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Authors

Pelham, William E

Tapert, Susan F

Gonzalez, Marybel Robledo

et al.

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Original article

Early Adolescent Substance Use Before and During the COVID-19 Pandemic: A Longitudinal Survey in the ABCD Study Cohort

William E. Pelham III, Ph.D. [a,*], Susan F. Tapert, Ph.D. [a], Marybel Robledo Gonzalez, Ph.D. [a], Connor J. McCabe, Ph.D. [a], Krista M. Lisdahl, Ph.D. [b], Elisabet Alzueta, Ph.D. [c], Fiona C. Baker, Ph.D. [c], Florence J. Breslin, M.S. [d], Anthony Steven Dick, Ph.D. [e], Gayathri J. Dowling, Ph.D. [f], Mathieu Guillaume, Ph.D. [g], Elizabeth A. Hoffman, Ph.D. [f], Andrew T. Marshall, Ph.D. [h,i], Bruce D. McCandliss, Ph.D. [g], Chandni S. Sheth, Ph.D. [j], Elizabeth R. Sowell, Ph.D. [h,i], Wesley K. Thompson, Ph.D. [k], Amandine M. Van Rinsveld, Ph.D. [g], Natasha E. Wade, Ph.D. [a], and Sandra A. Brown, Ph.D. [a]

[a] *Department of Psychiatry, University of California, San Diego, La Jolla, California*
[b] *Department of Psychology, University of Wisconsin at Milwaukee, Milwaukee, Wisconsin*
[c] *Center For Health Sciences, SRI International, Menlo Park, California*
[d] *Laureate Institute For Brain Research, Tulsa, Oklahoma*
[e] *Department of Psychology, Florida International University, Miami, Florida*
[f] *Division of Extramural Research, National Institute on Drug Abuse, Rockville, Maryland*
[g] *Graduate School of Education, Stanford University, Palo Alto, California*
[h] *Department of Pediatrics, University of Southern California, Los Angeles, California*
[i] *Department of Pediatrics, Children's Hospital Los Angeles, Los Angeles, California*
[j] *Department of Psychiatry, University of Utah, Salt Lake City, Utah*
[k] *Division of Biostatistics and Department of Radiology, Population Neuroscience and Genetics (PNG) Lab, University of California, San Diego, La Jolla, California*

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A B S T R A C T

Purpose: Evaluate changes in early adolescent substance use during the coronavirus disease 2019 (COVID-19) pandemic using a prospective, longitudinal, nationwide cohort.
Methods: Participants were enrolled in the Adolescent Brain Cognitive Development Study. A total of 7,842 youth (mean age = 12.4 years, range = 10.5–14.6) at 21 study sites across the U.S. completed a three-wave assessment of substance use between May and August 2020. Youth reported whether they had used alcohol, nicotine, cannabis, or other substances in the past 30 days. Data were linked to prepandemic surveys that the same youth had completed in the years 2018–2020, before the advent of the COVID-19 pandemic.
Results: Past-30-day substance use remained stable in the 6 months since stay-at-home orders were first issued in U.S. states/counties; was primarily episodic (1–2 days in the past month); and was typically limited to a single substance. Using pretest/posttest and age-period designs, we found that compared to before the pandemic, fewer youth were using alcohol and more youth were using nicotine or misusing prescription drugs. During the pandemic, youth were more likely to use substances when they were more stressed by pandemic-related uncertainty; their family experienced material hardship; their parents used alcohol or drugs; or they experienced greater depression or anxiety. Neither engagement in social distancing nor worry about COVID-19

IMPLICATIONS AND CONTRIBUTION

Onset of the COVID-19 pandemic shifted the pattern of early adolescent substance use (fewer using alcohol, more using nicotine and misusing prescription drugs). Rates of use remained stable between May and September 2020. Rates of use were higher among financially distressed families and emotionally distressed youth.

Conflicts of interest: The authors have no conflicts of interest to disclose.

* Address correspondence to: William Pelham, Ph.D., Department of Psychiatry, University of California, San Diego, 9500 Gilman Dr., La Jolla, CA, 92093.
E-mail address: wpelham@ucsd.edu (W.E. Pelham).

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infection was associated with substance use. Several risk factors were stronger among older (vs. younger) adolescents.
Conclusions: Among youth in early adolescence, advent of the COVID-19 pandemic was associated with decreased use of alcohol and increased use of nicotine and misuse of prescription drugs.

Substance use during early adolescence is associated with negative academic, health, and behavioral consequences [1,2], including greater lifetime risk of substance dependence [3]. Moreover, substance use during this developmental period is strongly dependent on environmental influences, including substance availability, parent and peer use, family functioning, and macroeconomic conditions [4]. Thus, it is critical to evaluate how substance use during early adolescence has been impacted by the coronavirus disease 2019 (COVID-19) pandemic [5–7], a source of large and sustained disruptions to adolescents' daily lives in terms of education [8], contact with family/friends [9,10], and health behaviors [11].

Two studies have reported changes in adolescents' substance use during the COVID-19 pandemic. First, Gaiha et al. [12] surveyed an online convenience sample of 1,442 e-cigarette users aged 13–20 years. In early May 2020, 67% of users reported they had reduced their use since the beginning of the pandemic; 37% had quit entirely. Second, Dumas et al. [13] surveyed an online convenience sample of 1,054 Canadian teens aged 16–18 years on their substance use in the 3 weeks before and after the government began to encourage social distancing. After social distancing began, significantly fewer teens reported binge drinking (16% before vs. 10% after), using cannabis (17% vs. 14%), and vaping (17% vs. 12%); the percentage reporting any alcohol use did not change significantly.

More work is needed to complement these initial investigations. First, both studies [12,13] were based on online convenience samples, with limited representation of males [12,13] and Black and Hispanic teens, [13] reducing the generalizability of findings [14]. Black and Hispanic communities in particular have suffered greater health consequences of the COVID-19 pandemic [15]. Second, neither study [12,13] examined use during early adolescence. The pandemic may have a different impact among youth in early adolescence, when fewer teens are using substances, it is more difficult to access substances and circumvent parental supervision, and use reflects greater psychosocial deviance [16,17]. Third, both studies [12,13] focused on the 3–6 weeks after the initial stay-at-home orders, spanning March to May 2020. Alcohol/drug use may have evolved as adolescents' lives continued to change into the summer and fall. Some changes may have contributed to increased alcohol/drug use as the pandemic continued (e.g., greater COVID-19 infection rates, decreased adherence to social distancing, and the accumulation of repeated stressors) while others may have contributed to decreased alcohol/drug use (e.g., less contact with friends after the school year ended).

Accordingly, it is important to identify the factors placing adolescents at risk of use during the COVID-19 pandemic. The pandemic presented novel risk/protective factors for which the impact on substance use has not previously been studied (e.g., social distancing). In addition, the pandemic may modify the impact of risk factors that are well-established under normal living conditions (e.g., parent's drinking may be more impactful when the family is confined to home). Risk of use might be concentrated particularly in families who have suffered greater economic disruption due to the pandemic (e.g., loss of employment) [18]. Finally, stress-coping [19] and affect-regulation [20] models of adolescent substance use suggest that the documented increases in internalizing symptoms [21,22] may convey increased risk of substance use.

The present study described substance use in a nationwide, sociodemographically diverse sample of youth in early adolescence followed up for approximately 6 months after stay-at-home orders were first issued in U.S. states/counties. A total of 7,842 adolescents at 21 study sites across the U.S. completed a three-wave survey measuring substance use between May and August 2020. Data were linked to prepandemic assessments of youths' substance use in 2018/2019/January 2020. We aimed to (1) describe substance use over the early course of the pandemic, (2) evaluate whether substance use had changed from the prepandemic levels, and (3) identify correlates of use during the pandemic.

Method

Sample

Participants were enrolled in the ongoing Adolescent Brain Cognitive Development (ABCD) Study, and a sample of 11,880 youth initially enrolled at ages 9–10 years at 22 study sites across the U.S. Recruitment was primarily school-based [23]. At study entry, 48% of youth were female, 20% were Hispanic, 15% were Black, and 2% were Asian. Sixty-eight percent of parents/guardians were married; 53% of families included a parent/guardian who completed BA/graduate degree. All procedures were conducted in accordance with the ethical standards of the 1964 Helsinki Declaration and its later amendments and were approved by an institutional review board.

Design

Stay-at-home orders were first issued across the study sites between March 19 and April 6, 2020. Beginning in May 2020, ABCD Study participants were invited to complete surveys measuring the impacts of the pandemic on youth and families. Legal guardians were emailed links for the parent and youth to separately complete three online surveys between May and August 2020, spaced 40 days apart. Links were sent on May 16 (survey 1), June 23 (survey 2), and August 4 (survey 3), with 90% of completions occurring within 2 weeks of sending. Among youth, 5,388, 5,716, and 5,284 completed surveys 1, 2, and 3, respectively. Among parents, 6,860, 7,064, and 6,489 completed surveys 1, 2, and 3, respectively.

Measurement of youth substance use

During the pandemic. At each survey, youth reported the number of days in the past 30 days in which they (1) drank alcohol; (2) smoked cigarettes; (3) used an electronic nicotine delivery system; (4) smoked a cigar/hookah/pipe; (5) used smokeless tobacco/chew/snus; (6) used a cannabis product (flower/concentrate/edible); (7) used prescription drugs in a way not prescribed; (8) used inhalants; or (9) used any other drugs. The response scale ranged from *0 days* to *10+ days*; for analysis, responses were dichotomized into no use versus any use. Responses were collapsed across items (2)-(5) to form an indicator of nicotine use and across items (1)-(9) to form an indicator of use of any substance. In addition, we analyzed vaping of nicotine as its own category given previous findings specific to this format [24].

Before the pandemic. Youths' substance use was also measured before the pandemic, in 2018, 2019 and January 2020, as part of semiannual ABCD Study assessments. We linked the pandemic surveys to prepandemic assessments that measured substance use on the same timescale (past-month use) with comparable item wording.

Measurement of correlates of youth substance use

We examined several potential correlates of youth substance use during the pandemic. Table S1 reports descriptive statistics for each correlate, and Table S2 shows when they were measured.

Correlates measured before pandemic. We measured youth sex and parent-reported youth race/ethnicity at entry to the ABCD Study. In addition, we drew these measures from the most recently completed assessment before the pandemic: parents being married, maximum level of education attained by parents, pre-existing youth externalizing problems (parent report) [25], youth internalizing problems (youth report) [26], and parent's frequency of drunkenness, drug use, and tobacco use [26].

Correlates measured during pandemic. Additional correlates were measured concurrently with youth substance use, during the pandemic.

Direct impacts of COVID-19. At surveys 1-3, youth rated the intensity of their worry about COVID-19 in the past week on a 5-point scale ranging from *not at all* to *extremely*. Youth also reported the current status/format of their education: not in school; in school, online only; in school partially or fully in-person. At survey 2, youth rated how stressful they had found COVID-19–related uncertainty about the future to be in the past week on a 5-point scale ranging from *very slightly/not at all* to *extremely*.

At surveys 1-3, parents reported whether anyone in their household had lost wages, sales, or work since January 2020 due to the impact of COVID-19. Parents also reported whether family had experienced any of these indicators of material hardship: needing food but being unable to afford it, going without telephone service due to expense, paying less than full rent/mortgage due to expense, having utilities turned off due to missed payments, or being evicted. Finally, parents reported whether the family had engaged in social distancing in the past week.

Youth's stress and emotionality. Youth completed a 4-item measure of perceived stress during the past month (surveys 1-3; $\alpha = .64$) [27], as well as 8-item measures of anxiety (survey two; $\alpha = .93$) [28] and depressive symptoms (surveys 1 and 3; $\alpha = .93$) [28] during the past week.

Parents' substance use. At survey 2, parents reported number of days in the past month on which they drank alcohol and the times per day they used nicotine or cannabis products (11-point response scale ranging from *0* to *10+*; for nicotine and cannabis, dichotomized into >0 vs. 0 times per day).

Analysis

Data were drawn from the ABCD 3.0 data release (DOI: 10.15154/1519007) and the ABCD COVID-19 Survey First Data Release (DOI: 10.15154/1520584). Figure S1 depicts which participants were used in each analysis. We used inverse probability weighting to ensure that the youth completing each pandemic survey reflected the sociodemographic characteristics of the ABCD Study sample at study entry. For analyses reporting the prevalence of substance use (Analyses 1 and 2), we multiplied the inverse probability weights by preconstructed baseline weights to make the survey completers representative of U.S. children aged 9/10 years in the U.S Census Bureau's American Community Survey (2011–2015) along the following variables: youth sex and race/ethnicity; family income, structure, and employment; census region; and household size (see Supplement for details) [29].

Analysis 1. We estimated the prevalence of alcohol/drug use at each survey during the pandemic and tested whether prevalence differed by timepoint using a chi-squared test [30].

Analysis 2. We used two complementary approaches to test whether the prevalence of alcohol/drug use changed from before to during the pandemic, seeking convergent findings. Older adolescents are more likely to use substances [17], so the goal of both designs was to separate the developmental, age-related increases in substance use from increases attributable to the pandemic. Our first approach was a pretest/posttest design: We tested whether the prevalence of substance use changed among a subsample of youth ($n = 1079$) who completed a main ABCD Study assessment in the months leading up to the pandemic (September 2019-January 2020) and completed the first survey during the pandemic. This window was intentionally brief to minimize the time elapsed between the prepandemic and during-pandemic surveys (and thus any expected developmental increases in substance use). Owing to study design, these 1,079 youth tended to be younger than the full sample (mean age = 11.8 vs. 12.4 years). While the pretest/posttest strength has the advantage of making a within-subject comparison of alcohol/drug use, it has the disadvantage of limiting sample size to only those youth who completed a prepandemic assessment within the acceptable interval.

The second approach was an age-period design [31]: We compared the prevalence of substance use among ABCD Study participants who were 11 or 12 years old in the years 2018, 2019, or (May/June) 2020 (total $n = 7{,}585$ 11-year-olds, 3,549 12-year-olds). The rates of substance use can be conceptualized as varying along three dimensions: age, period (i.e., calendar year), and cohort (i.e., year of birth) [31]. If we hold age constant (e.g., compare prevalences only within 11-year-olds) and assume no cohort effects (see Supplement for justification), then differences in prevalence can be attributed to the calendar year in which the

Table 1
Prevalence of youth substance use by survey during pandemic

Variable	Prevalence (%) of youth endorsing use in past 30 days [95% CI]			Summary across waves		*p* Value for test of difference by survey 1/2/3
	Survey 1 May 16 – June 11	Survey 2 June 23 – July 17	Survey 3 August 4 – August 19	Mean point prevalence	Cumulative prevalence [95% CI]	
Number of youth	5,388	5,716	5,284	-	3,159	-
Any substance	3.9 [3.2, 4.7]	3.6 [2.9, 4.3]	4.0 [3.2, 5.1]	3.8	8.0 [6.9, 9.2]	.60
Alcohol	1.7 [1.3, 2.1]	1.7 [1.3, 2.3]	1.9 [1.5, 2.5]	1.8	3.4 [2.5, 4.7]	.56
Nicotine (any form)	1.7 [1.3, 2.3]	1.5 [1.1, 1.9]	1.7 [1.3, 2.2]	1.6	3.6 [2.9, 4.4]	.75
Vaping nicotine	0.8 [0.6, 1.3]	0.6 [0.4, 1.0]	0.7 [0.5, 1.0]	0.7	1.1 [0.7, 1.7]	.51
Cannabis (any form)	0.3 [0.1, .6]	0.2 [0.1, .4]	0.3 [0.1, .7]	0.2	0.2 [0.1, 0.4]	.76
Prescription drugs	0.5 [0.3, .7]	0.4 [0.3, .7]	0.7 [0.4, 1.4]	0.5	1.1 [0.6, 2.0]	.28
Inhalants	0.4 [0.2, .6]	0.3 [0.1, .6]	0.2 [0.1, .5]	0.3	0.5 [0.3, .9]	.50
Other drugs	0.3 [0.1, .5]	0.2 [0.1, .3]	0.4 [0.2, 0.7]	0.3	0.5 [0.3, .8]	.08

Note. Mean point prevalence is the average prevalence across surveys 1, 2, and 3. Cumulative prevalence based on youth who completed all three surveys. Estimates of prevalence and confidence intervals are per logistic regression clustering on site, family, and youth. *p* Value is per chi-square test [30]. Months are in the year 2020. "Any substance" is pooled across all 13 items enquiring about substances. Prescription drugs refers to misuse thereof. Nicotine rates collapse across smoking cigarettes, cigars, hookah, or a pipe; vaping an e-nicotine product; using smokeless tobacco, chew, or snus. Cannabis rates collapse across smoking/vaping flower, smoking/vaping concentrates, and using edibles.
CI = confidence interval.

assessment was completed. This design is possible in the ACBD Study because recruitment was rolling (2016–2018), so although all youth were aged 9–10 years at study entry, participants varied in age in any given calendar year. Inspection of the distribution of youth age across calendar years revealed that we had substantial numbers of qualifying prepandemic assessments of 11-year-olds in the years 2018/2019 and of 12-year-olds in the year 2019. Thus, the age-period design consisted of comparing the prevalence of substance use among 11-year-olds in 2020 (during pandemic) versus 2018/2019 (before pandemic) and among 12-year-olds in 2020 (during pandemic) versus 2019 (before pandemic). There were no meaningful differences in the sociodemographic composition of 11- or 12-year-old youth in each of these calendar years after applying inverse probability weights (Table S5).

Analysis 3. We examined potential correlates of use of any substance among youth (i.e., collapsing across substances) during the pandemic. For each correlate, we fit a logistic regression to all available observations across the three waves using the *survey* package [32] in R, clustering on site, family, and youth to account for nonindependence of observations. Separate regressions were fit for each substance. Youth age and dummy variables for survey wave were included as covariates. For each correlate, we tested for moderation [33] of the association with youth use of any substance by youth sex and age. Given the multiple tests, we applied the false discovery rate (FDR) adjustment [34] and report adjusted *p* values in all instances in which a given association was no longer statistically significant at $p < .05$.

Results

Analysis 1: patterns of youth substance use during the pandemic

Table 1 shows the past-30-day prevalence of substance use across the repeated surveys. Collapsing data across all three surveys ($n = 3{,}159$), 8.0% of youth ever reported use of any substance, 3.4% ever reported use of alcohol, and 3.6% ever reported use of nicotine. Rates of substance use remained stable across the three surveys during the pandemic, from May to August 2020 (Table 1). Among those endorsing use, most youth (72%) indicated 1–2 days of use in the past month (Figure S3), and most youth (76%) indicated the use of a single substance. Twenty percent of those endorsing alcohol use also used nicotine; 21% of those endorsing nicotine use also used alcohol; and other overlaps were infrequent (<8%). Among endorsements of nicotine use, 42% were of vaping from an electronic nicotine delivery system; 20% of smoking a tobacco cigarette; 20% of using smokeless tobacco, chew, or snus; and 17% of smoking a tobacco cigar, hookah, or pipe. Among endorsements of cannabis use, 38% were of smoking flower, 14% of smoking oils or concentrates, 16% of vaping flower, 16% of vaping oils or concentrates, and 15% of using edible products.

Analysis 2: changes in substance use compared to before the pandemic

Using the pretest/posttest design, Figure 1 shows the change in rates of substance use from before the pandemic (September 2019-January 2020) to the first survey during the pandemic (May-June 2020) in a subsample of youth ($n = 1{,}079$). The past-30-day prevalence of alcohol use decreased from 1.9% to 0.7% ($p = .03$). The past-30-day prevalence increased for use of nicotine (0% to 1.5%; $p = .005$) and misuse of prescription drugs (0% to 0.7%; $p = .05$). Changes in the rates of use of any substance, cannabis, or inhalants were not statistically significant.

The age-period design yielded convergent results (Figure S4). More 11-year-olds reported past-30-day nicotine use (1.8 vs. 0.1%; $p < .001$) or misuse of prescription drugs (0.9% vs. 0%, $p = .005$) during May/June 2020 than in 2018/2019. Fewer 12-year-olds reported past-30-day alcohol use in May/June 2020 versus 2019 (1.2% vs. 2.2%, $p = .01$), but more reported nicotine use (1.2% vs. 0%, $p < .001$), misuse of prescription drugs (0.6% vs. 0%, $p = .006$), and inhalant use (0.5% vs. 0%, $p = .03$).

Analysis 3: correlates of substance use during the pandemic

Figure 2 shows the estimated associations. Table S4 reports the corresponding regressions.

Demographics and pre-existing psychopathology. Youth sex ($p = 0.78$) and race/ethnicity ($ps = 0.11$-0.55) were not associated with use of any substance during the pandemic. Youth whose parents were unmarried (relative risk [RR] = 1.27, $p = .02$) or had

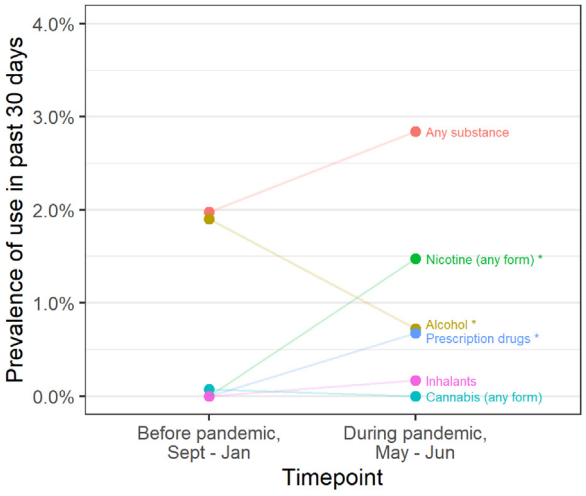

Figure 1. Changes in rate of youth substance use from before to during the pandemic. *Note.* Based on subsample of youth (n = 1079). "Before pandemic" measurement from September 2019-January 2020. "During pandemic" measurement from COVID surveys, May-June 2020. Asterisks next to labels for alcohol, nicotine, and prescription drugs indicate that the changes from before pandemic to during pandemic were statistically significant ($p < .05$) for these substances. Use of "any substance" was collapsed across use of alcohol, nicotine, cannabis, prescription drugs, and inhalants. Analysis could not be conducted for vaping nicotine because prepandemic assessments did not measure smoking and vaping separately.

lower educational attainment ($p = .03$) were more likely to use any substance, as were youth with more externalizing ($p < .001$) and internalizing ($p = .01$) problems before the pandemic (Figure 3).

Direct impacts of COVID-19. Youth were more likely to report use of any substance when endorsing greater levels of COVID-19–related uncertainty about the future (Figure 3; $p < .001$). Youth endorsing *extreme* stress about the uncertainty were 2.37 times more likely to use any substance than youth endorsing *very slight* stress. Youth were 1.23 times more likely to use any substance when their households had lost income due to COVID-19 ($p = .04$; $p = .06$ after FDR adjustment) and 1.39 times more likely when their parent endorsed 1+ indicators of material hardship in the past month ($p = .02$). Neither youths' frequency of worry about the COVID-19 virus ($p = .41$) nor family's engagement in social distancing ($p = .546$) was associated with the use of any substance. Compared with no schooling, neither online schooling ($p = .19$) nor in-person or hybrid schooling ($p = .13$) was significantly associated with youth use of any substance. However, there was a significant positive association ($p = .03$) when schooling was modeled as linear across three levels of school-related contact with peers: not completing any schooling (3.1% used substances); in school, online only (3.8% used); in school, partially or fully in-person (4.7% used). No association varied significantly by youth sex or age.

Youth's stress and emotionality. Youth stress, anxiety, and depressive symptoms during the pandemic were all positively associated with the use of any substance ($p < .001$), including when covarying internalizing problems measured before the pandemic. Figure 3 shows youth use rates within quintiles of stress, anxiety, and depressive symptoms: Use rates were 2.2–2.4 times greater in the uppermost versus lowermost quintiles of each construct. No association varied significantly by youth sex. The association varied by youth age for stress and depressive

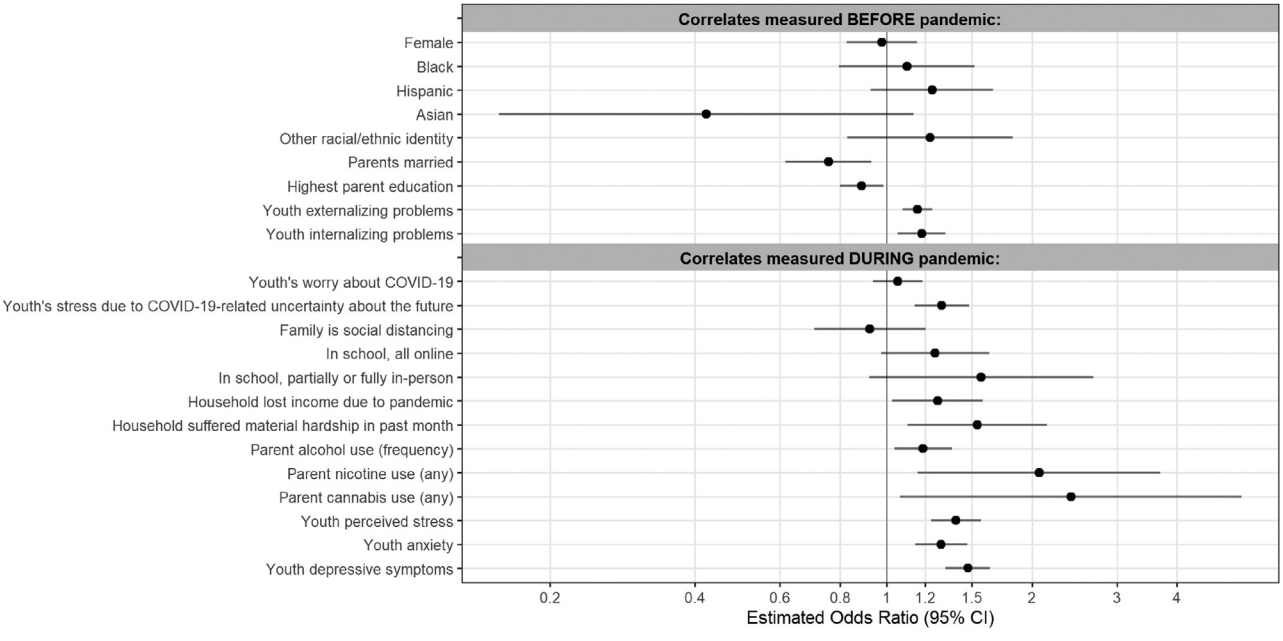

Figure 2. Associations between correlates measured before and during pandemic and youth use of any substance during pandemic. *Note.* Dots indicate estimated odds ratios, and horizontal bands indicate 95% confidence intervals (confidence intervals that exclude the value 1 indicate that the association was statistically significant, $p < .05$). Odds ratios were estimated in logistic regressions that covaried youth age and survey wave (Table S4). Odds ratios greater than one indicate positive associations; odds ratios lower than one indicate negative associations. Nondichotomous variables were rescaled to standard deviation units. For racial/ethnic identity, White youth served as reference level, and "other racial/ethnic identity" category included youth of Native Hawaiian, Pacific Islander, Alaskan Native, American Indian, and multiple races [23]. For schooling status/format, not completing any schooling served as reference level.

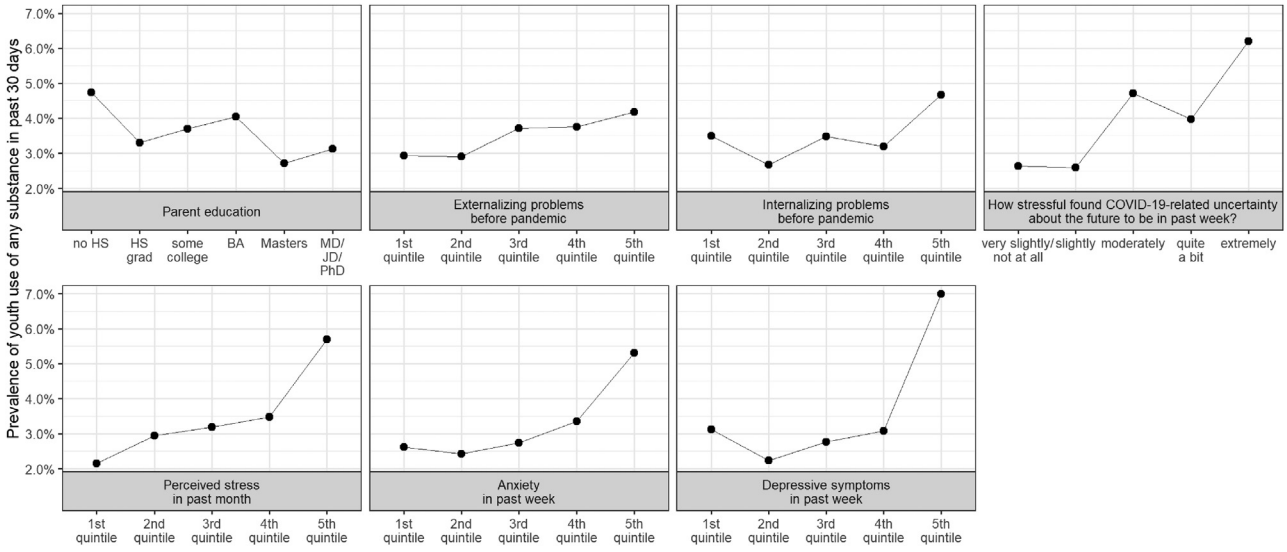

Figure 3. Statistically significant correlates of youth substance use during the pandemic. *Note.* Each panel depicts rate of youth substance use as a function of a different correlate. Association between correlate and youth use of any substance in past 30 days was statistically significant ($p < .05$) in all instances.

symptoms ($p < .001$; Figure 4): Associations were stronger among older youth and negligible for the youngest youth.

Parent's substance use. Youth were more likely to use any substance when parents drank alcohol more frequently ($p = .02$; RR = 1.90 for parents drinking 10+ days vs. 0 days in past month). This association was especially strong for youth use of alcohol in particular (RR = 5.25 vs. 1.90). Youth were more likely to use any substance when parents used nicotine (RR = 1.91, $p = .02$) or cannabis (RR = 2.19, $p = .05$; $p = .06$ after FDR adjustment) in the past month. Associations with parent alcohol, nicotine, and cannabis use remained statistically significant when covarying parent alcohol and nicotine use before the pandemic, suggesting these factors had acute effects. Associations between parent alcohol, nicotine, and cannabis use and youth use of any substance did not vary significantly by youth sex. Associations varied significantly by youth age for parent alcohol use ($p = .05$; $p = .18$ after FDR adjustment) but not nicotine or cannabis use: Parent alcohol use was more strongly associated with youth use among older youth (Figure 4).

Discussion

In a nationwide, sociodemographically diverse, prospective longitudinal sample of U.S. youth in early adolescence ($N = 7{,}842$), substance use remained stable in prevalence over the first 6 months since COVID-19 stay-at-home orders were first issued in the U.S.; was primarily episodic (1–2 days in the past month) versus regular; and was typically limited to a single substance. Using two different designs, we found that relative to before the pandemic, fewer youth were using alcohol, and more were using nicotine or misusing prescription drugs—the overall prevalence of substance use did not change significantly. Relative stability in the overall rate of substance use in this cohort is reassuring given that the pandemic has brought increases in teens' unoccupied time, stress, and loneliness [35], reduced access to support services [36], and disruptions to routines and family/parenting practices [18], all of which might be expected to have markedly increased youth substance use [7]. The impact of these changes on the rate of alcohol/drug use may have been

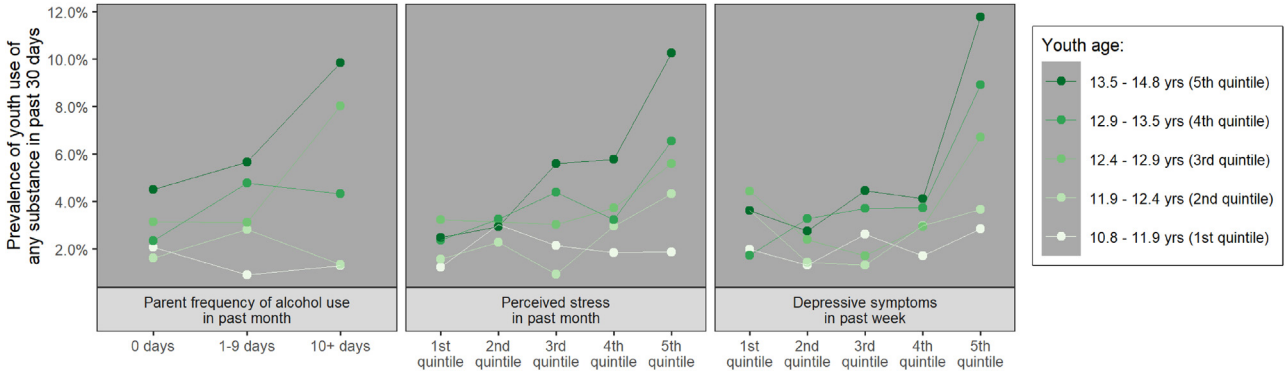

Figure 4. Associations with youth substance use during the pandemic that varied significantly by youth age. *Note.* Each panel depicts rate of youth substance use as a function of a different correlate. Interaction between each correlate and youth age in predicting youth use of any substance was statistically significant ($p < .05$) in all instances. Associations between prepandemic externalizing problems, parent alcohol use, youth perceived stress, and youth depressive symptoms were stronger among older youth. The interaction of parent frequency of alcohol use with youth age was no longer statistically significant after applying the false discovery rate (FDR) adjustment ($p = .18$).

offset by other pandemic-related changes expected to reduce use (e.g., reduced contact with friends).

Our findings complement those of existing studies [12,13] by describing changes among a younger, more diverse, community-based cohort and by documenting a durable reduction in alcohol use that extended beyond the initial stay-at-home orders. Our data do not explain why alcohol use decreased. The decrease may be explained by reduced contact with friends (and thus, reduced access to alcohol and/or the social contexts that often drive early use [13]) or by increased supervision/presence of parents in the home due to stay-at-home orders and remote work [37,38].

Our finding of increased nicotine use was in contrast to previous studies reporting reductions among older youth and among active e-cigarette users [12,13]. Far fewer youth use nicotine at the ages represented in our sample [13], so our discrepant finding may reflect differential impact of the pandemic among the more selected subset of early adolescents who use nicotine. Perhaps youth were more likely to engage in nicotine use (vs. alcohol) because it is easier to hide from parents when home together (particularly via a discreet method such as vaping).

Youth had higher rates of substance use when in school (vs. out of school), whether that schooling was online or in-person/hybrid. Thus, even online schooling may maintain greater contact with peers that facilitates access to substances, social use contexts, and even digital co-use (e.g., via FaceTime) [13].

Youth in families who experienced loss of income or material hardship during the pandemic were more likely to use substances, as were youth whose parents were unmarried or less educated. Also at elevated risk of use were youth with pre-existing externalizing/internalizing psychopathology [16] or whose parents drank alcohol more frequently or used nicotine/cannabis. Parental alcohol/drug use remained a significant predictor of youth use even when covarying parents' prepandemic use, so this effect may reflect pandemic-related escalations in use. These findings concord with existing evidence that the impact of the pandemic is concentrated among the most vulnerable families [18], with the effects of family stressors compounding.

We found that stress, depression, and anxiety were robustly associated with youth substance use, even when adjusting for the prepandemic level of internalizing problems. Thus, these effects may reflect pandemic-related escalations in emotional difficulties. Associations were stronger among older youth (Figure 4) and were stronger in the upper range of stress and depressive symptoms than in the lower range (Figure 3), consistent with an affect-regulation-based explanation [13,35]. Monitoring teens' stress and emotions and providing support as necessary is likely a fruitful path for parents to reduce substance use and promote health and safety [24,39] during the pandemic.

Youths' worry about the virus itself (i.e., infection) was not associated with youth substance use, while youth's general anxiety and stress were strongly associated. Clearly, the emotional impact of the pandemic is broader than just worry about getting sick. Youth may have limited insight into the source of their emotional distress; parents should focus on monitoring general stress/anxiety.

This study had limitations. First, we compared substance use before versus during the pandemic within younger subsamples—changes in use may have been different among older teens, who were using at a higher rate. Second, we identified several correlates of youth's substance use but did not establish causality. Third, surveys did not measure the intensity of youths' use (e.g., number of drinks), limiting our ability to characterize the potential for harm.

Strengths of this study include the nationwide sample and prospective longitudinal design. Rates of substance use were estimated within a weighted sample with demographic and socioeconomic backgrounds representative of same-aged youth in a recent U.S. Census. The large sample size was necessary to reliably estimate substance use, which occurs infrequently during early adolescence. The nationwide scope of the sample was important to ensure findings did not reflect a location-unique impact of the pandemic. Finally, youth had completed multiple prepandemic assessments of substance use, enabling us to evaluate changes over time without relying on retrospective report of use. Together, findings highlight the critical role of both pre-existing and acute risk/protective factors and suggest economic support to families and emotional support to youth as potential strategies to mitigate risk of substance use during the COVID-19 pandemic.

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Supplementary Data

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