in youth. This high-risk group is of interest due to the potential multiplicative health implications of concurrent use of these substances (105). The clustering of these risky behaviours should be the target of future health interventions to mitigate the risk in these vulnerable groups. Physical activity promotion efforts in youth need to address this relationship of high-risk users, while especially accounting for the link to youth who participate in sports.

Those who met the CSEP guidelines at baseline had experienced a roughly 56% decrease in relative MVPA on average when observed in the follow-up year. In our case, youth are seen to be active at the baseline year but have decreased their minutes of physical activity when observed at follow-up, which remains relatively consistent with other physical activity research. For instance, youth begin decreasing their physical activity rates through adolescence, where with each increasing year, youth are less likely to meet physical activity recommendations (13). In our sample, respondents were over three times more likely to meet the CSEP guidelines at follow-up if they met the guidelines at baseline. The decrease in MVPA over time is consistent with other literature, but the changes in CSEP achievement have not been heavily explored longitudinally. Potential reasoning behind the decrease in MVPA over time could be due to increased workloads and school related obligations which allow for less time spent in MVPA, non-mandatory participation in physical education over time, and an increase in sedentary behaviours. Some speculation may further surround the baseline ceiling effect of highly active youth, where those who start off as the most active may also experience larger relative declines in physical activity. However, despite this decrease in physical activity minutes over time, this should not be a major point of concern. Youth are initially meeting the CSEP guidelines and there are inherent benefits in achieving physical activity recommendations; the CSEP guidelines should continue to be promoted. There is an average decline in physical activity minutes, yet youth are still meeting the MVPA and CSEP recommendations for physical activity. Where our results suggest that MVPA is decreasing on average, youth also have the opportunity to become more active over time. More work should be done to uncover the underlying factors behind MVPA decreasing over time despite CSEP guideline achievement remaining consistent in order for schools to target the appropriate demographics and work towards an overall increase in MVPA.

6.4. Strengths and limitations

The design of this study has many inherent strengths. Primarily, this study used a longitudinal design to study the changes in physical activity and the changes in CSEP guideline achievement over time. To date, much of the literature published on the topic of physical activity concerns itself with cross-sectional or repeated cross-sectional designs assessing minutes of

MVPA. The longitudinal design allows for the investigation and confirmation of these relationships over time. Furthermore, the more stringent CSEP guidelines are infrequently investigated in comparison to MVPA rates, especially longitudinally. The CSEP guidelines provide a meaningful portrayal of overall physical activity with respect to various student-level characteristics. In our context, the trends in achieving the CSEP guidelines are not well known, and our study allows for the observation of the trajectory of CSEP achievement in youth, as well as many factors associated with physical activity achievement over time. Furthermore, the COMPASS study is not a substance use or physical activity specific study; the COMPASS host study was designed with the intention to evaluate a wide range of school programs and policies while assessing health behaviours. The study consists of a large sample of youth which provides a window into youth health behaviours.

This research is not without limitations, however. The study uses a convenience sample that is not nationally or provincially representative. Therefore, the results may not represent all Canadian youth. Furthermore, the data of the COMPASS study rely on self-report measures, where social desirability or recall bias may be introduced. Nonetheless, it has been seen that self-reported measures often provide an accurate representation of health behaviours (27,66). It should be mentioned that the COMPASS study bases many of its measures on valid and reliable national surveillance measures which allows for the collection of self-reported data from a large scope of students (89). Furthermore, while this study implemented a longitudinal design from baseline to two-year follow-up, there may be limitations surrounding the transitional changes of the year 6 wave. Due to the fact that this study focused on the overall change across time points, there may be intermediate changes from baseline to year 6 which may not be accounted for; a respondent may potentially change from baseline to year 6, but revert to their previous use category at two-year follow-up, resulting in no net behavioural change. There may be further contextual factors that are not captured in this examination, which were beyond the scope of this study. Within the study design, there also exists a hierarchical structure of data in which the clustering of responses must be considered. Where this study considered school level clustering, future studies may want to consider the investigation into between province clustering should the level of clustering, distribution of schools within provinces, and power within models be appropriate.

In this study, we found that the respondents in our longitudinal sample reported close to double the daily recommendation of MVPA for youth (121 min/day). Other objective Canadian longitudinal studies have found that youth were achieving an average of about 84 minutes of MVPA per day (18), where another study found that youth achieved an average of roughly 60 minutes of MVPA per day (106). However, consistent with evidence from longitudinal surveillance data using self-report, the rates of MVPA seem to be much higher than accelerometry data (62,87). Self-report cross-sectional surveillance data also seem to have similar achievements of daily MVPA (33). Accelerometry allows for more accurate estimates of physical activity, however these methods are not always plausible due to the time and cost intensiveness of this method (28). Self-report may instead be used as a cost-effective alternative to participants (28). Results for self-reported MVPA are consistently higher than objective MVPA measures, which suggests an overestimation of self-reported MVPA. Although our self-reported measures are higher, because our study addresses the longitudinal physical activity rates within the same students, the changes in physical activity are consistently overestimated within the same students over time.

Additionally, while the self-report questionnaire provides information regarding the time spent in MVPA, there is a lack of information on how respondents spent their time engaging in different forms of physical activity. For instance, questionnaire items do not assess the time spent in resistance training exercises, habitual physical activity, or type of sport participation (team versus individual; varsity versus intramural). Dependent on the time spent in different forms of physical activity the associations between physical activity and cannabis use may vary by context, which warrants future investigation.

In our sample, we employed complete-case analyses, where all variables with complete responses are included in analyses and any respondents with missing data were omitted. However, the COMPASS study also uses purposeful sampling methods based on active-information passive-consent parental permission protocols, which have demonstrated the ability to reduce social desirability bias and underreporting of questionnaire items through increased participation, while upholding confidentiality, which is imperative when dealing with substance use measures (77). Also, it should be acknowledged that in general, self-reported substance use patterns may not reflect actual amounts. It has been found that in the smoking literature – that youth often recant their smoking practices based on revising their definition of current use or failing to recall their smoking practices, which has been extended to cannabis use (107). Longitudinally, youth substance users may be misrepresented as well due to a higher degree of absenteeism (82). In these cases, youth decreases in substance use may be overestimated. Furthermore, the degree of non-response weight status data is objectively high, where there may be inherent motivations behind non-response, and weight status may be overestimated (70). To minimize these biases and underreporting, anonymity and confidentiality are ensured through the administration the self-reported questionnaire.

6.5. Implications

6.5.1. Implications for research

Findings from this thesis provided evidence that cannabis use had no significant association with either relative MVPA or the achievement of the CSEP guidelines over time in this sample of Canadian youth. Despite this, cannabis use and changes in cannabis use have important implications in youth health over time that should not be ignored. Evidence from this thesis also identified other student-level characteristics that were associated with physical activity, such as sex, binge drinking, and BMI weight status, which may be of greater focus for future interventions surrounding physical activity. As such, research which replicates this study are recommended in different samples of youth under the consideration that results were not as expected; for example, this may be achieved through using a longitudinal linked sample with additional study years.

Although beyond the scope of this study, other significant characteristics and moderating effects could be investigated in future research. Where cannabis use is independently associated with sex, race, BMI, and binge drinking in the literature, the moderation of these variables could provide meaningful results to better understand these relationships, and how they may be associated with physical activity. Additionally, future research which examines the role of type of specific sport and sports physical activity participation with cannabis use could identify important

associations in youth physical activity and cannabis use behaviours. The context in which youth accumulate MVPA may be more important than the amount of MVPA per se. Through this investigation, the exploration of moderating effects of type of sport in future research, for example (individual versus team sports), may assist in illustrating the complex relationship between physical activity and substance use. While our findings do suggest that physical activity and cannabis use are not associated, research can be more explicit in using team sports and sports participation as a forum to assist in preventing unhealthy behaviours, which includes cannabis use. Using the knowledge of the association between team sports and binge drinking, as well as co-occurring use of alcohol and cannabis, future practices could address these at-risk groups. Where these groups tend to be more active, initiatives should look to prevent unhealthy behaviours while maintaining physical activity rates. In addition, where past evidence suggests that the association between cannabis use and physical activity may be dependent on the biological mechanism of the endocannabinoid system, perhaps this association may be more dependent on various contextual and social factors surrounding these behaviours. Future practices using this knowledge may further help improve how physical activity promotion initiatives address the prevention of substance use.

Furthermore, though the details are unavailable on the student questionnaire, there may be potential mediating factors which may mask or attenuate the association between cannabis use and physical activity such as the mode of cannabis administration. The different modes of cannabis use can potentially modify this interaction, where the ability to control for this variable could account for this mediation. A point of future direction may look to investigate the impact of the mode of cannabis use administration on physical activity in youth over time.

It is important for future research to further investigate the measures of relative MVPA and CSEP guideline achievement. Relative MVPA can be used assess the amount that individuals change their physical activity minutes over time; this is important because we can then apply this to different levels of the population of active and inactive individuals to assess who is still benefitting, or who is most at risk, from changes in physical activity on average. The use of relative change also helps mitigate some of the over report bias from self-reported MVPA measures. If a student over-reports on their daily MVPA, they are likely to consistently over-report their MVPA rates (27); therefore, focusing on the change of MVPA may be more important than the actual amount of MVPA reported. Other sociodemographic or school-level variables could be investigated in future studies to determine which youth populations are most at risk from reducing physical activity, as well as who is likely to benefit the most from small increases in physical activity. Furthermore, research should work to assess the CSEP physical activity guidelines alongside the MVPA guidelines. The CSEP guidelines are an important measure to examine overall youth physical activity achievement, and research should explore characteristics associated with the infrequently investigated measure of CSEP guideline achievement. Though beyond the scope of this study, the specific type of sport, intramural and varsity programs, parental physical activity support, school-level characteristics, and student-level demographics may all play a part in CSEP guideline achievement. A greater understanding of relative MVPA and CSEP guideline achievement allows for a detailed analysis of physical activity rates which can help foster, or at the very least maintain, physical activity in schools.

Cannabis use changes are also of interest. Although cannabis use may not be associated with physical activity, the longitudinal changes in cannabis use may be associated with a number

of student and school-level characteristics. To validate any cross-sectional literature regarding cannabis use frequency, the investigation of the changes over time would assist in confirming current cannabis use evidence. While cross-sectional literature provides a meaningful understanding of associations, the confirmation of these associations should also be conducted through further longitudinal research. It should also be mentioned that despite the majority of youth increasing or maintaining the same cannabis use category over time, there remain youth who decrease their cannabis use at two-year follow-up. These youth have changed their use status to non-use without formal cessation supports. While many strategies look to reduce the maintenance and escalation of cannabis use, or prevent use altogether, the decreased users of cannabis remain as a very interesting demographic. In our sample, approximately 16% of current users of cannabis at baseline had reduced their use at two-year follow-up. A unique opportunity exists within this demographic of decreased users in investigating the reasoning behind cannabis cessation, where further research can be conducted to inform future cessation efforts.

6.5.2. Implications for Practice

Efforts to promote physical activity among youth may not need to address cannabis use based on the results from this study. While there are health benefits to promoting cannabis cessation, our results suggest that cannabis cessation would not necessarily be the most effective approach in promoting physical activity in youth. However, substance use is a complex, multifactorial behaviour which should not be neglected, and we should continue to integrate practices which promote cannabis cessation. Future programming should look to address cannabis use behaviours over time using existing literature, as cannabis use continues to impact other facets of youth health. Universal approaches and prevention strategies have been described to encourage health promoting behaviours, while preventing health diminishing behaviours, including the reduction of cannabis use (108). Universal programs are initiatives which target all individuals, whereas alternatively, targeted approaches focus on those within high risk groups (109). In the case of youth substance use, universal programs have demonstrated efficacy in both high risk groups as well as in the general youth population (108). Universal programming is especially effective in early adolescence; research conducted with a focus on improving life-skills and other behavioural qualities and have demonstrated effectiveness in preventing substance use (110). Other universal approaches such as Climate School courses work as drug prevention programs to improve youth knowledge of substances while also working to decrease substance use (110,111). Universal approaches appear to be most effective when they are implemented in a school setting and do not follow traditional initiatives such as simply promoting abstinence of substances (110,112). Regardless of the implemented initiative, the focus should be on prevention programming and risk reduction through a combination of universal approaches which address the importance of family, friends, and the school environment, while using new and existing evidence to inform new practices (110).

In the generation of interventions to promote physical activity, we should consider the link to other behaviours and sociodemographic characteristics. Many student-level characteristics were seen to be associated with physical activity rates in students over time. As such, the focus of schools should be at the student-level. For schools looking to address physical activity rates in

their students, using approaches which consider the factors related to this study could prove to be beneficial. For example, schools which are looking to implement interventions that promote or maintain physical activity across secondary school should intervene with a focus in populations who are attaining low physical activity rates. From our study, a select few student characteristics which were seen to be associated with decreased physical activity (i.e. female students, underweight or not stated BMI status), which should be the target of program adoption in schools. For instance, the inclusion of programs which are specific to females or a diversity of physical activity options offered throughout the day may assist in promoting physical activity in students with lower physical activity. Literature has described that girls prefer to participate in single-sex physical activity programs; these often address the specific needs of girls, such as reducing male to female comparisons and increasing perceived enjoyment in physical activity (113). For example, including single-sex physical education classes which provide a variety of competitive and non-competitive activities, as well as providing programs which are inclusive to all peers have been seen to improve physical activity in females (113). Furthermore, where physical activity should be at the forefront of school-based MVPA improvements, the complement of other programs which promote physical activity before and after school, as well as during breaks or class-time, have been most effective in promoting physical activity (114,115).

The understanding of these physical activity and cannabis use relationships can assist key stakeholders in highlighting areas which would benefit from policy and program implementation within schools to promote physical activity and reduce cannabis use practices. The results can also be used to bridge the gap between stakeholders, schools, and student populations to promote the understanding of health behaviours, implement beneficial programs, and foster future research opportunities.

7. Conclusions

Cannabis use and physical inactivity are amongst the leading health concerns in Canadian youth. Given that youth do not sufficiently meet physical activity recommendations and cannabis use has been on the rise, it is of importance to continue to investigate these topics to inform health promotion efforts. The longitudinal findings from this study provide evidence consistent with the student-level characteristics associated with physical activity and identified that changes in cannabis use were not significantly associated with physical activity changes and guideline achievement. These findings suggest that the prevention programs which focus on this association can be shifted to better suit the needs of at-risk groups. Future research should look to examine moderating effects and other factors which may contribute to increased physical activity, while also investigating methods in which to decrease or prevent cannabis use. Further research can be conducted through the COMPASS platform to examine additional longitudinal associations, provide context to the directionality of associations, and inform and evaluate school-based interventions over time.

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APPENDICES

Appendix A: Additional Descriptive Statistics

Table 7: Sample descriptive statistics of student-level characteristics of students participating in the longitudinal linked sample at baseline [year 5 (2016-2017)] of the COMPASS Study, Canada, stratified by sex (n=7400).

Variable	Female n=4079	Male n=3321	Chi-Square (χ^2) df p-value
Cannabis Use Frequency			
Non-Use *(ref.)*	3744 (91.8)	3046 (91.6)	χ^2=0.12
Non-Current Use	174 (4.3)	145 (4.4)	df=2
Current Use	161 (3.9)	135 (4.0)	p=0.94
Binge Drinking			
Never Binge Drinker *(ref.)*	3017 (73.9)	2521 (75.9)	χ^2=7.28
Non-Current Binge Drinker	782 (19.2)	557 (16.8)	df=2
Current Binge Drinker	280 (6.9)	243 (7.3)	p=0.03
Grade			
9 *(ref.)*	2059 (50.5)	1630 (49.1)	χ^2=26.03
10	1331 (32.6)	1148 (34.6)	df=3
11	34 (0.8)	68 (2.0)	p<0.0001
8 (Quebec Only)	655 (16.1)	475 (14.3)	
Spending Money			
$0	714 (17.5)	763 (23.0)	χ^2=67.56
$1-20 *(ref.)*	1519 (37.2)	1169 (35.2)	df=4
$21-100	881 (21.6)	652 (19.6)	p<0.0001
$100 or more	216 (5.3)	258 (7.8)	
Do not know	749 (18.4)	479 (14.4)	
Race			
White *(ref.)*	3053 (74.8)	2466 (74.2)	χ^2=0.34
Non-White	1026 (25.2)	855 (25.8)	df=1
			p=0.56
Weight Status			
Under Weight	513 (12.6)	429 (12.9)	χ^2=32.90
Normal Weight *(ref.)*	2210 (54.2)	1698 (51.2)	df=4
Over-Weight	264 (6.5)	302 (9.1)	p<0.0001
Obese	83 (2.0)	111 (3.3)	
Not Stated	1009 (24.7)	781 (23.5)	
CSEP			
Doesn't Meet Guidelines *(ref.)*	3119 (76.5)	2168 (65.3)	χ^2=112.22

Meets Guidelines	960 (23.5)	1153 (34.7)	df=1
			p<0.0001
Sleep			
< 8 hours *(ref.)*	2029 (49.7)	1499 (45.1)	χ^2=15.56
8-10 hours	2050 (50.3)	1822 (54.9)	df=1
			p<0.0001
Screen Time			
2+ hours *(ref.)*	3824 (93.8)	3174 (95.6)	χ^2=11.87
< 2 hours	255 (6.2)	147 (4.4)	df=1
			p=0.0006
			t-test
			Pr > |t|
MVPA (mean)	**110.9 (±73.4)**	**133.8 (±84.2)**	**t= -12.30**
			<0.0001

Note: Students in Grade 8 pertain to the Quebec Sample only. Students in Grade 11 were linked across three years indicating that they enrolled in an additional year of school following Grade 12.

Appendix B: Additional Calculations

Appendix B.1: Relative MVPA Calculation:

Table 8: Moderate-to-Vigorous Physical Activity and Relative MVPA Values for Baseline [year 5 (2016-2017)] and Follow Up [year 7 (2018-2019)] in the COMPASS study, Canada (n=7400)

Variable	
MVPA 2016 (DVACTAVE_2016)	121.17
MVPA 2018 (DVACTAVE_2018)	106.83
RELATIVE MVPA	-11.8%

$$\text{Relative MVPA} = (\frac{DVACTAVE\_2018 - DVACTAVE\_2016}{DVACTAVE\_2016}) \times 100$$

$$\text{Relative MVPA} = (\frac{106.83 - 121.17}{121.17}) \times 100$$

Relative MVPA = -11.8%

Appendix B.2: ICC Calculations:

ICC Calculation for Research Question 1:

The calculation provides us with an ICC $= \frac{150.74}{(150.74+31367)} = 0.0048$, which means that 0.48% of the variation in relative min/day of MVPA are a function of the school a student attended. Adjustment for clustering was not necessary.

ICC Calculation for Research Question 2:

The calculation provides us with an ICC $= \frac{0.1506}{(0.1506+3.2898681337)} = 0.044$ for those who did not meet the CSEP guidelines at baseline. This means that 4.4% of the variation in the likelihood of meeting the CSEP guidelines are associated with the school that a student attended. Adjustment for clustering was not necessary.

Appendix C: COMPASS Student Questionnaire (Cq)

Compass

- **This is NOT a test.** All of your answers will be kept **confidential**. No one, not even your parents or teachers, will ever know what you answered. So, please be honest when you answer the questions.

- Mark only **one option per question** unless the instructions tell you to do something else.

- Choose the option that is the **closest** to what you think/feel is true for you.

Please, use a pencil to complete this questionnaire

Please mark all your answers with full, dark marks like this: ○ ● ○ ○
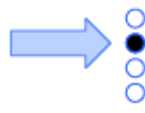
START HERE

Please read each sentence below carefully. Write the correct letter, number, or word on the line and then fill in the corresponding circle.

Note: These five questions are only used to link data from one year to the next. They cannot be used to identify participants. Only University of Waterloo researchers have access to the responses, and they never have access to student names or other information. All responses are strictly confidential.

The first letter of your middle name (if you have more than one middle name use your first middle name; if you don't have a middle name use "Z"):____	The name of the month in which you were born: _____	The last letter of your full last name: ___	The second letter of your full first name: ___	The first initial of your mother's first name (think about the mother you see the most):___
Ⓐ Ⓙ Ⓢ Ⓑ Ⓚ Ⓣ Ⓒ Ⓛ Ⓤ Ⓓ Ⓜ Ⓥ Ⓔ Ⓝ Ⓦ Ⓕ Ⓞ Ⓧ Ⓖ Ⓟ Ⓨ Ⓗ Ⓠ Ⓩ Ⓘ Ⓡ	① January ② February ③ March ④ April ⑤ May ⑥ June ⑦ July ⑧ August ⑨ September ⑩ October ⑪ November ⑫ December	Ⓐ Ⓙ Ⓢ Ⓑ Ⓚ Ⓣ Ⓒ Ⓛ Ⓤ Ⓓ Ⓜ Ⓥ Ⓔ Ⓝ Ⓦ Ⓕ Ⓞ Ⓧ Ⓖ Ⓟ Ⓨ Ⓗ Ⓠ Ⓩ Ⓘ Ⓡ	Ⓐ Ⓙ Ⓢ Ⓑ Ⓚ Ⓣ Ⓒ Ⓛ Ⓤ Ⓓ Ⓜ Ⓥ Ⓔ Ⓝ Ⓦ Ⓕ Ⓞ Ⓧ Ⓖ Ⓟ Ⓨ Ⓗ Ⓠ Ⓩ Ⓘ Ⓡ	Ⓐ Ⓙ Ⓢ Ⓑ Ⓚ Ⓣ Ⓒ Ⓛ Ⓤ Ⓓ Ⓜ Ⓥ Ⓔ Ⓝ Ⓦ Ⓕ Ⓞ Ⓧ Ⓖ Ⓟ Ⓨ Ⓗ Ⓠ Ⓩ Ⓘ Ⓡ

© COMPASS 2017

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About You

1. What grade are you in?

- ○ Grade 9
- ○ Grade 10
- ○ Grade 11
- ○ Grade 12

Quebec students only

- ○ Secondary I
- ○ Secondary II
- ○ Secondary III
- ○ Secondary IV
- ○ Secondary V
- ○ Other

2. How old are you today?

- ○ 12 years or younger
- ○ 13 years
- ○ 14 years
- ○ 15 years
- ○ 16 years
- ○ 17 years
- ○ 18 years
- ○ 19 years or older

3. Are you female or male?

- ○ Female
- ○ Male

4. How would you describe yourself? *(Mark all that apply)*

- ○ White
- ○ Black
- ○ Asian
- ○ Aboriginal (First Nations, Métis, Inuit)
- ○ Latin American/Hispanic
- ○ Other

5. About how much money do you usually get <u>each week</u> to spend on yourself or to save?
(Remember to include all money from allowances and jobs like baby-sitting, delivering papers, etc.)

- ○ Zero
- ○ $1 to $5
- ○ $6 to $10
- ○ $11 to $20
- ○ $21 to $40
- ○ $41 to $100
- ○ More than $100
- ○ I do not know how much money I get each week

6. How do you <u>usually</u> travel to and from school? *(If you use two or more modes of travel, choose the one that you spend most <u>time</u> doing)*

<u>To school</u>
- ○ By car (as a passenger)
- ○ By car (as a driver)
- ○ By school bus
- ○ By public bus, subway, or streetcar
- ○ By walking
- ○ By bicycling
- ○ Other

<u>From school</u>
- ○ By car (as a passenger)
- ○ By car (as a driver)
- ○ By school bus
- ○ By public bus, subway, or streetcar
- ○ By walking
- ○ By bicycling
- ○ Other

7. Did you attend <u>this</u> school last year?
- ○ Yes, I attended the same school last year
- ○ No, I was at another school last year

8. How tall are you <u>without</u> your shoes on? (Please write your height in feet and inches <u>OR</u> in centimetres, and then fill in the appropriate numbers for your height.)

- ○ I do not know how tall I am

"My height is _____ feet, _____ inches"

OR

"My height is _____ centimetres"

Height	
Feet	Inches

Height
Centimetres

Example:
My height is <u>5 ft 7 in</u>

Height	
Feet	Inches

9. How much do you weigh <u>without</u> your shoes on? (Please write your weight in pounds <u>OR</u> in kilograms, and then fill in the appropriate numbers for your weight.)

- ○ I do not know how much I weigh

"My weight is _____ pounds"

OR

"My weight is _____ kilograms"

Weight
Pounds

Weight
Kilograms

Example:
My weight is <u>127 lbs</u>

Weight
Pounds

[serial]

○○○○○○○○○○○○○○○○○○○○○○○○○○○○

10. How do you describe your weight?

- ○ Very underweight
- ○ Slightly underweight
- ○ About the right weight
- ○ Slightly overweight
- ○ Very overweight

11. Which of the following are you trying to do about your weight?

- ○ Lose weight
- ○ Gain weight
- ○ Stay the same weight
- ○ I am not trying to do anything about my weight

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

For example: If you spend about 3 hours watching TV each day, you will need to fill in the 3 hour circle, and the 0 minute circle as shown below:

	Hours											Minutes			
a) Watching/streaming TV shows or movies	⓪	①	②	●	④	⑤	⑥	⑦	⑧	⑨		●	⑮	㉚	㊺

	Hours											Minutes			
a) Watching/streaming TV shows or movies	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨		⓪	⑮	㉚	㊺
b) Playing video/computer games	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨		⓪	⑮	㉚	㊺
c) Doing homework	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨		⓪	⑮	㉚	㊺
d) Talking on the phone	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨		⓪	⑮	㉚	㊺
e) Surfing the internet	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨		⓪	⑮	㉚	㊺
f) Texting, messaging, emailing (note: 50 texts = 30 minutes)	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨		⓪	⑮	㉚	㊺
g) Sleeping	⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨		⓪	⑮	㉚	㊺

13. In the last 30 days, did you gamble online for money?

- ○ Yes
- ○ No

Physical Activity

HARD physical activities include jogging, team sports, fast dancing, jump-rope, and _any other_ physical activities that increase your heart rate and make you breathe hard and sweat.

MODERATE physical activities include lower intensity activities such as walking, biking to school, and recreational swimming.

---

14. Mark how many minutes of HARD physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time.

	Hours					Minutes			
Monday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Tuesday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Wednesday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Thursday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Friday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Saturday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Sunday	⓪	①	②	③	④	⓪	⑮	㉚	㊺

For example: If you did 45 minutes of _hard_ physical activity on Monday, you will need to fill in the 0 hour circle and the 45 minute circle, as shown below:

	Hours					Minutes			
Monday	●	①	②	③	④	⓪	⑮	㉚	●

---

15. Mark how many minutes of MODERATE physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time. Do not include time spent doing hard physical activities.

	Hours					Minutes			
Monday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Tuesday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Wednesday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Thursday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Friday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Saturday	⓪	①	②	③	④	⓪	⑮	㉚	㊺
Sunday	⓪	①	②	③	④	⓪	⑮	㉚	㊺

For example: If you did 1 hour and 30 minutes of _moderate_ physical activity on Monday, you will need to fill in the 1 hour circle and the 30 minute circle, as shown below:

	Hours					Minutes			
Monday	⓪	●	②	③	④	⓪	⑮	●	㊺

---

16. Were the last 7 days a typical week in terms of the amount of physical activity that you usually do?

○ Yes
○ No, I was _more_ active in the last 7 days
○ No, I was _less_ active in the last 7 days

○○○○○○○○○○○○○○○○○○○○○○○○○○○○   [serial]

58

17. Your closest friends are the friends you like to spend the most time with. How many of your closest friends are <u>physically active</u>?

- ○ None
- ○ 1 friend
- ○ 2 friends
- ○ 3 friends
- ○ 4 friends
- ○ 5 or more friends

18. Are you taking a physical education class at school this year?

- ○ Yes, I am taking one **this term**
- ○ Yes, I will be taking one or have taken one this school year, but **not this term**.
- ○ No, I am not taking a physical education class at school this year

19. Do you participate in before-school, noon hour, or after-school physical activities organized by your school? *(e.g., intramurals, non-competitive clubs)*

- ○ Yes
- ○ No
- ○ None offered at my school

20. Do you participate in competitive school sports teams that compete against other schools? *(e.g., junior varsity or varsity sports)*

- ○ Yes
- ○ No
- ○ None offered at my school

21. Do you participate in league or team sports outside of school?

- ○ Yes
- ○ No
- ○ There are none available where I live

22. On how many days in the last 7 days did you do exercises to strengthen or tone your muscles? *(e.g., push-ups, sit-ups, or weight-training)*

- ○ 0 days
- ○ 1 day
- ○ 2 days
- ○ 3 days
- ○ 4 days
- ○ 5 days
- ○ 6 days
- ○ 7 days

Healthy Eating

23. If you do not eat breakfast every day, why do you skip breakfast? *(Mark all that apply)*

- ○ I eat breakfast every day

- ○ I don't have time for breakfast
- ○ The bus comes too early
- ○ I sleep in
- ○ I'm not hungry in the morning

- ○ I feel sick when I eat breakfast
- ○ I'm trying to lose weight
- ○ There is nothing to eat at home
- ○ Other

24. In a *usual* school week *(Monday to Friday)*, on how many days do you do the following?	None	1 day	2 days	3 days	4 days	5 days
a) Eat breakfast	○	○	○	○	○	○
b) Eat breakfast provided to you as part of a school program	○	○	○	○	○	○
c) Eat lunch at school - lunch packed and brought <u>from home</u>	○	○	○	○	○	○
d) Eat lunch at school - lunch <u>purchased in the cafeteria</u>	○	○	○	○	○	○
e) Eat lunch purchased at a fast food place or restaurant	○	○	○	○	○	○
f) Eat snacks purchased from a vending machine **in your school**	○	○	○	○	○	○
g) Eat snacks purchased from a vending machine, corner store, snack bar, or canteen **off school property**	○	○	○	○	○	○
h) Drink sugar-sweetened beverages (soda pop, Kool-Aid, Gatorade, etc.) <u>Do not include diet/sugar-free drinks</u>	○	○	○	○	○	○
i) Drink high-energy drinks (Red Bull, Monster, Rock Star, etc.)	○	○	○	○	○	○
j) Drink coffee or tea **with sugar** (include cappuccino, frappuccino, iced-tea, iced-coffees, etc.)	○	○	○	○	○	○
k) Drink coffee or tea **without sugar**	○	○	○	○	○	○

25. On a *usual* weekend *(Saturday and Sunday)*, on how many days do you do the following?	None	1 day	2 days
a) Eat breakfast	○	○	○
b) Eat lunch	○	○	○
c) Eat foods purchased at a fast food place or restaurant	○	○	○
d) Eat snacks purchased from a vending machine, corner store, snack bar, or canteen	○	○	○
e) Drink sugar-sweetened beverages (soda pop, Kool-Aid, Gatorade, etc.) <u>Do not include diet/sugar-free drinks</u>	○	○	○
f) Drink high energy drinks (Red Bull, Monster, Rock Star, etc.)	○	○	○
g) Drink coffee or tea **with sugar** (include cappuccino, frappuccino, iced-tea, iced-coffees, etc.)	○	○	○
h) Drink coffee or tea **without sugar**	○	○	○

○○○○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

26. YESTERDAY, *from the time you woke up until the time you went to bed,* **how many servings** of meats and alternatives did you have? *One 'Food Guide' serving of meat and alternatives includes cooked fish, chicken, beef, pork, or game meat, eggs, nuts or seeds, peanut butter or nut butters, legumes (beans), and tofu.*

- ○ None
- ○ 1 serving
- ○ 2 servings
- ○ 3 servings
- ○ 4 servings
- ○ 5 or more servings

Canada's Food Guide Serving Sizes of Meats and Alternatives

Cooked fish, shellfish, poultry, lean meat 75g (2½ oz.) / 125 mL (½ cup) | Cooked legumes 175 mL (¾ cup) | Eggs 2 eggs | Peanut or nut butters 30 mL (2 Tbsp) | Shelled nuts and seeds 60 mL (¼ cup)

27. YESTERDAY, *from the time you woke up until the time you went to bed,* **how many servings** of vegetables and fruits did you have? *One 'Food Guide' serving of vegetables and fruit includes pieces of fresh vegetable or fruit, salad or raw leafy greens, cooked leafy green vegetables, dried or canned or frozen fruit, and 100% fruit or vegetable juice.*

- ○ None
- ○ 1 serving
- ○ 2 servings
- ○ 3 servings
- ○ 4 servings
- ○ 5 servings
- ○ 6 servings
- ○ 7 servings
- ○ 8 servings
- ○ 9 or more servings

Canada's Food Guide Serving Sizes of Vegetables and Fruits

Fresh, frozen or canned vegetables 125 mL (½ cup) | Leafy vegetables Cooked: 125 mL (½ cup) Raw: 250 mL (1 cup) | Fresh, frozen or canned fruits 1 fruit or 125 mL (½ cup) | 100% Juice 125 ml (½ cup)

28. YESTERDAY, *from the time you woke up until the time you went to bed,* **how many servings** of milk and alternatives did you have? *One 'Food Guide' serving of milk or milk alternatives includes milk, fortified soy beverage, reconstituted powdered milk, canned (evaporated) milk, yogurt or kefir (another type of cultured milk product), and cheese.*

- ○ None
- ○ 1 serving
- ○ 2 servings
- ○ 3 servings
- ○ 4 servings
- ○ 5 servings
- ○ 6 or more servings

Canada's Food Guide Serving Sizes of Milk and Alternatives

Milk or powdered milk (reconstituted) 250 mL (1 cup) | Fortified soy beverage 250 mL (1 cup) | Yogurt 175 mL (¾ cup) | Kefir 175 mL (¾ cup) | Cheese 50g (1½ oz.)
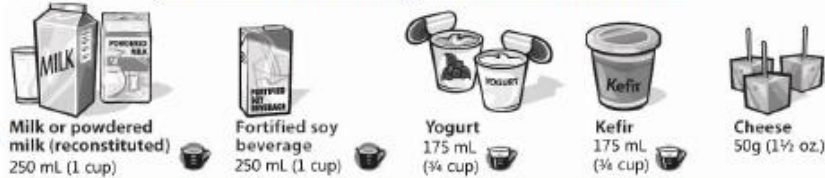
29. YESTERDAY, *from the time you woke up until the time you went to bed,* **how many servings** of grain products did you have? *One 'Food Guide' serving of grain products includes bread, bagels, flatbread such as tortilla, pita, cooked rice or pasta, and cold cereal.*

- ○ None
- ○ 1 serving
- ○ 2 servings
- ○ 3 servings
- ○ 4 servings
- ○ 5 servings
- ○ 6 servings
- ○ 7 servings
- ○ 8 servings
- ○ 9 or more servings

Canada's Food Guide Serving Sizes of Grain Products

Bread 1 slice (35 g) | Bagel ½ bagel (45 g) | Cooked rice, bulgur or quinoa 125 mL (½ cup) | Cereal Cold: 30g Hot: 175 mL (¾ cup) | Cooked pasta or couscous 125 mL (½ cup)

Your Experience with Smoking

30. Have you <u>ever</u> tried cigarette smoking, even just a few puffs?

○ Yes
○ No

31. Do you think in the future you <u>might try smoking</u> cigarettes?

○ Definitely yes
○ Probably yes
○ Probably not
○ Definitely not

32. If one of your best friends were to offer you a cigarette, would you smoke it?

○ Definitely yes
○ Probably yes
○ Probably not
○ Definitely not

33. At any time during the <u>next year</u> do you think you will smoke a cigarette?

○ Definitely yes
○ Probably yes
○ Probably not
○ Definitely not

34. Have you ever smoked 100 or more <u>whole</u> cigarettes in your life?

○ Yes
○ No

35. On how many of the <u>last 30 days</u> did you smoke one or more cigarettes?

○ None
○ 1 day
○ 2 to 3 days
○ 4 to 5 days
○ 6 to 10 days
○ 11 to 20 days
○ 21 to 29 days
○ 30 days *(every day)*

36. Your closest friends are the friends you like to spend the most time with. How many of your closest friends smoke cigarettes?

○ None
○ 1 friend
○ 2 friends
○ 3 friends
○ 4 friends
○ 5 or more friends

37. Have you <u>ever</u> tried to quit smoking cigarettes?

- ○ I have never smoked
- ○ I have only smoked a few times
- ○ I have never tried to quit
- ○ I have tried to quit once
- ○ I have tried to quit 2 or 3 times
- ○ I have tried to quit 4 or 5 times
- ○ I have tried to quit 6 or more times

38. Have you <u>ever</u> tried an <u>electronic cigarette</u>, also known as an e-cigarette?

- ○ Yes
- ○ No

39. Have you used <u>e-cigarettes</u> for any of the following reasons? *(Mark all that apply)*

- ○ I have not used e-cigarettes
- ○ Curiosity / to try something new
- ○ I can use e-cigarettes in places where smoking is not allowed
- ○ To smoke fewer cigarettes
- ○ To help me quit smoking cigarettes
- ○ I have used e-cigarettes for some other reason

40. In the <u>last 30 days</u>, did you use any of the following? *(Mark all that apply)*

- ○ Pipe tobacco
- ○ Cigarillos or little cigars (*plain or flavoured*)
- ○ Cigars (not including cigarillos or little cigars, *plain or flavoured*)
- ○ Roll-your-own cigarettes (tobacco only)
- ○ Loose tobacco mixed with marijuana
- ○ E-cigarettes (electronic cigarettes that look like cigarettes/cigars, but produce vapour instead of smoke)
- ○ Smokeless tobacco (chewing tobacco, pinch, snuff, or snus)
- ○ Nicotine patches, nicotine gum, nicotine lozenges, or nicotine inhalers
- ○ Hookah (water-pipe) to smoke tobacco
- ○ Hookah (water-pipe) to smoke herbal sheesha/shisha
- ○ Blunt wraps (a sheet or tube made of tobacco used to roll cigarette tobacco)
- ○ I have not used any of these things in the last 30 days

41. On how many of the <u>last 30 days</u> did you use an <u>e-cigarette</u>?

- ○ None
- ○ 1 day
- ○ 2 to 3 days
- ○ 4 to 5 days
- ○ 6 to 10 days
- ○ 11 to 20 days
- ○ 21 to 29 days
- ○ 30 days *(every day)*

○○○○○○○○○○○○○○○○○○○○○○○○○○○○○ [serial]

63

Alcohol and Drug Use

*Please remember that we will keep your answers **completely confidential**.*

> A **DRINK** means: 1 regular sized bottle, can, or draft of beer; 1 glass of wine; 1 bottle of cooler; 1 shot of liquor (rum, whisky, etc); or 1 mixed drink (1 shot of liquor with pop, juice, energy drink).

42. In the <u>last 12 months</u>, how often did you have a drink of alcohol that was more than just a sip?
- ○ I have never drunk alcohol
- ○ I did not drink alcohol in the last 12 months
- ○ I have only had a sip of alcohol
- ○ 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

43. How old were you when you first had a drink of alcohol that was more than just a sip?
- ○ I have never drunk alcohol
- ○ I have only had a sip of alcohol
- ○ I do not know

- ○ 8 years or younger
- ○ 9 years
- ○ 10 years
- ○ 11 years
- ○ 12 years
- ○ 13 years
- ○ 14 years
- ○ 15 years
- ○ 16 years
- ○ 17 years
- ○ 18 years or older

44. In the <u>last 12 months</u>, 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

45. In the <u>last 12 months</u>, have you had <u>alcohol</u> mixed or pre-mixed with an energy drink (such as Red Bull, Rock Star, Monster, or another brand)?
- ○ I have never done this
- ○ I did not do this in the last 12 months
- ○ Yes
- ○ I do not know

64

46. 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

47. If you have used marijuana or cannabis in the last 12 months, how did you use it? *(Mark all that apply)*

- ○ I have used it by smoking it (e.g., in a joint, a pipe, a bong)
- ○ I have used it by vaping it
- ○ I have used it by eating or drinking it (e.g., in brownies, cookies, candies, tea)
- ○ I have not used marijuana or cannabis in the last 12 months

48. How old were you when you first used marijuana or cannabis?

- ○ I have never used marijuana
- ○ I do not know

- ○ 8 years or younger
- ○ 9 years
- ○ 10 years
- ○ 11 years
- ○ 12 years
- ○ 13 years
- ○ 14 years
- ○ 15 years
- ○ 16 years
- ○ 17 years
- ○ 18 years or older

49. Do you think it would be difficult or easy for you to get marijuana if you wanted some?

- ○ Difficult
- ○ Easy
- ○ I do not know

50. Have you used or tried any of the following medications TO GET HIGH?

	No, I have never done this	Yes, I have done this in the last 12 months	Yes, I have done this, but NOT in the last 12 months
a) Oxycodone (oxy, OC, APO, OxyContin®, percs, roxies, OxyNEO®)	○	○	○
b) Fentanyl (china white, synthetic heroin, china girl)	○	○	○
c) Other prescription pain relievers (codeine, morphine, Tylenol 3)	○	○	○

51. Do you think it would be difficult or easy to get pain relievers (Oxycodone, Fentanyl, codeine, etc.) if you wanted some?

- ○ Difficult
- ○ Easy
- ○ I do not know

○○○○○○○○○○○○○○○○○○○○○○○○○○○○   [serial]

65

Mental Health

52. How much do you agree or disagree with the following statements?

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a) I have a happy home life	○	○	○	○	○
b) My parents/guardians expect too much of me	○	○	○	○	○
c) I can talk about my problems with my family	○	○	○	○	○
d) I can talk about my problems with my friends	○	○	○	○	○

53. How much do you agree or disagree with the following statements?

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a) I lead a purposeful and meaningful life	○	○	○	○	○
b) My social relationships are supportive and rewarding	○	○	○	○	○
c) I am engaged and interested in my daily activities	○	○	○	○	○
d) I actively contribute to the happiness and well-being of others	○	○	○	○	○
e) I am competent and capable in the activities that are important to me	○	○	○	○	○
f) I am a good person and live a good life	○	○	○	○	○
g) I am optimistic about my future	○	○	○	○	○
h) People respect me	○	○	○	○	○
i) I generally recover from setbacks quickly	○	○	○	○	○

54. Choose the answer that best describes how you feel.

	True	Mostly true	Sometimes true, sometimes false	Mostly false	False
a) In general, I like the way I am	○	○	○	○	○
b) Overall, I have a lot to be proud of	○	○	○	○	○
c) A lot of things about me are good	○	○	○	○	○
d) When I do something, I do it well	○	○	○	○	○
e) I like the way I look	○	○	○	○	○

55. If you had concerns regarding your mental health, are there any reasons why you would not talk to an adult at school (e.g., a school social worker, child and youth worker, counsellor, psychologist, nurse, teacher, or other staff person)? *(Mark all that apply)*

○ I would have no problem talking to an adult at school about my mental health

○ Worried about what others would think of me (e.g., I'd be too embarrassed)
○ Lack of trust in these people - word would get out
○ Prefer to handle problems myself
○ Do not think these people would be able to help
○ Would not know who to approach
○ There is no one I feel comfortable talking to

56. Over the last 2 weeks, how often have you been bothered by the following problems?

	Not at all	Several days	Over half the days	Nearly every day
a) Feeling nervous, anxious, or on edge	○	○	○	○
b) Not being able to stop or control worrying	○	○	○	○
c) Worrying too much about different things	○	○	○	○
d) Trouble relaxing	○	○	○	○
e) Being so restless that it is hard to sit still	○	○	○	○
f) Becoming easily annoyed or irritable	○	○	○	○
g) Feeling afraid as if something awful might happen	○	○	○	○

57. Please indicate how often the following statements apply to you:

	Almost never	Sometimes	About half the time	Most of the time	Almost always
a) I have difficulty making sense out of my feelings	○	○	○	○	○
b) I pay attention to how I feel	○	○	○	○	○
c) When I'm upset, I have difficulty concentrating	○	○	○	○	○
d) When I'm upset, I believe there is nothing I can do to make myself feel better	○	○	○	○	○
e) When I'm upset, I lose control over my behaviour	○	○	○	○	○
f) When I'm upset, I feel ashamed for feeling that way	○	○	○	○	○

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

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

59. In general, how would you rate your mental health?
- ○ Excellent
- ○ Very good
- ○ Good
- ○ Fair
- ○ Poor

[serial]

Your School and You

60. 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	○	○	○	○
b) I feel I am part of my school	○	○	○	○
c) I am happy to be at my school	○	○	○	○
d) I feel the teachers at my school treat me fairly	○	○	○	○
e) I feel safe in my school	○	○	○	○
f) Getting good grades is important to me	○	○	○	○

61. In the last 30 days, in what ways were you bullied by other students? *(Mark all that apply)*

- ○ I have not been bullied in the last 30 days
- ○ Physical attacks (e.g., getting beaten up, pushed, or kicked)
- ○ Verbal attacks (e.g., getting teased, threatened, or having rumours spread about you)
- ○ Cyber-attacks (e.g., being sent mean text messages or having rumours spread about you on the internet)
- ○ Had someone steal from you or damage your things

62. In the last 30 days, how often have you been bullied by other students?

- ○ I have not been bullied by other students in the last 30 days
- ○ Less than once a week
- ○ About once a week
- ○ 2 or 3 times a week
- ○ Daily or almost daily

63. In the last 30 days, in what ways did you bully other students? *(Mark all that apply)*

- ○ I did not bully other students in the last 30 days
- ○ Physical attacks (e.g., beat up, pushed, or kicked them)
- ○ Verbal attacks (e.g., teased, threatened, or spread rumours about them)
- ○ Cyber-attacks (e.g., sent mean text messages or spread rumours about them on the internet)
- ○ Stole from them or damaged their things

64. In the last 30 days, how often have you taken part in bullying other students?

- ○ I did not bully other students in the last 30 days
- ○ Less than once a week
- ○ About once a week
- ○ 2 or 3 times a week
- ○ Daily or almost daily

65. How supportive is your school of the following?

	Very supportive	Supportive	Unsupportive	Very unsupportive
a) Making sure there are opportunities for students to be physically active	○	○	○	○
b) Making sure students have access to healthy foods and drinks	○	○	○	○
c) Making sure no one is bullied at school	○	○	○	○
d) Giving students the support they need to resist or quit tobacco	○	○	○	○
e) Giving students the support they need to resist or quit drugs and/or alcohol	○	○	○	○

66. In your current or most recent Math course, what is your approximate overall mark?
(Think about last year if you have not taken math this year)

- ○ 90% - 100%   ○ 55% - 59%
- ○ 80% - 89%   ○ 50% - 54%
- ○ 70% - 79%   ○ Less than 50%
- ○ 60% - 69%

67. In your current or most recent English course, what is your approximate overall mark?
(Think about last year if you have not taken English this year)

- ○ 90% - 100%   ○ 55% - 59%
- ○ 80% - 89%   ○ 50% - 54%
- ○ 70% - 79%   ○ Less than 50%
- ○ 60% - 69%

68. What is the highest level of education you would like to get? *(Choose only one)*

- ○ Some high school or less
- ○ High school diploma or graduation equivalency
- ○ College/trade/vocational certificate
- ○ University Bachelor's degree
- ○ University Master's / PhD / law school / medical school / teachers' college degree
- ○ I don't know

69. What is the highest level of education you think you will get? *(Choose only one)*

- ○ Some high school or less
- ○ High school diploma or graduation equivalency
- ○ College/trade/vocational certificate
- ○ University Bachelor's degree
- ○ University Master's / PhD / law school / medical school / teachers' college degree
- ○ I don't know

70. In the last 4 weeks, how many days of school did you miss because of your health?

- ○ 0 days
- ○ 1 or 2 days
- ○ 3 to 5 days
- ○ 6 to 10 days
- ○ 11 or more days

71. In the last 4 weeks, how many classes did you skip when you were not supposed to?

- ○ 0 classes
- ○ 1 or 2 classes
- ○ 3 to 5 classes
- ○ 6 to 10 classes
- ○ 11 to 20 classes
- ○ More than 20 classes

72. How often do you go to class without your homework complete?

- ○ Never
- ○ Seldom
- ○ Often
- ○ Usually

○○○○○○○○○○○○○○○○○○○○○○○○○○○○   [serial]

GLOSSARY

Binge Drinking: Defined as the consumption of 5 or more alcoholic drinks on one occasion within the last 30 days (1).

Body Mass Index (BMI): BMI is a calculated anthropometric measure which uses height and weight characteristics to define a categorical weight status of Underweight, Normal Weight, Overweight, and Obese (2).

Canadian Society of Exercise Physiology (CSEP) Guidelines: A comprehensive set of Canadian 24-hour movement guidelines which provide recommendations for physical activity, sedentary behaviours, and sleep in the Canadian population for defined age categories (3,4).

Legalization: Refers to the passing of the Cannabis Act (Bill C-45) in Canadian legislation which permits the possession, purchase, and sale of cannabis for those at least over the age of 18 in most Canadian jurisdictions (5–7).

Moderate to Vigorous Physical Activity (MVPA): The category of physical activity intensity which is associated with providing optimal health benefits; it is defined through engaging in physical activity which is both of lower intensity and that of which increases your heart rate (8).

Youth: Individuals in their adolescent period of development (12-17 years of age).