




BMJ Open Youth in a pandemic: a longitudinal examination of youth mental health and substance use concerns during COVID-19

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ABSTRACT

Objective This study analyses longitudinal data to understand how youth mental health and substance use are evolving over the course of the COVID-19 pandemic, which is critical to adjusting mental health response strategies.

Setting Participants were recruited from among existing participants in studies conducted in an urban academic hospital in Ontario, Canada.

Participants A total of 619 youth aged 14–28 years participated in the study (62.7% girls/young women; 61.4% Caucasian).

Measures Data on mood, substance use and COVID-19-related worries were collected over four time points, that is, every 2 months beginning in the early stages of the pandemic in April 2020. Latent class analyses were conducted on the longitudinal data to identify distinct groups of youth who have different trajectory profiles of pandemic impact on their mood, substance use and COVID-19-related worries.

Results For the majority of participants, mood concerns increased early in the pandemic, declined over Canada's summer months and subsequently increased in autumn. Among the youth with the highest level of mood symptoms at the beginning of the pandemic, increases in mental health concerns were sustained. Substance use remained relatively stable over the course of the pandemic. COVID-19-related worries, however, followed a trajectory similar to that of mood symptoms. Girls/young women, youth living in urban or suburban areas, in larger households, and with poorer baseline mental and physical health are the most vulnerable to mental health concerns and worries during the pandemic.

Conclusions Youth mental health symptom levels and concerns are evolving over the course of the COVID-19 pandemic, in line with the evolution of the pandemic itself, and longitudinal monitoring is therefore required. It is also essential that we engage directly with youth to cocreate pandemic response strategies and mental health service adaptations to best meet the needs of young people.

BACKGROUND

The ongoing COVID-19 pandemic is having substantial impacts on the world's population, across many segments of peoples' lives.

Strengths and limitations of this study

- This study prospectively and longitudinally examined mental health and substance use at a bimonthly intervals beginning early in the pandemic.
- Mental health and substance use ratings before the pandemic were reported retrospectively and may have been subject to recall bias.
- The sample was not representative and some diverse groups of youth may not have been reached.

The World Health Organization declared COVID-19 a pandemic on 11 March 2020.¹ In the months since then, jurisdictions have implemented diverse public health guidelines and directives, including closing business and limiting social contact, with gradual reopenings, all substantially disrupting public life.²

At the onset of the pandemic, concerns were rapidly raised about the impacts of these public health steps on the mental health of the population as a whole and on specific vulnerable subgroups.^{3–7} Given research findings from previous quarantines,⁸ the monitoring of mental health and well-being became a priority. Mental health impacts have indeed been observed in the rapidly emerging pandemic research.^{9–11} Meta-analytical data show that rates of depression and anxiety have been higher during the COVID-19 pandemic than in non-pandemic times and are particularly associated with younger age.^{12 13}

Youth constitute a particularly vulnerable population in terms of mental health and substance use.^{6 14} About one in five youth experience mental health and substance use disorders in Canada¹⁵ during non-pandemic times, reflecting high prevalence rates internationally.^{16–18} Mental health and substance use disorders often first emerge during

adolescence and young adulthood.^{19–21} This makes youth a particularly vulnerable group during the COVID-19 pandemic. Many typical developmental milestones,^{22–23} such as schooling, workforce engagement, early career development, relationship development, and autonomous living and decision-making have been disrupted or altered by public health guidelines. In addition, youth already experiencing mental health or substance use concerns pre-pandemic may experience an exacerbation of their needs, in conjunction with service disruption,^{7–24} although some may not experience greater concerns and may even experience symptom improvements.²⁵

Studies conducted at the emergence of the pandemic suggested high levels of youth mental health and well-being issues and a wide range of concerns, particularly among certain vulnerable subgroups.^{24–26–31} Concerns include symptoms of post-traumatic stress disorder,^{27–32} internalising disorders^{24–32} and stress and distress in general.^{27–29} Health behaviours such as physical activity and sleep behaviours have been negatively affected.^{29–33–34} However, many youth have positive coping strategies that help them manage the pandemic.^{24–28–29}

However, longitudinal data are urgently needed to understand how youth mental health changes and evolves over the course of the pandemic.^{35–36} The objectives of this study are to: (1) examine trajectories of youth mental health and well-being in a longitudinal manner, bimonthly from April to October 2020, and (2) to understand the characteristics of different youth who have experienced different mental health trajectories during this time. This information will enhance our knowledge of the impacts of the pandemic on the mental health of young people; this knowledge will help guide decision making in responding to the COVID-19 pandemic, future pandemics and other public health emergencies.

METHOD

Participants and recruitment

The sample consists of 619 youth between the ages of 14 and 28 years, in line with the Statistics Canada definition of ‘youth’.³⁷ Recruitment for the study leveraged four existing studies led by the Centre for Addiction and Mental Health (CAMH) in Ontario, Canada, including three clinical studies and a non-clinical study cohort.^{38–40} Participants from the clinical studies were recruited from tertiary-level mental health and/or substance use services for youth, while non-clinical cohort participants were initially recruited from schools in 2011–2013 (see Hawke *et al.*²⁴ for more details). Participants in the original source cohorts had consented to be contacted for future research.

Recruitment for the first wave of data collection began on 8 April 2020, that is, 3 weeks after the declaration of a state of emergency due to the pandemic in the province of Ontario, Canada,⁴¹ and continued for approximately 3 weeks. Three subsequent data collection waves were launched at 2-month intervals. All participants who

completed the first survey wave were eligible to complete subsequent waves. In Ontario, Canada, April 2020 represented the early pandemic period, when the first wave of COVID-19 cases was rising and public health guidelines to control the spread of the virus were new and strict (ie, substantial shutdown of activity, including closure of all non-essential businesses). In June and August 2020, between the first and second wave of COVID-19 cases in Ontario, the number of cases was progressively declining and public health restrictions were substantially loosened; the first provincial state of emergency was declared over. In September, many youth went back to school either in person or virtually or were home schooled; case counts began to rise, and further restrictions began to be put into place. In October 2020, a second wave of COVID-19 was occurring, with the highest case counts to date;⁴² tightened public health restrictions were put into place on a regional basis in Ontario.

Procedure

Participants received an email containing a link to an online survey, hosted on REDCap electronic data capture software⁴³ on a secure CAMH server. Participants provided informed consent, then completed self-report questionnaires. Survey reminder email messages were sent approximately every 2–3 days. For each wave, participants received a \$15 gift card as an honorarium.

Patient and public involvement

This study employed the principles of youth engagement in research.^{44–45} Youth were involved in developing supplementary questions for the survey and reviewed the progressive results. The overarching project includes substantial youth engagement from design to knowledge translation; youth coresearchers have partnered throughout the project. Leveraging findings from this project and youth-led discussions, they have produced a series of youth-facing tools on coping with COVID-19, available on the CAMH website. The project will also involve a series of youth summits at the end of the funding period to disseminate knowledge to young people and garner their feedback, guiding our team’s next steps in this overarching line of work.

Measures

Demographics characteristics were collected, including age, current gender identity, ethnic background, employment status and other variables. We also used the *CoRona-virus Health Impact Survey* (CRISIS),⁴⁶ Youth Self-Report Baseline V.0.1, which was developed by the National Institute of Mental Health in the USA. For the second wave, we updated the CRISIS survey to include V.0.3 items. Three scales from the CRISIS survey were used: mood states, substance use and COVID-19 worries.⁴⁷ The mood states scale includes 10 items regarding mood and anxiety, including sadness, enjoyment, irritability and concentration issues, among others, answered on a 5-point Likert scale. The Substance Use scale includes frequency of use

of various substances, including alcohol, cannabis, opiates and others. COVID-19 worries includes seven items rated on a five-point Likert scale regarding the degree of worry about being infected, worry about friends or family being infected, worry about their mental and physical health in the context of the pandemic and the degree of hopefulness about the pandemic ending soon. Mean scores were calculated for each scale, for a score range of 1–5 in each domain. In addition to the four longitudinal time points, the first administration of the CRISIS survey (baseline, April 2020) also asks about mood states and substance use retrospectively at 3 months earlier (January 2020, prior to the pandemic), providing five time points to model for these two scales. The COVID-19 worries scale does not have a retrospective, pre-pandemic time point, and four time points are therefore available. The CRISIS survey is demonstrating preliminary psychometric validity and reliability.⁴⁷

The *GAIN-Short Screener* (GAIN-SS) was used to screen for internalising, externalising and substance use disorders and crime/ violence issues.⁴⁸ Participants rate the items on a 0–4 scale, where 4 indicates the presence of the symptom in the past month. Scale norms suggest that three or more endorsements of past-month symptomatology are consistent with a high likelihood of meeting diagnostic criteria or requiring services in that domain.^{48 49} Research has validated the GAIN-SS among youth.⁴⁸

Analyses

Frequencies were used to summarise descriptive statistics. Since demographic characteristics by sample of origin were compared in an earlier publication²⁴ with few differences across samples, the current analyses present the clinical and non-clinical samples together to understand trajectories among a broader range of youth. Participants recruited from clinical sources had a significantly different age range than those recruited from non-clinical sources, and age was therefore not analysed. Exploratory analysis revealed that for the April 2020 measurement time, mood states and substance use scales correlated at $r=0.27$, $p<0.001$, while the mood states and COVID-19 worries scales correlated at $r=0.55$, $p<0.001$, and substance use and COVID-19 worries correlated at $r=0.13$, $p=0.001$; strength of the correlations suggested different constructs relevant to analyses in separate models.

We then conducted a latent class analysis (LCA) of the CRISIS survey mood states, substance use and COVID-19 worries scales to observe mental health and substance use trajectories. Full information maximum likelihood was used to include all participants in the analyses. After a first wave of data collection from 619 youth in April 2020, 450 (72.7%) participated at time 2 (June 2020), 410 (66.2%) at time 3 (August 2020) and 411 (66.4%) at time 4 (October 2020). The sample size was considered sufficient for an LCA approach.^{50 51} After examining interpretability and LCA fit indices (loglikelihood, parametric bootstrapped likelihood ratio test, Akaike Information

Criterion, Bayesian Information Criterion and sample size-adjusted Bayesian Information Criterion), along with class sizes and interpretability, class models were retained for each of the three scales. Demographic and clinical profiles across the classes for each set of LCA models were examined using χ^2 analysis with post hoc tests. Demographic variables were dichotomised or trichotomised based on cell sizes; variables with small cell sizes (<4) were not examined by class. The LCAs were conducted using MPlus, and the remaining analyses were conducted using SPSS V.25.

RESULTS

Average age was 20.6 years ($SD=2.4$, range 14–28). Demographic and clinical characteristics of are presented in [table 1](#). While the univariate majority of participants were Caucasian, female, born in Canada, speaking English as a first language, students, employed and living in large cities with family members, with good to excellent physical health, due to diversity in the sample, only 18 participants (2.9%) in the sample met this full nine-variable multivariate profile, demonstrating intersectionality.

Fit statistics for one to six latent classes are presented in the online supplemental material. Based on these findings, in combination with interpretability, the number of classes chosen was as follows: CRISIS survey mood states, 4 classes; substance use, three classes; and COVID-19 worries, three classes.

Mood states

Four classes demonstrate the longitudinal evolution of mood symptoms over the course of the first 7 months since the pandemic was declared, with a retrospective rating of 3 months prior to the time one assessment ([figure 1](#)). All classes of participants reported an increase in mood symptoms early in the pandemic. The largest proportion of participants (class 1: $n=270$, 43.6%) thereafter showed some decline over Canada's summer months, with some increase in October 2020. The second largest class (class 3: $n=187$, 30.2%) showed a higher overall level of mood symptoms, with a similar increase in mood symptoms early in COVID-19, followed by a decline, without the October 2020 increase. A small class of participants (class 2: $n=82$, 13.2%) expressed the lowest burden of mood symptoms, with the most considerable decline in symptoms over the summer months but a subsequent increase. Another small group (class 4: $n=80$, 12.9%) demonstrated the highest level of mood symptoms. For them, mood symptoms increased early in the pandemic and were sustained.

Comparing the latent classes based on demographic variables ([table 2](#)), the class with the lowest level of mood symptom (class 2) consisted of significantly more boys/young men and fewer girls/young women, as well as significantly more participants living in small city or rural areas compared with large cities or suburbs and participants with better baseline physical and mental health. The latent class with the highest level of mood symptoms

Table 1 Demographic and clinical characteristics of participants

Demographic and clinical characteristics (n=619)		n	%
Age	<18	59	9.6
	18–22	449	73.2
	23–28	105	17.1
Gender	Man/boy	202	32.6
	Woman/girl	388	62.7
	Transgender or gender diverse	29	4.7
Ethnic origin/ background	Caucasian	378	61.4
	Asian (East and Southeast)	65	10.6
	South Asian	46	7.5
	Black (African, Caribbean, North American)	28	4.5
	Multiple	48	7.8
	Indigenous	7	1.1
	Another background	44	7.1
Born in Canada		542	87.7
First language English		562	90.9
Student		394	63.8
Employment status	Employed	374	60.7
	Unemployed	199	32.3
	Other	43	7.0
Region of residence	Large city or suburbs	414	66.9
	Small city	135	21.8
	Town, village, rural area	70	11.3
Number of people living with	0–1	102	17.2
	2–4	409	68.9
	5+	83	14.0
Living situation	With parents and grandparents	461	74.5
	Other	158	25.5
Self-rated physical health	Good to excellent	506	82.1
	Fair or poor	110	17.9
GAIN short screener	Internalising disorder	320	53.0
	Externalising disorder	166	27.5
	Substance use disorder	72	11.9
	Crime/violence	5	0.8

(class 4) was significantly more likely to be girls/young women, be living in large cities or suburbs, be living with five or more people, and have poorer physical and mental health. Participants living with parents and/or grandparents compared with other living situations were more likely to be in a class with lower symptom levels. Transgender/gender diverse youth also appeared to be most likely to be in the class with the highest mood symptoms

(class 4). Those in the higher mood states symptom classes (classes 3 and 4) were more likely to meet screening criteria for internalising or externalising mental health concerns and were more likely to be in the classes with higher levels of concern for substance use and COVID-19 worries compared with those with profiles of lower mood states scores. There was no difference in class membership based on ethnicity, status as Canadian born, native English speakers, students or employed.

Substance use

Three classes demonstrate the longitudinal evolution of substance use (figure 1). The majority of participants (class 1: n=364, 58.8%) report low levels of substance use and relatively stable trajectories during the pandemic. Over a quarter of participants (class 2: n=171, 27.6%) fall into a class reporting somewhat higher levels of use, but again relatively stable trajectories. A smaller group of participants (class 3: n=84, 13.6%), report the highest level of substance use, again with little variation over time.

The class with the lowest level of substance use (class 1) was significantly more likely to have a background other than Caucasian, to be students, to be living with two to four people, to be living with parents and/or grandparents and to have good physical health, while being significantly less likely to meet criteria for mental health concerns (table 3). Participants in the latent class with the highest substance use concerns (class 3) were more likely to be in the oldest age group, identify as Caucasian, not be students, be living alone or with one other person, not be living with parents/grandparents and to meet screening criteria for an internalising, externalising or substance use disorder. Participants with the highest substance use symptom profile were more likely to be in a higher symptom-level class on the mood states scale, but substance use profiles were not associated with COVID-19 worries profiles. There was no difference between classes in terms of gender, Canadian-born or English-speaking status, employment status or region of residence.

COVID-19 worries

Three classes demonstrate the longitudinal evolution of COVID-19 worries. All three latent classes reported the highest level of worry early in the pandemic, followed by a decline over the summer, then an increase in October 2020 (figure 1). A large group (class 1: n=217, 35.1%) reported the lowest level of worry. For over half of participants (class 2: n=322, 52.0%), worries were moderate compared with the other latent classes. A small but important group (class 3: n=80, 12.9%) reported the highest level of worries and the sharpest increase in October 2020.

The latent class with the lowest level of COVID-19 worries (class 1) consisted of significantly more boys/young men, participants living in small cities, towns, villages or rural areas and fewer mental health concerns (table 4). The latent class with the most COVID-19 worries (class 3) contained a significantly higher proportion of

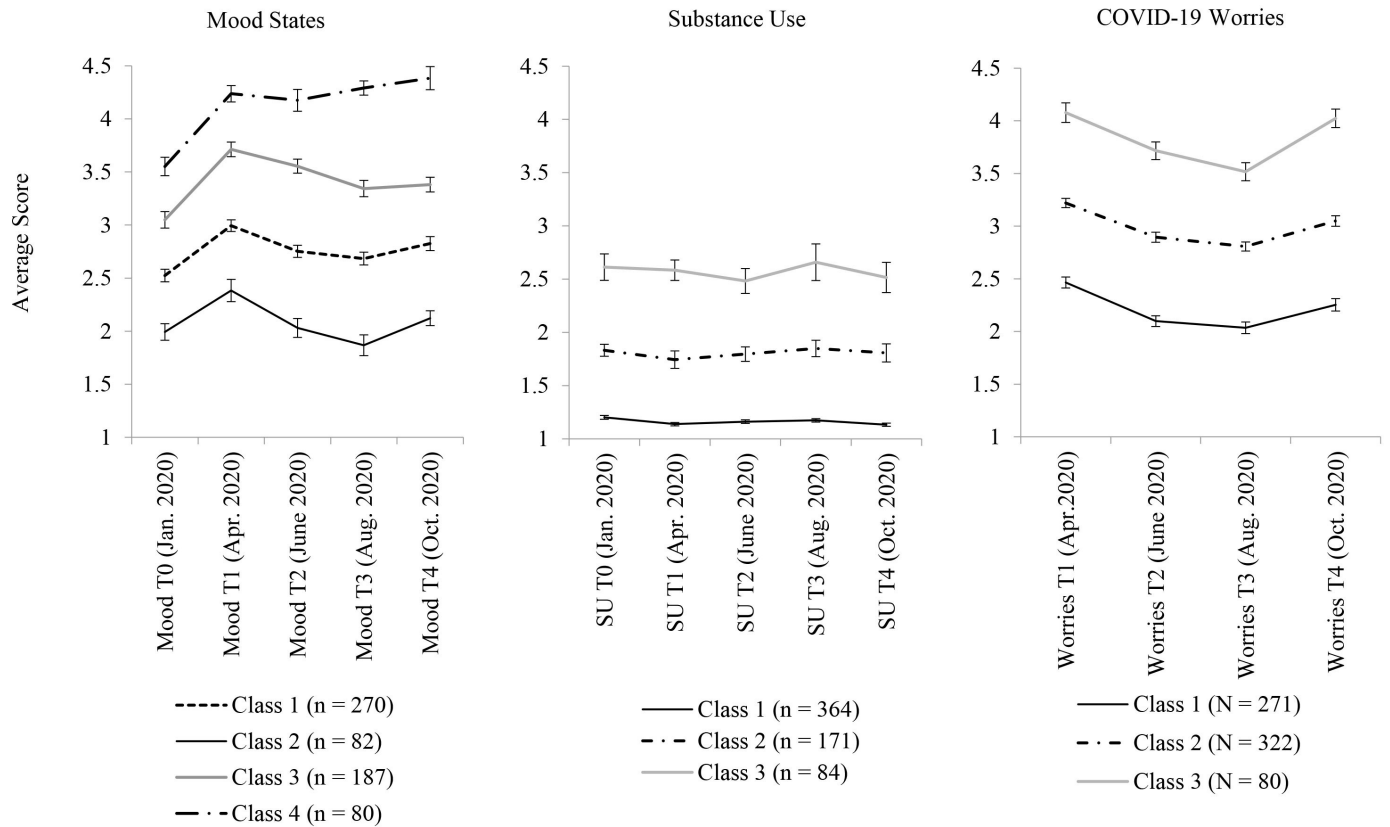


Figure 1 Latent classes of the retained four-class model for the mood states scale, three-class model for the substance use scale and three-class model for the COVID-19 worries scale. Error bars represent the standard error of the mean. Mood, mood states scale; SU, substance use scale; Worries, COVID-19 worries scale.

girls/young women, participants living in large urban or suburban areas and participants screening positive for internalising or externalising disorders at baseline. Transgender/gender diverse youth also appeared to be more likely to be in the highest worries class (class 3). Higher COVID-19 worries were associated with higher symptom classes on the mood states scale, but not substance use. There were no differences in class membership based on age, ethnicity, Canadian-born status, English-language status, student status, employment status, family living situation, number of people living in the home, physical health or the presence of a substance use disorder.

DISCUSSION

This study examined the longitudinal trajectories of youth mental health, substance use and worries during the COVID-19 pandemic. Results show that course is heterogeneous; youth as a whole were impacted in terms of mental health in the early stages of the pandemic, after which some youth experienced improvements followed by a resurgence of symptoms, while others did not. Particularly affected are girls/young women, possibly transgender/gender diverse youth,³¹ youth living in larger households and in urban or suburban areas and those meeting criteria for mental health or substance use concerns at the beginning of the pandemic. Substance use findings showed that while youth have different levels

of substance use, there was little change in use over the course of the pandemic. Levels of pandemic worry vary across youth, with higher levels of worries found among girls/young women, youth living in urban or suburban areas and those meeting criteria for mental health concerns. COVID-19 worries declined as viral transmission declined locally and increased again when transmission increased in the province, particularly for those youth with the greatest level of worry.

A growing number of cross-sectional studies show that the COVID-19 pandemic is having detrimental impacts on youth mental health.^{24 26–29 31} However, the pandemic has been an evolving reality for many months. Individuals and societies have moved beyond the initial shock of the public health emergency, and many are transitioning to a new way of life for the time being. Rates of mental health concerns may vary as COVID-19 infection rates vary in a given area. It is important to note that in the last wave of data collection in the current study, COVID-19 infection rates were sharply rising, which may explain the increase in mood symptoms and worries. Other societal and seasonal factors may have also been affecting young people. For example, many youth went back to school in September after the summer break; while the return to school can have mental health implications for some youth during non-pandemic times,⁵² there may be a particular impact during COVID-19, when many youth went back to school

**Table 2** Baseline demographic and clinical characteristics of participants across the four latent classes of the mood states scale

		Class 1	Class 2	Class 3	Class 4	χ^2	P value	Cramer's V
		n=270	n=82	n=187	n=80			
		n (%)	n (%)	n (%)	n (%)			
Gender*	Man/boy	98 (36.3)	49 (59.8)†	39 (20.9)†	16 (20.0)†	39.956	<0.001	0.26
	Woman/girl	165 (61.1)	33 (40.2)†	138 (73.8)†	52 (65.0)†			
	Transgender/ gender diverse	7 (2.6)	0 (0.0)	10 (5.3)	12 (15.0)			
Ethnic origin/ background	Caucasian	163 (60.6)	45 (55.6)	116 (62.0)	54 (68.4)	2.883	0.410	0.07
	Another background	106 (39.4)	36 (44.4)	71 (38.0)	25 (31.6)			
Born in Canada		236 (87.4)	71 (87.7)	163 (87.2)	72 (90.0)	0.463	0.927	0.03
First language English		248 (91.9)	70 (86.4)	169 (90.4)	75 (93.8)	3.120	0.373	0.07
Student		173 (64.1)	46 (56.8)	125 (66.8)	50 (62.5)	2.539	0.468	0.06
Employment status	Employed	170 (67.5)	55 (72.4)	104 (60.5)	45 (61.6)	4.398	0.222	0.09
	Unemployed	82 (32.5)	21 (27.6)	68 (39.5)	28 (38.4)			
Region of residence	Large city or suburbs	171 (63.3)	45 (54.9)†	136 (72.7)†	62 (77.5)†	13.826	0.003	0.15
	Small city, town, village, rural	99 (36.7)	37 (45.1)†	51 (27.3)†	18 (22.5)†			
Number of people living with	0–1	41 (15.8)	10 (12.5)	37 (20.9)	14 (18.2)	15.026	0.020	0.11
	2–44	195 (75.0)†	57 (71.3)	111 (62.7)†	46 (59.7)			
	5+	24 (9.2)†	13 (16.3)	29 (16.4)	17 (22.1)†			
Housing	With parents/ grandparents	217 (80.4)†	61 (74.4)	129 (69.0)†	54 (67.5)	9.950	0.019	0.13
	Other	53 (19.6)†	21 (25.6)	58 (31.0)†	26 (32.5)			
Self-rated physical health	Good to excellent	234 (87.0)†	75 (92.6)†	143 (76.5)†	54 (68.4)†	24.678	<0.001	0.20
	Fair or poor	35 (13.0)†	6 (7.4)†	44 (23.5)†	25 (31.6)†			
GAIN-SS	Internalising disorder	94 (35.9)†	15 (18.5)†	138 (75.0)†	73 (94.8)†	159.263	<0.001	0.51
	Externalising disorder	49 (18.7)†	4 (4.9)†	74 (40.2)†	39 (50.6)†	66.499	<0.001	0.33
	Substance use disorder	18 (6.8)†	2 (2.5)†	32 (17.4)†	20 (26.0)†	33.123	<0.001	0.23
Substance use class membership	Class 1	182 (67.4)†	63 (76.8)†	94 (50.3)†	25 (31.3)†	62.105	<0.001	0.22
	Class 2	70 (25.9)	12 (14.6)†	59 (31.6)	30 (37.5)			
	Class 3	18 (6.7)†	7 (8.5)	34 (18.2)†	25 (31.3)†			
COVID-19 worries class membership	Class 1	112 (41.5)†	68 (82.9)†	32 (17.1)†	5 (6.3)†	216.631	<0.001	0.42
	Class 2	151 (55.9)	14 (17.1)†	117 (62.6)†	40 (50.0)			
	Class 3	7 (2.6)†	0 (0.0)†	38 (20.3)†	35 (43.8)†			

*Significance test conducted on man/boy versus woman/girl due to sample size; when including transgender/gender diverse participants in the significance test on an exploratory basis, these youth were significantly more likely to be in class 4 and significantly less likely to be in classes 1 and 2.

†Post hoc test $p < 0.05$.

Table 3 Baseline demographic and clinical characteristics of participants across the three latent classes of the substance use scale

Demographic and clinical characteristics		Class 1	Class 2	Class 3	χ^2	P value	Cramer's V
		n=364	n=171	n=84			
		n (%)	n (%)	n (%)			
Gender*	Man/boy	115 (31.6)	58 (33.9)	29 (34.5)	0.855	0.652	0.04
	Woman/girl	236 (64.8)	100 (58.5)	52 (61.9)			
	Transgender/ gender diverse	13 (3.6)	13 (7.6)	3 (3.6)			
Ethnic origin/ background	Caucasian	199 (55.0)†	117 (68.4)†	62 (74.7)†	16.055	<0.001	0.16
	Another background	163 (45.0%)†	54 (31.6%)†	21 (25.3%)†			
Born in Canada		314 (86.5)	154 (90.1)	74 (88.1)	1.378	0.502	0.05
First language English		322 (88.7%)	162 (94.7%)	78 (92.9%)	5.566	0.062	0.10
Student		253 (69.7)†	97 (56.7)†	44 (52.4)†	13.906	0.001	0.15
Employment status	Employed	215 (64.2)	105 (66.0)	54 (68.4)	0.549	0.760	0.03
	Unemployed	120 (35.8)	54 (34.0)	25 (31.6)			
Region of residence	Large city or suburbs	232 (63.7)	120 (70.2)	62 (73.8)	4.284	0.117	0.08
	Small city, town, village, rural	132 (36.3)	51 (29.8)	22 (26.2)			
Number of people living with	0–1	38 (10.8)†	38 (22.9)†	26 (34.2)†	30.808	<0.001	0.23
	2–4	265 (75.3)†	102 (61.4)†	42 (55.3)†			
	5+	49 (13.9)	26 (15.7)	8 (10.5)			
Living situation	With parents/ grandparents	300 (82.4)†	117 (68.4)	44 (52.4)†	36.946	<0.001	0.24
	Other	64 (17.6)†	54 (31.6)	40 (47.6)†			
Self-rated physical health	Good to excellent	310 (85.4)†	133 (78.7)	63 (75.0)	6.913	0.032	0.11
	Fair or poor	53 (14.6)†	36 (21.3)	21 (25.0)			
GAIN-SS	Internalising disorder	162 (45.5)†	98 (59.0)	60 (73.2)†	23.847	<0.001	0.20
	Externalising disorder	71 (19.9)†	57 (34.3)†	38 (46.3)†			
	Substance use disorder	4 (1.1)†	29 (17.4)†	39 (47.6)†			
Mood states class membership	Class 1	182 (50.0)†	70 (40.9)	18 (21.4)†	62.105	<0.001	0.22
	Class 2	63 (17.3)†	12 (7.0)†	7 (8.3)			
	Class 3	94 (25.8)†	59 (34.5)	34 (40.5)†			
	Class 4	25 (6.9)†	30 (17.5)†	25 (29.8)†			
COVID-19 worries class membership	Class 1	131 (36.0)	58 (33.9)	28 (33.3)	4.193	0.380	0.06
	Class 2	194 (53.3)	87 (50.9)	41 (48.8)			
	Class 3	39 (10.7)	26 (15.2)	15 (17.9)			

*Significance test conducted on man/boy vs woman/girl due to sample size; when including transgender/gender diverse youth in the significance test, there was no significant difference between classes based on gender.

†Post hoc test $p < 0.05$.

**Table 4** Baseline demographic and clinical characteristics of participants across the three latent classes of the COVID-19 worries scale

Demographic and clinical characteristic		Class 1	Class 2	Class 3	χ^2	P value	Cramer's V
		n=217	n=322	n=80			
		n (%)	n (%)	n (%)			
Gender*	Man/boy	100 (46.1)†	91 (28.3)†	11 (13.8)†	27.966	<0.001	0.22
	Woman/girl	115 (53.0)†	213 (66.1)†	60 (75.0)†			
	Transgender/ gender diverse	2 (0.9)	18 (5.6)	9 (11.3)			
Ethnic origin/ background	Caucasian	137 (63.4)	186 (57.9)	55 (69.6)	4.242	0.120	0.08
	Another background	79 (36.6)	135 (42.1)	24 (30.4)			
Born in Canada		188 (87.0)	283 (87.9)	71 (88.8)	0.180	0.914	0.02
First language English		196 (90.7)	292 (90.7)	74 (92.5)	0.272	0.873	0.02
Student		128 (59.3)	216 (67.1)	50 (62.5)	3.485	0.175	0.08
Employment status	Employed	135 (66.5)	190 (64.0)	49 (67.1)	0.467	0.792	0.03
	Unemployed	68 (33.5)	107 (36.0)	24 (32.9)			
Region of residence	Large city or suburbs	133 (61.3)†	218 (67.7)	63 (78.8)†	8.248	0.016	0.12
	Small city, town, village, rural	84 (38.7)†	104 (32.3)	17 (21.3)†			
Number of people living with	0–1	30 (14.3)	58 (19.0)	14 (17.9)	2.066	0.724	0.04
	2–4	151 (71.9)	205 (67.0)	53 (67.9)			
	5+	29 (13.8)	43 (14.1)	11 (14.1)			
Living situation	With parents/ grandparents	167 (77.0)	240 (74.5)	54 (67.5)	2.752	0.253	0.07
	Other	50 (23.0)	82 (25.5)	26 (32.5)			
Self-rated physical health	Good to excellent	186 (86.5)	259 (80.7)	61 (76.3)	5.156	0.076	0.09
	Fair or poor	29 (13.5)	62 (19.3)	19 (23.8)			
GAIN-SS	Internalising disorder	79 (37.6)†	184 (57.5)†	57 (77.0)†	39.693	<0.001	0.26
	Externalising disorder	47 (22.4)†	85 (26.6)	34 (45.9)†			
	Substance use disorder	21 (10.0)	42 (13.1)	9 (12.2)			
Mood states class membership	Class 1	112 (51.6)†	151 (46.9)	7 (8.8)†	216.631	<0.001	0.42
	Class 2	68 (31.3)†	14 (4.3)†	0 (0.0)†			
	Class 3	32 (14.7)†	117 (36.3)†	38 (47.5)†			
	Class 4	5 (2.3)†	40 (12.4)	35 (43.8)†			
Substance use class membership	Class 1	131 (60.4)	194 (60.2)	39 (48.8)	4.193	0.380	0.06
	Class 2	58 (26.7)	87 (27.0)	26 (32.5)			
	Class 3	28 (12.9)	41 (12.7)	15 (18.8)			

*Significance test conducted on man/boy versus woman/girl due to sample size; when including transgender/gender diverse participants in the significance test, these youth were significantly less likely to be in class 1 and significantly more likely to be in class 3.

†Post hoc test $p < 0.05$.

using remote means; this is an important area for future research. Other contextual factors include the move into the darker winter months,⁵³ interruptions in new seasonal activities and the prolonged move to a less active lifestyle associated with COVID-19 restrictions,³⁴ all of which may also impact mental health. It is therefore essential that we understand how youth mental health is affected through a prospective lens, in the medium and long terms, in order to respond rapidly and effectively to emerging needs.

Youth are a heterogeneous group, with different experiences and needs. This holds true during the pandemic. Girls and young women typically demonstrate higher rates of mood symptoms,⁵⁴ which remains true during the COVID-19 pandemic, in terms of both mood symptoms and COVID-19 worries. Youth with transgender/gender diverse identities are a vulnerable group in terms of mental health and COVID-19.³¹ Youth with physical health challenges also appear to be more affected in their mental health during COVID-19 than those without physical health concerns,²⁶ and their particular need for integrated care should be taken into consideration.⁵⁵

In addition, the current finding that youth living in urban or suburban settings, where COVID-19 infection rates are higher, are experiencing heightened mental health challenges and COVID-19 worries merits attention. A study conducted among adult outpatients in China during COVID-19 demonstrated heightened mental health concerns in those living in urban areas as opposed to rural, interpreted to reflect in part the more dense living situations, more extensive media coverage and more impact on employment.⁵⁶ These concerns may also be experienced among young people in Canada. However, those findings stand in contrast to suggestions that those living in rural areas will experience more impacts due to a lack of internet connection and the digital divide.⁵⁷ A study also found higher mental health concerns among people living in larger households,⁵⁶ reflected again in the current study. This is a concern of note for youth mental health, given that youth living with others may experience more challenges with confidentiality when seeking virtual services.^{30 58} Attending to confidentiality concerns and technological barriers is important in improving the utilisation of virtually delivered mental health and substance use services.

Public health and mental health and substance use service research, evaluations and system-level responses must take heterogeneity in the population into account and provide diverse options to reach different youth. To do so, a key component is to engage with diverse youth locally to hear from youth themselves about what they need and want to cocreate research evaluating and solutions supporting mental health, substance use and well-being during the pandemic and beyond.⁵⁹ By engaging young people in cocreating the research and evaluation approaches and the solutions to emerging projects, initiatives can become more attuned to the needs of youth and more effective at addressing these needs.^{45 60 61}

Strengths and limitations

This study prospectively and longitudinally examined mental health and substance use at a bimonthly intervals beginning early in the pandemic. It used a measurement tool designed to understand the impacts of the COVID-19 pandemic on youth.⁴⁶ However, some limitations are to be noted. Mental health and substance use ratings for before the pandemic were reported retrospectively and may have been subject to recall bias. Recruitment bias is also possible, as the severity of mental health and substance use challenges may have differentially affected study participation. The sample was not representative and some diverse groups of youth may not have been reached, particularly those without internet access; the results may therefore not be generalisable to Canadian youth as a whole. It is unknown the degree to which mental health status during the pandemic will have long-term impacts leading to a mental illness trajectory or treatment requirements; future outcomes research will be required. Multiyear longitudinal monitoring is required to examine long-term impacts as stressors related to disruptions in developmental milestones and broader impacts accumulate for vulnerable youth,³⁵ including modelling over the medium term with additional waves of the virus and vaccine availability, as restrictions are increased or reduced and as enhanced treatment options become available.

CONCLUSIONS

Youth mental health has been affected by the COVID-19 pandemic, and youth have substantial concerns related to the pandemic. Symptom levels and concerns are evolving over time, in line with COVID-19 infection rates and potentially evolving with seasonal factors affecting young people. In order to address youth mental health concerns during this public health emergency, it is essential that we continue to monitor the evolving impacts of the pandemic on mental health. It is also essential that we engage directly with youth to cocreate pandemic response strategies and mental health service adaptations to best meet the needs of young people.

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REFERENCES

- World Health Organization. WHO Timeline - COVID-19 2020. Available: <https://www.who.int/news/item/29-06-2020-covid-timeline> [Accessed 15 Oct 2020].
- Public Health Agency of Canada. Community-based measures to mitigate the spread of coronavirus disease (COVID-19) in Canada: government of Canada, 2020. Available: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals/public-health-measures-mitigate-covid-19.html#_Physical_distancing
- Duan L, Zhu G. Psychological interventions for people affected by the COVID-19 epidemic. *Lancet Psychiatry* 2020;7:300–2.
- Yao H, Chen J-H, Xu Y-F. Patients with mental health disorders in the COVID-19 epidemic. *Lancet Psychiatry* 2020;7:e21.
- Ho CS, Chee CY, Ho RC. Mental health strategies to combat the psychological impact of coronavirus disease 2019 (COVID-19) beyond paranoia and panic. *Ann Acad Med Singap* 2020;49:1–3.
- Holmes EA, O'Connor RC, Perry VH, et al. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry* 2020;7:547–60.
- Courtney D, Watson P, Battaglia M, et al. COVID-19 impacts on child and youth anxiety and depression: challenges and opportunities. *Can J Psychiatry* 2020;65:688–91.
- Brooks SK, Webster RK, Smith LE, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 2020;395:912–20.
- Wang QQ, Kaelber DC, Xu R. COVID-19 risk and outcomes in patients with substance use disorders: analyses from electronic health records in the United States. *Mol Psychiatry* 2020.
- Singh S, Roy D, Sinha K, et al. Impact of COVID-19 and lockdown on mental health of children and adolescents: a narrative review with recommendations. *Psychiatry Res* 2020;293:113429.
- Xiong J, Lipsitz O, Nasri F, et al. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J Affect Disord* 2020;277:55–64.
- Santabábara J, Lasheras I, Lipnicki DM, et al. Prevalence of anxiety in the COVID-19 pandemic: an updated meta-analysis of community-based studies. *Prog Neuropsychopharmacol Biol Psychiatry* 2021;109:110207.
- Bueno-Notivol J, Gracia-García P, Olaya B, et al. Prevalence of depression during the COVID-19 outbreak: a meta-analysis of community-based studies. *Int J Clin Health Psychol* 2021;21:100196.
- Perrin PC, McCabe OL, Everly GS, et al. Preparing for an influenza pandemic: mental health considerations. *Prehosp Disaster Med* 2009;24:223–30.
- Boyle MH, Georgiades K. Disorders of childhood and adolescence. In: Cairney J, Streiner D, eds. *Mental disorders in Canada: an epidemiological perspective*. Toronto, Ontario: University of Toronto Press, 2009.
- Belfer ML. Child and adolescent mental disorders: the magnitude of the problem across the globe. *J Child Psychol Psychiatry* 2008;49:226–36.
- Baxter AJ, Scott KM, Vos T, et al. Global prevalence of anxiety disorders: a systematic review and meta-regression. *Psychol Med* 2013;43:897–910.
- Auerbach RP, Mortier P, Bruffaerts R, et al. Who world mental health surveys international college student project: prevalence and distribution of mental disorders. *J Abnorm Psychol* 2018;127:623–38.
- Boak A, Elton-Marshall T, Mann RE. *Drug use among Ontario students, 1977-2019: detailed findings from the Ontario student drug use and health survey (OSDUHS)*. Toronto, ON: Centre for Addiction and Mental Health, 2020.
- Kessler RC, Angermeyer M, Anthony JC, et al. Lifetime prevalence and age-of-onset distributions of mental disorders in the world Health organization's world mental health survey initiative. *World Psychiatry* 2007;6:168–76.
- Kessler RC, Amminger GP, Aguilar-Gaxiola S. Age of onset of mental disorders: a review of recent literature. *Curr Opin Psychiatry* 2007;20:359–64.
- Arnett JJ. *Emerging adulthood: the winding road from the late teens through the twenties*. New York, NY, US: Oxford University Press, 2004.
- d'Entremont L, Gregor M, Kirou E, et al. Developmental milestones for productivity occupations in children and youth: An integrative review. *Work* 2017;56:75–89.
- Hawke LD, Barbic SP, Voineskos A. Impacts of COVID-19 on youth mental health, substance use, and well-being: a rapid survey of clinical and community samples. *Canadian J Psych* 2020;65:701–9. doi:10.1111/eip.13052
- Hamza CA, Ewing L, Heath NL. *When social isolation is nothing new: a longitudinal study psychological distress during COVID-19 among university students with and without preexisting mental health concerns*. Educational Publishing Foundation, 2020.
- Hawke LD, Monga S, Korczak D, et al. Impacts of the COVID-19 pandemic on youth mental health among youth with physical health challenges. *Early Interv Psychiatry* 2021;15:1146–53. doi:10.1111/eip.13052
- Liang L, Ren H, Cao R, et al. The effect of COVID-19 on youth mental health. *Psychiatr Q* 2020;91:841–52.
- Shanahan L, Steinhoff A, Bechtiger L, et al. Emotional distress in young adults during the COVID-19 pandemic: evidence of risk and resilience from a longitudinal cohort study. *Psychol Med* 2020;150:1–10.
- Son C, Hegde S, Smith A, et al. Effects of COVID-19 on college students' mental health in the United States: interview survey study. *J Med Internet Res* 2020;22:e21279.
- Fish JN, McInroy LB, Pacey MS, et al. "I'm kinda stuck at home with unsupportive parents right now": LGBTQ youths' experiences with COVID-19 and the importance of online support. *J Adolesc Health* 2020;67:450–2.
- Hawke LD, Hayes E, Darnay K, et al. Mental health among transgender and gender diverse youth: an exploration of effects during the COVID-19 pandemic. *Psychol Sex Orientat Gen Divers* 2021;8:180–7.
- Liu CH, Zhang E, Wong GTF, et al. Factors associated with depression, anxiety, and PTSD symptomatology during the COVID-19 pandemic: clinical implications for U.S. young adult mental health. *Psychiatry Res* 2020;290:113172.
- Moore SA, Faulkner G, Rhodes RE, et al. Impact of the COVID-19 virus outbreak on movement and play behaviours of Canadian children and youth: a national survey. *Int J Behav Nutr Phys Act* 2020;17:85.
- Zheng C, Huang WY, Sheridan S, et al. COVID-19 pandemic brings a sedentary lifestyle in young adults: a cross-sectional and longitudinal study. *Int J Environ Res Public Health* 2020;17:6035.
- Wade M, Prime H, Browne DT. Why we need longitudinal mental health research with children and youth during (and after) the COVID-19 pandemic. *Psychiatry Res* 2020;290:113143–43.
- Racine N, Cooke JE, Eirich R, et al. Child and adolescent mental illness during COVID-19: a rapid review. *Psychiatry Res* 2020;292:113307–07.
- Statistics Canada. A portrait of Canadian youth: March 2019 updates 2019. Available: <https://www150.statcan.gc.ca/n1/pub/11-631-x/11-631-x2019003-eng.htm> [Accessed 15 May 2020].
- Henderson JL, Cheung A, Cleverley K, et al. Integrated collaborative care teams to enhance service delivery to youth with mental health and substance use challenges: protocol for a pragmatic randomised controlled trial. *BMJ Open* 2017;7:e014080.

- 39 Henderson JL, Brownlie EB, McMain S, *et al.* Enhancing prevention and intervention for youth concurrent mental health and substance use disorders: the research and action for teens study. *Early Interv Psychiatry* 2019;13:110–9.
- 40 Hawke LD, Koyama E, Henderson J. Cannabis use, other substance use, and co-occurring mental health concerns among youth presenting for substance use treatment services: sex and age differences. *J Subst Abuse Treat* 2018;91:12–19.
- 41 Government of Ontario. Ontario enacts declaration of emergency to protect the public. Queen's Printer for Ontario, 2020. Available: <https://news.ontario.ca/opo/en/2020/03/ontario-enacts-declaration-of-emergency-to-protect-the-public.html> [Accessed 1 Jun 2020].
- 42 Public Health Ontario. *COVID-19 in Ontario: focus on October 25, 2020 to October 31, 2020. Weekly epidemiological summary. Toronto, Ontario, Canada, 2020.*
- 43 Harris PA, Taylor R, Thielke R, *et al.* Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009;42:377–81.
- 44 Heffernan OS, Herzog TM, Schiralli JE, *et al.* Implementation of a youth-adult partnership model in youth mental health systems research: challenges and successes. *Health Expect* 2017;20:1183–8.
- 45 Hawke LD, Relihan J, Miller J, *et al.* Engaging youth in research planning, design and execution: practical recommendations for researchers. *Health Expect* 2018;21:944–9.
- 46 Merikangas K, Milham M, Stringaris A. *The coronavirus health impact survey (CRISIS)*. Bethesda, MD: Intramural Research Program, National Institute of Mental Health and the Child Mind Institute, 2020. <https://github.com/nimh-mbdu/CRISIS>
- 47 Nikolaidis A, Paksarian D, Alexander L, *et al.* The coronavirus health and impact survey (crisis) reveals reproducible correlates of pandemic-related mood states across the Atlantic. *medRxiv* 2020
- 48 Dennis ML, Chan Y-F, Funk RR. Development and validation of the GAIN short screener (GSS) for internalizing, externalizing and substance use disorders and crime/violence problems among adolescents and adults. *Am J Addict* 2006;15:80–91.
- 49 Dennis ML, Feeney T, Hanes Stevens LV. *Global Appraisal of Individual Needs—Short Screener (GAIN-SS): Administration and Scoring Manual Version 2.0.3*. Bloomington, IL: Chestnut Health Systems, 2008.
- 50 Nylund-Gibson K, Choi AY. Ten frequently asked questions about latent class analysis. *Transl Issues Psychol Sci* 2018;4:440–61.
- 51 Dziak JJ, Lanza ST, Tan X. Effect size, statistical power and sample size requirements for the bootstrap likelihood ratio test in latent class analysis. *Struct Equ Modeling* 2014;21:534–52.
- 52 Hansen B, Lang M. Back to school blues: seasonality of youth suicide and the academic calendar. *Econ Educ Rev* 2011;30:850–61.
- 53 Magnusson A, Partonen T. The diagnosis, symptomatology, and epidemiology of seasonal affective disorder. *CNS Spectr* 2005;10:625–34.
- 54 Wiens K, Bhattarai A, Pedram P, *et al.* A growing need for youth mental health services in Canada: examining trends in youth mental health from 2011 to 2018. *Epidemiol Psychiatr Sci* 2020;29:e115–e15.
- 55 Asarnow JR, Rozenman M, Wiblin J, *et al.* Integrated medical-behavioral care compared with usual primary care for child and adolescent behavioral health. *JAMA Pediatr* 2015;169:929–37.
- 56 Liu L, Xue P, Li SX, *et al.* Urban-Rural disparities in mental health problems related to COVID-19 in China. *Gen Hosp Psychiatry* 2021;69:119–20.
- 57 Summers-Gabr NM. Rural–urban mental health disparities in the United States during COVID-19. *Psychological Trauma: Theory, Research, Practice, and Policy* 2020;12:S222–4.
- 58 Hawke LD, Sheikhan NY, MacCon K, *et al.* Going virtual: youth attitudes toward and experiences of virtual mental health and substance use services during the COVID-19 pandemic. *BMC Health Services Research* 2021;21:1–10.
- 59 Centre for Children and Young People's Participation. *COVID-19: Children's Participation in shaping responses*. 21. University of Central Lancashire, 2020.
- 60 Hawke LD, Mehra K, Settapani C, *et al.* What makes mental health and substance use services youth friendly? A scoping review of literature. *BMC Health Serv Res* 2019;19:257.
- 61 Brownlie EB, Chaim G, Heffernan O, *et al.* Youth services system review: moving from knowledge gathering to implementation through collaboration, youth engagement, and exploring local community needs. *Can J Commun Ment Health* 2017;36:133–49.