Original quantitative research

Perceptions of and adherence to early COVID-19-related restrictions and associations with substance use among youth in Canada

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Abstract

Introduction: As a largely social behaviour, substance use may have decreased for some youth overall in Canada during the COVID-19 pandemic; however, continued use may indicate nonadherence to pandemic-related restrictions and social distancing measures. In a sample of Canadian adolescents (aged 12–19 years), our objective was to examine how substance use (cannabis, binge drinking, cigarettes, vaping) is associated with perceptions of, and adherence to, early COVID-19-related public health measures, taking into consideration sociodemographic factors.

Methods: Cross-sectional data were retrieved from online data collected during Year 8 of the COMPASS school-based study, during the early months of the COVID-19 pandemic (May–July 2020) in British Columbia, Ontario and Quebec. We fitted two models using generalized estimating equations to examine how substance use was associated with separate measures of (1) perceptions of, and (2) adherence to early COVID-19 restrictions.

Results: In our sample, 10% of adolescents perceived COVID-19 restrictions as too weak and 14% perceived them as too strict. Nearly half (46%) reported taking restrictions very seriously, and 5% did not take them seriously at all. Binge drinking, cigarette use and vaping were associated with perceptions that restrictions were too strict and with nonadherence. However, adolescents who used cannabis were less likely to perceive COVID-19-related restrictions as too strict.

Conclusion: This study highlights the association of adolescent substance use with perceptions of, and adherence to, COVID-19-related public health restrictions in Canada. Our findings emphasize a need for continual monitoring of substance use behaviours during the COVID-19 pandemic to better characterize adolescent risk and further inform targeted public health strategies accordingly.

Keywords: COVID-19 pandemic, substance use, adolescent health

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Highlights

- Fourteen percent of adolescents perceived COVID-19-related restrictions as too strict; 5% did not take them seriously at all.
- Use of alcohol, cigarettes and vapes was associated with perceptions that COVID-19-related restrictions were too strict, and with nonadherence.
- Adolescents who used cannabis were less likely to perceive COVID-19-related restrictions as too strict compared to those who did not use cannabis.

restrictions were introduced to curb community spread of the novel SARS-CoV-2 coronavirus, and theoretically might have led to reduced access to substances and fewer opportunities for use among adolescents.

In addition to access, perception of risk is identified as a key determinant of adolescent substance use; adolescents who perceive that using a certain substance carries a higher risk are less likely to use that substance.[3] In general, adolescents tend to underestimate health risks and consequences[4] and are more likely to take risks,[5] especially as a function of social reward.[6] As noted by Dumas and colleagues,[7] adolescents may therefore perceive themselves to be at lower risk for

Introduction

Among adolescents, substance use is largely a social behaviour occurring within peer contexts.[1] The use of some substances, such as alcohol, among adolescents may be especially influenced by social and peer factors.[2] Therefore, the prevalence of substance use for some youth may have decreased during the COVID-19 pandemic as a function of stay-at-home and physical distancing mandates. Pandemic-related

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COVID-19 and thus may decide not to comply with COVID-19-related restrictions in favour of gathering with peers.

Some emerging research shows trends of decreasing rates of substance use among adolescents in various jurisdictions since March 2020,[8-10] when governments began enacting lockdown measures such as school closures. Findings are indeed heterogenous, and an overall decrease in substance use may not have been the case in other jurisdictions; for example, in the US, adolescent alcohol use appears to have decreased while nicotine use increased.[11] Yet, even among Canadian adolescents, a sizable proportion has reported continued use of substances during the pandemic—even in the presence of public health restrictions intended to limit their interaction with others outside of their home.[7,9] In the US, recent findings showed that despite self-perceived reduced availability of substances, the actual prevalence of cannabis and alcohol use among adolescents did not significantly change during the COVID-19 pandemic.[12]

In response to COVID-19-related stressors and social isolation, youth have reported engaging in substance-related coping[9,11] and other generally maladaptive coping mechanisms during the pandemic.[13] Continued substance use among adolescents despite school closures and social distancing measures may also be indicative of nonadherence to pandemic-related restrictions—given the social nature of substance use behaviours in this population age group.[1] Understanding the risks associated with continued substance use despite pandemic restrictions is therefore important for informing public health measures meant to protect youth from the novel SARS-CoV-2 coronavirus and its variants.

In particular, understanding the association between continued substance use and nonadherence to restrictions could provide context for more fulsome population-level monitoring in order to better characterize adolescents' risk of COVID-19 infection. This evidence could help identify specific groups at high risk for COVID-19, thereby informing targeted strategies for public health measures or programs to reduce their risk. Fendrich and colleagues[14] recently investigated the association between substance use and adherence to COVID-19 public health guidelines in a sample of US adults. Consistent with their hypothesis, it was found that adults who used cannabis and alcohol were less likely to adhere to COVID-19-related guidelines.[14] To our knowledge, this is the only published study to explore associations between substance use and COVID-19-related policy adherence, and to date no studies have investigated this phenomenon among youth.

Adolescents with greater pandemic knowledge and higher risk perceptions toward COVID-19 may be more likely to comply with preventive measures.[15] Certain factors may influence perceptions of and adherence to COVID-19-related restrictions. Greater nonadherence has been observed among some individuals who are not especially vulnerable to COVID-19 infection or illness,[16] whereas those more vulnerable or at greater risk are more likely to adhere to public health measures.[17] Evidence from previous viral outbreaks indicates that lower risk perceptions are directly associated with lower adherence to preventive efforts.[18,19] Sociodemographic factors such as older age and female cisgender have also been associated with greater adherence.[17-19] Transgender and gender-diverse youth may be at unique risk for the negative residual impacts of COVID-19 due to program and service disruption and inadequate support from their families.[20] In a recent study, 2SLGBTQ youth reported concerns about confinement with unsupportive family members during COVID-19 lockdowns.[21]

Using a substance-specific approach to account for unique social influences on different substance use behaviours, the objective of our study was to examine how substance use (cannabis use, binge drinking, cigarette use and vaping) is associated with adolescents' perceptions of and adherence to early COVID-19-related public health measures, taking into consideration sociodemographic factors. We hypothesized that substance use would be positively associated with perceptions of early COVID-19 restrictions as too strict, while negatively associated with adherence. This research was based on a sample of Canadian secondary school students from the COMPASS study surveyed during the early months of COVID-19 pandemic, between May and July 2020.

Methods

Study design

Data for this study were retrieved from Year 8 (Y_8; 2019/20) of COMPASS—an ongoing prospective cohort study that collects survey data from a rolling sample of secondary school students in Alberta, British Columbia, Ontario and Quebec, Canada.[22] Full-school student samples are invited to participate in COMPASS by completing a behavioural health questionnaire. Data are collected anonymously using a student-generated identification code allowing for data linkage across study cycles. Active-information, passive-consent data collection procedures employed by COMPASS have been approved by the University of Waterloo Office of Research Ethics and participating school boards. Detailed information about COMPASS is available in print[22] and online (http://www.compass.uwaterloo.ca/).

After COVID-19 was declared a pandemic in March 2020, COMPASS data were collected online in British Columbia, Ontario and Quebec, as schools in Canada were closed to in-person learning due to public health measures (data collection in Alberta was not possible during this time). The online COMPASS Student Questionnaire (CQ-o)[23] was adopted and used Qualtrics XM online survey software.[24] Starting 1 May 2020, participating schools emailed a link for the CQ-o to all students, followed by a reminder email one week after the original link was disseminated. The last survey closed on 6 July 2020. Table 1 presents the timing of implementation for different public health restrictions across British Columbia, Ontario and Quebec during this data collection period.

Sample

There were 9630 students who participated in the Y_8 CQ-o across 51 schools in British Columbia, Ontario and Quebec (2 in BC, 20 in ON, 29 in QC). A complete-case analytic sample of 7876 students was used for the current study, after cases with missing data were deleted.

Measures

Dependent variables of interest—perceptions of and adherence to COVID-19 measures

To capture students' perceptions of pandemic-related restrictions, the CQ-o

TABLE 1

Timing of implementation for different public health restrictions across participating provinces during COMPASS Y_8 (May–July 2020)

Pandemic response measure	Province		
	British Columbia	Ontario	Quebec
Provincial state of emergency declared	18 March 2020—ongoing	17 March 2020—ongoing	13 March 2020—ongoing
School closures	18 March–1 June 2020 (at reduced capacity)	14 March 2020 until end of school year	13 March 2020 until end of school year (elementary schools re-opened 11 May except in Montréal)
Recreation closures (facilities, parks, etc.)	8 April 2020—ongoing	17 March 2020—ongoing	15 March 2020—ongoing
Gathering restrictions	16 March 2020—ongoing	13 March 2020—ongoing	13 March 2020—ongoing
Work-from-home recommendations	19 March 2020—ongoing	25 March 2020—ongoing	25 March 2020—ongoing
Use of face masks	10 April 2020—ongoing	20 May 2020—ongoing	7 April 2020—ongoing
Nonessential service restrictions (e.g. restaurants, businesses)	17 March 2020— ongoing	17 March 2020—ongoing	15 March 2020—ongoing

Abbreviation: Y_8, year 8 of the COMPASS survey.

Notes: COMPASS is an ongoing prospective cohort study that collects survey data from a rolling sample of secondary school students in Canada.[22] Data were retrieved from the Canadian Institute for Health information COVID-19 Intervention Timeline in Canada tool (https://www.cihi.ca/en/covid-19-intervention-timeline-in-canada). "Ongoing" refers to the remaining duration of the COMPASS Y_8 data collection period and beyond.

included the question: "How do you feel about the rules that governments have recommended or required to reduce the spread of COVID-19? (e.g. no school, staying at least 2 metres away from people, not going out in public unless you have to)?" Students responded by indicating whether they believed the restrictions to be (1) "too weak"; (2) "appropriate/good"; or (3) "too strict."

Adherence to early COVID-19-related restrictions was assessed by asking students, "How seriously are you taking the new rules laid out by governments to reduce the spread of COVID-19?" There were three response options to this question: (1) "I take them very seriously—I stay home most or all of the time, and do not go within 2 metres of people if I am outside"; (2) "I take them somewhat seriously—I go outside quite a bit and/or I sometimes do not stay a full 2 metres away from people when I am outside"; and (3) "I do not take them seriously—I go out when I want to, visit whomever I want, do not worry about staying 2 meters away from people when I am outside."

Independent variables of interest
Current substance use
Students were asked how often they used cannabis or marijuana (e.g. "a joint," "pot," "weed," "hash") in the past 12 months. Current cannabis use was defined as any use at a frequency of at least once per month. Similarly, students were asked about the frequency with which they participated in binge drinking in the past 12 months; current binge drinking was defined as 5 or more drinks on one occasion at least once per month. Cigarette and vaping use were captured by asking students on how many of the last 30 days they smoked one or more cigarettes, or used a vape, respectively. Current cigarette or vaping use was defined as use on at least one day in the last 30 days. Measures of student substance use were consistent with national surveillance measures.[25,26]

Sociodemographic factors
Students self-reported their sex/gender in answer to the question "Are you female or male?" with the following response options: "female," "male," "I describe my gender in a different way" and "I prefer not to say." We recategorized students' sex/gender into three levels (male, female, other/prefer not to say). Age was collected in years. Students were asked to describe their ethnicity by selecting one or more of the following categories: Asian, Black, Indigenous (First Nations/Métis/Inuit), Latin American, White, or other, and responses were recategorized as Black/Indigenous/person of colour (BIPOC; i.e. Asian, Black, Indigenous, Latin American, other, mixed/multiple) or White. Students were also asked to report their weekly available spending money (zero, $1–$20, $21–$100, $100+, don't know) as a proxy measure for individual-level socioeconomic status (SES) and part-time employment, given the apparent associations with substance use.[27]

Analyses
We computed descriptive statistics using chi-square (χ^2) and one-way ANOVA (F)

tests to compare students' sociodemographics and current substance use across levels of their perceptions of and adherence to early COVID-19 restrictions. We fitted two models using generalized estimating equations (GEE) to examine how substance use was associated with each dependent variable: perceptions of early COVID-19 restrictions (Model I), and adherence to early COVID-19 restrictions (Model II). Each model also tested for the effects of sociodemographic covariates, controlling for province. A generalized logit link function under the SAS PROC GEE procedure was specified to account for the multinomial distributions of the dependent variables; the referent response categories were "thinks restrictions are appropriate/good" for Model I and "takes restrictions somewhat seriously" for Model II, as neutral midpoints of the response options. According to the computed intraclass correlation coefficients (ICC), school-level clustering accounted for less than 1% of variation observed in each of the dependent variables ($ICC_{Perceptions} = 0.0005$; $ICC_{Adherence} = 0.0016$) but we proceeded to account for the clustered structure of the data using an independent covariance structure in PROC GEE. Estimates and 95% confidence limits were exponentiated to obtain adjusted odds ratios (aORs) with 95% confidence intervals (CIs). We used SAS version 9.4 statistical software.[28]

Results

Sample characteristics are presented for the full study sample (N = 7876) in Table 2. A majority of students in our sample identified

TABLE 2
Sample characteristics of COMPASS Y_8 students (May–July 2020), N = 7876

Measure	N	%
Sex/gender		
Male	2893	36.7
Female	4837	61.4
Other/prefer not to say	146	1.9
Age (years)		
Mean age	15.0	SD = 1.6
Ethnicity		
White	6116	77.6
BIPOC	1760	22.4
Weekly spending money		
Zero	1751	22.2
$1–$20	1565	19.9
$21–$100	1292	16.4
$101+	1387	17.6
Don't know	1881	23.9
Current (≥ once/month) cannabis use		
No	7373	93.6
Yes	503	6.4
Current (≥ once/month) binge drinking		
No	6981	88.6
Yes	895	11.4
Current (≥ once/month) cigarette use		
No	7593	96.4
Yes	283	3.6
Current (≥ once/month) vaping		
No	6869	87.2
Yes	1007	12.8
Perceptions of early COVID-19 restrictions		
Thinks restrictions are **too weak**	809	10.3
Thinks restrictions are **appropriate/good**	5952	75.5
Thinks restrictions are **too strict**	1115	14.2
Adherence to early COVID-19 restrictions		
Takes restrictions **very seriously**	3630	46.1
Takes restrictions **somewhat seriously**	3883	49.3
***Does not* take restrictions seriously**	363	4.6

Abbreviations: BIPOC, Black/Indigenous/person of colour; SD, standard deviation; Y_8, year 8 of the COMPASS survey.

Note: COMPASS is an ongoing prospective cohort study that collects survey data from a rolling sample of secondary school students in Canada.[22]

as female (60%), and 2% identified as other than male or female or reported they preferred not to state a sex or gender. Students were on average 15 (SD ± 1.6) years of age (ranging from 12–19 years), and 22% identified as BIPOC.

Table 3 presents the results of a missing-data analysis showing the student-level factors associated with missingness in the dependent variables. Overall, students were

less likely to have missing data if they identified as female compared to male, and were more likely to have missing data if they identified as BIPOC compared to White.

Overall, 6.4% (n = 503) of students reported current use of cannabis, 11.4% (n = 895) reported current binge drinking, 3.6% (n = 283) currently used cigarettes, and 12.8% (n = 1007) reported

current vaping. A majority of students in our sample (75.5%) reported that the early COVID-19 restrictions implemented during May to July 2020 were "appropriate/good." Approximately 10% of students felt that the restrictions were "too weak," whereas a greater proportion (14.2%) perceived early COVID-19 restrictions to be "too strict." In terms of students' adherence to early COVID-19 restrictions, roughly half (49.3%) reported taking the restrictions "somewhat seriously," while nearly as many students (46.1%) reported taking them "very seriously." Fewer than 5% of students indicated that they did not take the COVID-19 restrictions seriously.

Students' perceptions of early COVID-19 restrictions differed by all sociodemographic factors and current substance use measures, as shown in Table 4. Similar results are shown across different levels of students' reported adherence to early COVID-19 restrictions (Table 4).

GEE model results

Table 5 presents the results of the GEE models estimating the associations between students' substance use and their perceptions of (Model I) and adherence to (Model II) early COVID-19 restrictions. Model I shows that students who reported engaging in binge drinking (aOR = 1.68; 95% CI: 1.39–2.04) were significantly more likely to perceive the restrictions as too strict compared to those who did not drink. Similarly, compared to students who did not vape, students who reported vaping (aOR = 2.00; 95% CI: 1.61–2.49) were also more likely to perceive early COVID-19 restrictions as too strict. Those who engaged in cannabis use, however, were one-third less likely to report that COVID-19 restrictions were too strict (aOR = 0.66; 95% CI: 0.48–0.91) compared to those who did not engage in cannabis use. Students who reported cigarette use were both more likely to perceive restrictions as too weak (aOR = 1.58; 95% CI: 1.06–2.36) *and* too strict (aOR = 1.80; 95% CI: 1.30–2.48), versus those who did not use cigarettes.

Model II (Table 5) estimated self-reported adherence to early COVID-19 restrictions. Students who engaged in binge drinking and vaping were significantly more likely to report that they do not take COVID-19 restrictions seriously (aOR = 1.66, 95% CI: 1.23–2.23 and aOR = 2.27, 1.69–3.05,

TABLE 3
Logistic regression models estimating the log-odds of missing data for measures of perceptions of (Model I) and adherence to (Model II) early COVID-19 restrictions among COMPASS Y_8 students (May–July 2020)

Measure	aOR (95% CI)	
	Model I	**Model II**
Sex/gender		
Male (ref)	1.00	1.00
Female	**0.72 (0.63–0.81)*****	**0.73 (0.64–0.83)*****
Other/prefer not to say	0.84 (0.54–1.32)	0.86 (0.54–1.35)
Age (years)		
Estimate (SE)	1.02 (0.98–1.07)	1.03 (0.98–1.08)
Ethnicity		
White (ref)	1.00	1.00
BIPOC	**1.28 (1.10–1.48)*****	**1.34 (1.16–1.56)*****
Weekly spending money		
Zero (ref)	1.00	1.00
$1–$20	1.10 (0.90–1.33)	1.08 (0.89–1.32)
$21–$100	1.05 (0.85–1.29)	1.07 (0.87–1.33)
$101+	1.29 (1.06–1.58)*	1.28 (1.04–1.58)*
Don't know	1.24 (1.03–1.49)*	1.25 (1.03–1.51)*

Abbreviations: aOR, adjusted odds ratio; BIPOC, Black/Indigenous/person of colour; CI, confidence interval; ref, reference category; SE, standard error; Y_8, year 8 of the COMPASS survey.

Notes: COMPASS is an ongoing prospective cohort study that collects survey data from a rolling sample of secondary school students in Canada.[22] Model I estimates the log-odds of missing data for perceptions of early COVID-19 restrictions; Model II estimates the log-odds of missing data for adherence to early COVID-19 restrictions. For each model outcome, missing = 1 vs. not missing = 0 (ref). Both models are adjusted for province.

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

respectively), and were significantly less likely to report adhering to restrictions very seriously (aOR = 0.55, 95% CI: 0.46–0.66 and aOR = 0.37, 95: CI: 0.31–0.45, respectively), compared to those who did not engage in current binge drinking or vaping. Cigarette use was also associated with more than 2.5 times higher odds of not adhering to early COVID-19 restrictions (aOR = 2.65, 95% CI: 1.86–3.78) compared to cigarette non-users. We did not identify any significant associations between cannabis use and adherence to restrictions among students in our sample.

Student sociodemographic covariates were also associated with perceptions of and adherence to early COVID-19 restrictions. Compared to males, students who identified as female were less likely to perceive the restrictions as too weak (aOR = 0.74, 95% CI: 0.65–0.85) or take them seriously (aOR = 0.59, 95% CI: 0.47–0.72). Every unit increase in student age (years) was associated with 14% lower odds of both perceptions of the restrictions as too strict and not taking adherence to the restrictions seriously, and increases in age were associated with greater likelihood that students reported taking the early COVID-19 restrictions very seriously (aOR = 1.12, 95% CI: 1.07–1.16). Students who identified as BIPOC were more likely than White students to report that the restrictions were too weak (aOR = 1.61, 95% CI: 1.37–1.90), and were also more likely to adhere to the restrictions very seriously (aOR = 1.41, 95% CI: 1.23–1.61]). Similarly, BIPOC students were less likely than White students to perceive the restrictions as too strict (aOR = 0.73, 95% CI: 0.57–0.93). Generally, students with greater weekly spending money were more likely to perceive the restrictions as too strict, and increasingly less likely to take them seriously.

Discussion

The objective of our study was to examine associations of substance use and (1) perceptions of and (2) adherence to early COVID-19-related public health measures. While 3 in 4 adolescents in our sample perceived early COVID-19-related restrictions as appropriate, less than half of the sample actually reported taking the restrictions very seriously by adhering to public health guidelines. Fewer adolescents perceived the restrictions as too strict or did not adhere to them—14% and 5%, respectively. As hypothesized, those who engaged in current binge drinking, cigarette use and vaping were significantly more likely to perceive COVID-19-related restrictions as too strict and to report nonadherence, and in some cases were less likely to take the restrictions very seriously. These findings are consistent with the established evidence base surrounding perceptions of risk and risk-taking behaviours among adolescents in relation to substance use, and provide further evidence of an apparent association between substance use and nonadherence to COVID-19-related restrictions.[12] Where youth substance use prevention has been a key public health priority in Canada, understanding its relevance to the current COVID-19 pandemic may be important for attempts to "flatten the curve."[29]

We adopted a substance-specific analytic approach in our study rather than assessing general use of substances and, interestingly, we did not find a significant association between current cannabis use and adherence to COVID-19-related restrictions. In fact, adolescents in our sample who used cannabis were 34% less likely to perceive restrictions as too strict. Since adult recreational cannabis use has been legalized in Canada,[30] normalization among adolescents may partially explain this finding. Cannabis may also serve a different social purpose for some adolescents than other substances. Alcohol use, for example, tends to occur almost exclusively in social settings with peers[31] whereas solitary cannabis use is far more common among adolescents than solitary alcohol use.[32] Additional research is required to validate this finding and longitudinal evidence from future waves of the COMPASS study can be used to do so. Notably, recent findings that account for increases typically observed with age suggest that the early stages of the COVID-19 pandemic were not associated with changes in adolescent cannabis use.[8]

We also found that students who used cigarettes were simultaneously more likely

TABLE 4
Descriptive comparisons by perceptions of and adherence to early COVID-19 restrictions among COMPASS Y_8 students (May–July 2020), N = 7876

Measure	Perceptions of early COVID-19 restrictions, n (%)					Adherence to early COVID-19 restrictions, n (%)				
	Thinks restrictions are too weak (n = 809, 10%)	Thinks restrictions are appropriate/ good (n = 5952, 76%)	Thinks restrictions are too strict (n = 1115, 14%)	χ^2, F	p	Takes restrictions very seriously (n = 3360, 46%)	Takes restrictions somewhat seriously (n = 3883, 49%)	Does not take restrictions seriously (n = 363, 5%)	χ^2, F	p
Sex/gender										
Male	336 (11.6)	2138 (73.9)	419 (14.5)			1292 (44.7)	1435 (49.6)	166 (5.7)		
Female	446 (9.2)	3715 (76.8)	676 (14.0)	**23.4**	**0.001**	2263 (46.8)	2391 (49.4)	183 (3.8)	**28.9**	**< 0.001**
Other/prefer not to say	27 (18.5)	99 (67.8)	20 (13.7)			75 (51.4)	57 (39.0)	14 (9.6)		
Age (years)										
Mean age (SD)	15.2 (1.6)	15.0 (1.5)	14.8 (1.6)	**18.1**	**< 0.001**	15.1 (1.6)	15.0 (1.6)	15.0 (1.5)	2.7	0.064
Ethnicity										
White	533 (8.7)	4629 (75.7)	954 (15.6)	**104.8**	**< 0.001**	2648 (43.3)	3174 (51.9)	294 (4.8)	**86.0**	**< 0.001**
BIPOC	276 (15.7)	1323 (75.2)	161 (9.1)			982 (55.8)	709 (40.3)	69 (3.9)		
Weekly spending money										
Zero	220 (12.5)	1339 (76.5)	192 (11.0)			979 (55.9)	701 (40.0)	71 (4.1)		
$1–$20	144 (9.2)	1210 (77.3)	211 (13.5)			784 (50.1)	735 (47.0)	46 (2.9)		
$21–$100	132 (10.2)	974 (75.4)	186 (14.4)	**50.2**	**< 0.001**	540 (41.8)	687 (53.2)	65 (5.0)	**218.1**	**< 0.001**
$101+	145 (10.4)	986 (71.1)	256 (18.5)			444 (32.0)	837 (60.4)	106 (7.6)		
Don't know	168 (8.9)	1443 (76.7)	270 (14.4)			883 (46.9)	923 (49.1)	75 (4.0)		
Current (≥ 1/month) cannabis use										
No	753 (10.2)	5598 (75.9)	1022 (13.9)	**9.4**	**0.009**	3491 (47.4)	3593 (48.7)	289 (3.9)	**166.3**	**< 0.001**
Yes	56 (11.1)	354 (70.4)	93 (18.5)			139 (27.6)	290 (57.7)	74 (14.7)		
Current (≥ 1/month) binge drinking										
No	738 (10.6)	5355 (76.7)	888 (12.7)	**105.4**	**< 0.001**	3423 (49.0)	3317 (47.5)	241 (3.5)	**333.6**	**< 0.001**
Yes	71 (7.9)	597 (66.7)	227 (25.4)			207 (23.2)	566 (63.2)	122 (13.6)		
Current (≥ 1/month) cigarette use										
No	773 (10.2)	5791 (76.3)	1029 (13.5)	**69.9**	**< 0.001**	3573 (47.1)	3729 (49.1)	291 (3.8)	**320.9**	**< 0.001**
Yes	36 (12.7)	161 (56.9)	86 (30.4)			57 (20.2)	154 (54.4)	72 (25.4)		
Current (≥ 1/month) vaping										
No	713 (10.4)	5305 (77.2)	851 (12.4)	**138.8**	**< 0.001**	3435 (50.0)	3222 (46.9)	212 (3.1)	**511.7**	**< 0.001**
Yes	96 (9.5)	647 (64.3)	264 (26.2)			195 (19.4)	661 (65.6)	151 (15.0)		

Abbreviations: BIPOC, Black/Indigenous/person of colour; SD, standard deviation; Y_8, year 8 of the COMPASS survey.

Notes: COMPASS is an ongoing prospective cohort study that collects survey data from a rolling sample of secondary school students in Canada.[22] Bold values indicate significance at $\alpha < 0.05$.

to perceive COVID-19-related restrictions as too weak compared to appropriate, and too strict. This bifurcation suggests some level of heterogeneity among adolescents who use cigarettes; further research is needed to understand the specific factors which might lead to differences in their perceptions. Antisocial deviance may be a risk factor predicting adolescent tobacco use,[33] and is also associated with increased risk of generalized anxiety.[34] Efforts are required to clarify the role mental health

may play in the associations of substance use and adherence to public health measures. Emerging evidence shows that youth anxiety during COVID-19 may be associated with motivation and adherence to social distancing measures put in place by governments.[35] In one study, those who reported compliance reported greater psychological distress compared to those who did not.[36]

Females were less likely than males to perceive COVID-19-related restrictions as

too weak, yet they were also less likely to report nonadherence. Emerging research conducted within adult populations shows that women report taking the pandemic more seriously than men, and demonstrate higher rates of adherence to public health measures such as physical distancing.[37] Interestingly, findings from Paramita and colleagues[38] suggest that differences may be more closely related to gender psychology and gendered roles; in their study, males were more likely to comply

TABLE 5

Generalized estimating equation model results estimating the odds of perceptions of (Model I) and adherence to (Model II) early COVID-19 restrictions among COMPASS Y_8 students (May–July 2020), N = 7876

Measure	aOR (95% CI)			
	MODEL I		MODEL II	
	Perceptions of early COVID-19 restrictions		Adherence to early COVID-19 restrictions	
	Thinks restrictions are too weak[a]	Thinks restrictions are too strict[a]	Takes restrictions very seriously[b]	Does not take restrictions seriously[b]
Sex/gender				
Male (ref)	1.00	1.00	1.00	1.00
Female	**0.74 (0.65–0.85)*****	0.90 (0.79–1.02)	1.12 (0.99–1.26)	**0.59 (0.47–0.72)*****
Other/prefer not to say	1.42 (0.89–2.25)	0.98 (0.56–1.70)	1.39 (0.96–2.03)	1.17 (0.58–2.34)
Age (years)				
Estimate (SE)	1.03 (0.97–1.09)	**0.86 (0.80–0.92)*****	**1.12 (1.07–1.16)*****	**0.86 (0.80–0.93)*****
Ethnicity				
White (ref)	1.00	1.00	1.00	1.00
BIPOC	**1.61 (1.37–1.90)*****	**0.73 (0.57–0.93)****	**1.41 (1.23–1.61)*****	0.99 (0.78–1.28)
Weekly spending money				
Zero (ref)	1.00	1.00	1.00	1.00
$1–$20	**0.75 (0.60–0.94)***	1.17 (0.94–1.46)	**0.79 (0.69–0.91)****	**0.59 (0.42–0.81)****
$21–$100	0.86 (0.67–1.09)	1.26 (0.98–1.63)	**0.59 (0.50–0.69)*****	0.81 (0.56–1.19)
$101+	0.96 (0.79–1.18)	**1.61 (1.30–1.99)*****	**0.44 (0.37–0.52)*****	0.97 (0.73–1.28)
Don't know	**0.78 (0.65–0.94)***	1.25 (0.99–1.57)	**0.71 (0.62–0.81)*****	0.83 (0.64–1.09)
Current (≥ 1/month) cannabis use				
No (ref)	1.00	1.00	1.00	1.00
Yes	0.96 (0.67–1.39)	**0.66 (0.48–0.91)***	0.99 (0.76–1.29)	1.13 (0.79–1.65)
Current (≥1/month) binge drinking				
No (ref)	1.00	1.00	1.00	1.00
Yes	0.76 (0.57–1.01)	**1.68 (1.39–2.04)*****	**0.55 (0.46–0.66)*****	**1.66 (1.23–2.23)*****
Current (≥1/month) cigarette use				
No (ref)	1.00	1.00	1.00	1.00
Yes	**1.58 (1.06–2.36)***	**1.80 (1.30–2.48)*****	0.93 (0.65–1.34)	**2.65 (1.86–3.78)*****
Current (≥1/month) vaping				
No (ref)	1.00	1.00	1.00	1.00
Yes	1.12 (0.82–1.53)	**2.00 (1.61–2.49)*****	**0.37 (0.31–0.45)*****	**2.27 (1.69–3.05)*****

Abbreviations: aOR, adjusted odds ratio; BIPOC, Black/Indigenous/person of colour; CI, confidence interval; ref, reference category; SE, standard error; Y_8, year 8 of the COMPASS survey.

Notes: COMPASS is an ongoing prospective cohort study that collects survey data from a rolling sample of secondary school students in Canada.[22] Models estimate the log-odds of students' perceptions of (Model I) and adherence to (Model II) early COVID-19-related restrictions. Both models are adjusted for province.

[a] vs. "appropriate/good."

[b] vs. "somewhat seriously."

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

with COVID-19-related restrictions if they perceived egalitarian gender roles, and males exhibiting masculine psychology characteristics (e.g. aggressiveness, competitiveness) were less likely to adhere to mask-wearing. Studies examining adherence to COVID-19-related restrictions have largely considered sex/gender as dichotomous (e.g. males/men/boys vs. females/women/girls).[39-41] Our study did not find a significant association among nonbinary or non-cissexual/non-cisgender adolescents, but we suspect this is due to limited statistical power. More comprehensive definitions of sex and gender should be employed in future research.

Adolescents who identified as BIPOC were more likely than White adolescents to perceive COVID-19-related restrictions as too weak and less likely to perceive them as too strict. Consistent with evidence that Black, Latinx and Asian adults may be more likely to comply with COVID-19 mask-wearing regulations,[42-44] we also found that BIPOC-identifying adolescents in our sample were more likely to take restrictions very seriously. Racialized and

historically marginalized groups have been disproportionately impacted by COVID-19,[45] and so perceived vulnerability may play an important role in the way that ethnicity shapes adherence.[44] Hearne and Niño[44] further identified that ethnicity can intersect with gender to influence adherence; during April to June 2020 (overlapping with the timeframe in which our data were collected), they found White males to be least likely to wear masks in compliance with COVID-19-related restrictions. While intersectionality was not a direct consideration in our current study, due to limited power to make comparisons, further research is required.

Other sociodemographic factors were associated with perceptions of and adherence to COVID-19-related restrictions. Adherence increased with age, and older adolescents were less likely to perceive restrictions as too strict or to not take them seriously. Younger Canadians may be less likely to adhere to COVID-19-related restrictions.[17,46,47] Lower income levels may also be associated with noncompliance.[46] Essential service workers who cannot work from home also face increased risk of viral exposure, given that the ability to work remotely favours those with higher levels of education and income.[48]

Strengths and limitations

A primary strength of our study is its timely, large COVID-19-related sample size enabled by COMPASS data collection procedures. The use of active-information, passive-consent protocols supports robust self-report research by limiting self-selection and response biases for youth substance use measures.[49,50] Student anonymity encourages honest reporting and helps to mitigate the risk of social desirability bias in COMPASS. Our complex modelling approach represents another key strength by adjusting for student-level clustering to account for shared variation in substance use behaviours among students within the same school environments.[51]

There are, however, certain limitations. First, a notable limitation of this study is its cross-sectional design, which precludes us from making causal or directional inferences about any correlation between substance use and perceptions of or adherence to early COVID-19-related restrictions among adolescents. As noted by Fendrich and colleagues,[14] it is also plausible that adhering to COVID-19-related restrictions such as physical distancing could increase risk for problematic substance use via social isolation. As longer-term impacts unfold, ongoing COMPASS longitudinal data collection will provide a unique opportunity to fully understand the association between public health restrictions and substance use among adolescents. Since data were collected in the early stages of the pandemic, longitudinal research would better capture any changes in adolescent substance use and restriction perceptions or adherence over time as restrictions evolve.

Second, it is important to note that the questions used in this study to assess COVID-19 restriction perceptions and adherence have not been validated. Given that adolescents' perceptions and adherence might have differed according to specific government restrictions, we recommend future studies consider how adolescents' attitudes and behaviours may have compared in specific instances (e.g. physical distancing from peers vs. elderly family members). Additional research should also further consider the role of substance use as a potential coping method among youth during COVID-19.[9,11] It is a limitation of the current study that analyses do not consider coping motives or mental health as an underlying mechanism of adolescent substance use during COVID-19.

Third, the measure of adolescents' weekly spending money is a limited SES proxy measure better reflecting individuals' available pocket money or part-time employment rather than household SES. While commonly used as a more accessible measure for youth than household income,[52] it is possible that adolescents from higher SES households would report lower weekly spending money and vice versa. However, weekly spending money remains a relevant covariate of these analyses, as it reflects opportunity to purchase substances. Indeed, previous research has shown that greater available spending money is associated with greater likelihood of individual and polysubstance use among adolescents.[51,53-56]

Fourth, it is important to note that the COMPASS participant sample is not representative of all adolescents in Canada. The COMPASS study relies on purposive sampling to achieve a robust sample size. Therefore, findings are not necessarily generalizable.

Fifth, the COVID-19 pandemic has naturally imposed limitations on normal COMPASS data collection procedures. Study protocol changes and implications have been described elsewhere in the literature.[23] The change in survey delivery mode from paper-based to online resulted in a lower-than-normal participation rate, with fewer students completing the survey. Bias due to self-selection should be considered as a possible confounder of the associations observed in this study.

Conclusion

Using data collected in the early months of the COVID-19 pandemic, we sought to examine how substance use is associated with adolescents' perceptions of and adherence to COVID-19-related restrictions in Canada. Adolescents who engaged in current binge drinking, cigarette use and vaping were more likely to perceive COVID-19-related restrictions as too strict and to report nonadherence; however, these associations were not consistent across substances—those who used cannabis were less likely to perceive COVID-19-related restrictions as too strict.

Our findings have implications for public health data collection measures informing COVID-19 preventive practices in Canada. Comprehensive and continual monitoring of adolescent health behaviours during the COVID-19 pandemic can help to better characterize adolescent risk. More specifically, ongoing population-level monitoring should consider adolescent substance use as an important indicator of perceptions and adherence to COVID-19-related public health measures. By identifying specific behavioural risk groups—such as adolescents who engaged in binge drinking, cigarette use and vaping during the early months of COVID-19—this study can directly inform targeted public health measures aimed at reducing the risk and transmission of COVID-19 across communities.

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Conflicts of interest

There are no conflicts of interest to declare.

Scott T. Leatherdale is an Associate Scientific Editor with the HPCDP Journal, but has recused himself from the review process for this paper.

Authors' contributions and statement

IR planned the methodology, conducted the formal analysis, interpreted the results and drafted the manuscript. STL conceptualized the COMPASS study, acquired funding, managed resources, provided supervision for the host study and corresponding data in this manuscript, and revised the manuscript for critical intellectual content. MDG and YJ provided supervision for the analyses and revised the manuscript for critical intellectual content.

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