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Adolescents' Adverse Childhood Experiences, Poor Mental Health, and Substance Use During the COVID-19 Pandemic

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Abstract

Purpose: Adverse childhood experiences (ACEs) increase the risk for poor mental health (MH) and substance use. We describe relationships between adolescents' ACEs, substance use, and poor MH occurring during the COVID-19 pandemic.

Methods: We conducted a secondary analysis of data among U.S. high school students aged <18 years, who participated in the nationally representative Adolescent Behaviors and Experiences Survey. Data were collected from January to June 2021. Bivariate and multivariable analyses assessed associations between individual ACEs (physical, emotional abuse by parent or caregiver, parent or caregiver job loss, food insecurity, sexual violence, physical dating violence, or cyber bullying) and cumulative ACEs (0, 1–2, 3, 4+) experienced during the pandemic and substance use; stratified analyses assessed effects of poor MH on associations between ACEs and substance use.

Results: Use of all substances was higher among adolescents with ACEs, particularly those who experienced both ACEs and poor MH during the COVID-19 pandemic. Prevalence of substance

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Contributor's Statement

Dr. Swedo coordinated the project, conceptualized and designed the study, accessed and verified data analysis, drafted the initial manuscript, and reviewed and revised the final manuscript.

Dr. Anderson conducted the data analysis, created tables and figures, drafted the initial manuscript, and reviewed and revised the final manuscript.

Drs. Okwori, DePadilla, Clayton, Villaveces, Ray, Nolon, and Massetti provided subject matter expertise on methodology, data sources, substance use, and violence; drafted the initial manuscript; and reviewed and revised the final manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Supplementary Datas

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use was especially high among adolescents exposed to any sexual violence or physical dating violence. Compared to adolescents without ACEs, a higher percentage of adolescents with 4+ ACEs reported current use of alcohol (adjusted prevalence ratio [aPR], 5.32) or marijuana (aPR, 5.86), misuse of prescription pain medications (aPR, 8.82), binge drinking (aPR, 7.70), and increased alcohol (aPR, 6.54) or drug (aPR, 7.09) use during the pandemic.

Discussion: The individual and combined impact of ACEs and MH on adolescent substance use reinforce the need for trauma-informed care and primary prevention of ACEs to prevent and mitigate poor MH and substance use among adolescents.

Keywords

Adverse childhood experiences; Mental health; Substance use; Adolescents; Pandemic

Adverse childhood experiences, or ACEs, are preventable, potentially traumatic events that occur in childhood [1]. The COVID-19 pandemic and associated restrictions implemented to slow the spread of disease led to significant disruptions in adolescents' academic and personal lives [2] and raised concerns that ACEs could increase during the public health emergency [3]. While exact comparisons of ACEs prevalence both before and during the COVID-19 pandemic are difficult to find, a recent study of adolescents found that ACEs were common during the COVID-19 pandemic, with 55.1% of youth reporting emotional abuse and 11.3% reporting physical abuse by a parent or caregiver during the pandemic [2]. A national, longitudinal survey conducted twice during the COVID-19 pandemic found that between wave 1 (the fall of 2020) and wave 2 (the spring of 2021) of the study, 17.6% of respondents experienced one new ACE, 6.1% experienced 2 new ACEs, and 2.7% experienced 4 or more new ACEs [4].

There is an established link between ACEs and increased risk for smoking, alcohol use, and illicit drug use in adolescence [5–7] and adulthood [8–15]. In addition to worries regarding ACEs, concerns about potential increases in adolescents' substance use during the COVID-19 pandemic emerged [16]. In 2021, 7.0% or 1.8 million adolescents aged 12–17 reported any alcohol use and 3.8% or nearly one million adolescents reported binge drinking in the past month [17]. During the same period, 14.1% or 3.7 million adolescents reported past-year illicit drug use, and 8.5% or 2.2 million adolescents reported a drug or alcohol use disorder in the past year. Although estimates of illicit drug use for this same age group did not increase consistently between 2019 and 2022 [17], electronic health record data showed that mean weekly emergency department visits for all drug overdoses were 10% higher in the fall of 2022 compared to fall of 2019 among adolescents aged 12–17 years [18]; cannabis-related emergency department visits for children aged 11–14 years increased in 2020, 2021, and 2022, compared with 2019 [19]; and mortality data showed that fatal overdoses among those aged 14–18 increased by 94% from 2019 to 2020 and 20% from 2020 to 2021 [20]. Reviews of multiple studies of data collected during the pandemic concluded that the results were mixed or unclear as to whether substance use among adolescents had increased or decreased during COVID-19 [21]. Results from national surveys of high school students showed that, in 2021, current use of alcohol [22], lifetime and past-year use of illicit drugs [22,23], and binge drinking in the previous 2 weeks [23]

decreased from the previous year, and the current misuse of prescription opioids was stable [22].

The COVID-19 pandemic had an undeniable impact on stress and MH concerns among children and adolescents [22,24]. A recent systematic review documented increased symptomology of anxiety, depression, attention-deficit/hyperactivity disorder, sleep disorders, and eating disorders during the COVID-19 pandemic for adolescents [24]. Adolescents may have been particularly vulnerable during this period due to the combined stress of decreased interaction with peers, transitions to virtual learning, adolescent development, routine disruptions, and family stressors and conflict [25,26]. Recent studies have demonstrated compounding effects of ACEs and pandemic-related stress on adolescent MH [27,28]. Verlenden et al.'s 2024 study of longitudinal COVID-19 survey data built evidence for a possible causal relationship between ACEs, pandemic-related stress, and subsequent depressive symptoms, showing significant direct effects of both pandemic-related stress and ACEs reported in Wave 1 on subsequent depressive symptoms reported at Wave 2 [28].

To date, no study has assessed the relationship between ACEs experienced during the pandemic and substance use among adolescents. Moreover, very few studies have examined the combined impact of ACEs and poor mental health on substance use in adolescents [29–31]. The objective of the present study was to: (1) describe the relationship between adolescents' exposure to individual and cumulative ACEs during the pandemic and substance use during the COVID-19 pandemic, and (2) understand the influence of poor mental health on associations between ACEs and substance use in adolescents.

Methods

Participants

This study used data from the 2021 Adolescent Behavior and Experiences Survey (ABES), conducted by the Centers for Disease Control and Prevention (CDC) during January–June 2021. ABES was a one-time, probability-based web survey of U.S. high school students in grades 9 through 12. ABES used a stratified, 3-stage cluster sample design to obtain a nationally representative sample of public- and private-school students in the 50 states and District of Columbia (N = 7,705; 128 schools). School response rate was 38%, student response rate was 48%, and overall response rate was 18%. Data were weighted to account for school and student nonresponse and oversampling of Black and Hispanic students. ABES study protocol was reviewed and approved by institutional review boards at CDC and ICF International Inc., CDC's survey contractor. Additional ABES information has been previously published, including study protocol [32], and the prevalence of individual and cumulative ACEs [2,27], substance use [33], and poor MH [34] experienced during the pandemic by participants.

Survey content

Our exposure of interest was the ACEs experienced during the COVID-19 pandemic. Adolescents self-reported on experiences of adversities “during the COVID-19 pandemic”

(physical abuse by a parent or caregiver, emotional abuse by a parent or caregiver, parent or caregiver job loss, or food insecurity) or during the past 12 months (sexual violence by any perpetrator, physical dating violence, or cyberbullying; Table S1). Given the timing of the widespread onset of the U.S. COVID-19 pandemic (March 2020) and ABES survey administration (January–June 2021), the “past 12 months” reference period largely reflected experiences during the COVID-19 pandemic, overlapping considerably with the time period for the “during the COVID-19 pandemic” questions. All relevant measures from ABES were included as ACEs experienced during the COVID-19 pandemic for this analysis.

Students self-reported their current substance use in the past 30 days (including any alcohol use, binge drinking, marijuana use, or prescription opioid misuse) and whether their alcohol or drug use increased during the COVID-19 pandemic (Table S2). Poor MH during the pandemic was measured by combining 2 items: self-reported MH from the past 30 days and during the COVID-19 pandemic (Table S2).

Statistical analysis

The final analytic sample included 4,374 high school students aged <18 years (to align with the focus on ACEs), with complete data on analytic variables of interest. Students with missing data on variables of interest ($n = 2,261$) and/or who were ≥ 18 years ($n = 1,070$) were excluded from the analysis. Exposure to ACEs during the pandemic was examined by individual type (physical abuse, emotional abuse, sexual violence, physical dating violence, cyberbullying, parent lost job, or food insecurity), category (experiencing abuse by a parent [physical abuse and emotional abuse], experiencing other violence [sexual violence, physical dating violence, or cyberbullying], family economic challenges [parent lost job and food insecurity]), and the cumulative number of ACEs (0, 1–2, 3, or 4+). We calculated weighted pairwise prevalence estimates and corresponding 95% confidence intervals (CIs) for recent ACE exposure (type, category, and cumulative number) by each type of substance used. Adjusted prevalence ratios (aPRs) with 95% CIs were calculated using Poisson regression with robust standard errors (SEs) to examine associations between recent ACE exposure and substance use, adjusted for adolescent sex, race and ethnicity, age, sexual identity, and method of school instruction (i.e., virtual, inperson, or hybrid) at the time the school was recruited to participate in ABES. To examine the relative contribution of different ACEs, a second set of aPRs for recent ACE exposure and substance use was also calculated, which adjusted for the aforementioned sociodemographics and each additional individual ACE.

We also examined whether poor MH affected substance use among those who were exposed to each recent ACE type or category. We calculated weighted pairwise prevalence estimates for the presence of self-reported poor MH for each substance use outcome among those who were exposed to each ACE type or category. APRs with 95% CIs were calculated using Poisson regression with robust SE to examine links between poor MH and substance use among those exposed to each ACE, adjusting for the sociodemographics noted above. Finally, we examined how poor MH impacted the relationship between cumulative ACEs and substance use. To do so, we stratified by the presence of each substance use outcome and calculated the mean and the SE for cumulative number of ACEs among those with and without poor MH. Significant differences in mean ACEs reported by those with and without

poor MH were assessed using t-tests; no additional covariates were included. We examined poor MH for the time frame that aligned with the substance use (i.e., during the past 30 days or during the COVID-19 pandemic) outcome of interest. Analyses were conducted using SAS statistical software (version 9.4, SAS Institute), accounting for complex survey design.

Results

Associations between specific ACEs during the pandemic and substance use varied by individual ACE type and substance (Table 1). Use of all types of substances was higher among individuals exposed to any individual ACE during the pandemic compared to those who did not report exposure to an individual ACE during the pandemic. The prevalence of substance use was especially high among individuals exposed to any sexual violence or physical dating violence during the pandemic—30.1% of adolescents who experienced any sexual violence in the past 12 months and 29.6% of adolescents who experienced any physical dating violence in the past 12 months reported increased use of drugs during the COVID-19 pandemic. When adjusted for sociodemographics, all individual ACEs during the pandemic were associated with current or increased use of most included substances. After controlling for both sociodemographics and exposure to other ACEs during the pandemic, there was variation in individual ACEs' associations with substance use (Table 1). Emotional abuse during the pandemic was consistently associated with all types of substance use, after controlling for both sociodemographics and exposure to other ACEs during the pandemic.

The magnitude and significance of associations between ACE categories (experiencing abuse by a parent during the pandemic, experiencing other violence during the pandemic, or family economic challenges during the pandemic) and substance use differed for individual outcomes (Table 2). All ACE categories were associated with current or increased use of substances in models adjusted for sociodemographics. In models controlling for sociodemographics and exposure to other ACE categories during the pandemic, experiencing abuse by a parent during the pandemic generally had the highest prevalence ratios for use of each substance (aPR range, 1.88–2.73), apart from current binge drinking, which was most strongly associated with experiences of other forms of violence during the pandemic (aPR, 2.42; 95% CI, 1.82–3.20). Family economic challenges during the pandemic had smaller, but significant, associations with substance use in models adjusted for sociodemographics; when controlling for experiences of other ACEs categories, family economic challenges were not significantly associated with current binge drinking, current prescription opioid misuse, or increased drug use during the COVID-19 pandemic.

A strong dose-response relationship was observed between cumulative exposure to ACEs during the pandemic and substance use (Figure 1). Experiencing even 1–2 ACEs during the pandemic (compared to 0 ACEs during the pandemic) doubled or tripled the prevalence of substance use (aPR range of 2.34 for current alcohol use to 3.51 for current prescription opioid misuse). Compared to adolescents who did not experience ACEs during the pandemic, adolescents who experienced 4+ ACEs during the pandemic had 5.32 times (95% CI, 3.85–7.37) higher prevalence of current alcohol use, 7.70 times (95% CI, 4.84–12.23) higher prevalence of binge drinking, 6.54 times (95% CI, 4.31–9.95) higher prevalence of reporting increased use of alcohol during the COVID-19 pandemic, 5.86 times (95% CI

3.98–8.64) higher prevalence of current marijuana use, 8.82 times (95% CI 3.62–21.49) higher prevalence of current prescription pain medication misuse, and 7.09 times (95% CI 4.55–11.05) higher prevalence of reporting increased use of drugs during the COVID-19 pandemic compared to adolescents who did not experience ACEs during the pandemic.

The mean number of ACEs during the pandemic was higher among students with poor MH compared to students without poor MH (Table 3). The mean number of ACEs during the pandemic was also higher among students reporting the use of each substance compared to those who did not. The mean number of ACEs experienced during the pandemic was the highest among adolescents with both poor MH and substance use.

Among adolescents who experienced each ACE during the pandemic, poor MH was associated with increased prevalence of nearly all types of substance use (Table 4). The absolute prevalence of substance use was especially notable among adolescents who experienced both poor MH and any sexual violence: 51.7% reported current alcohol use, 30.7% reported current binge drinking, 32.8% reported increased alcohol use during the COVID-19 pandemic, 34.1% reported current marijuana use, and 31.1% reported increased drug use during the COVID-19 pandemic. Similarly, adolescents with both poor MH and the physical dating violence ACE reported high levels of alcohol use as follows: 53.0% reported current alcohol use, 32.7% reported current binge drinking, and 38.5% reported their alcohol use increased during the pandemic. The strongest association between an individual ACE, poor MH, and substance use was observed for parental job loss and increased drug use during COVID-19, with these adolescents having 3.52 times (95% CI 1.97–6.31) higher prevalence of reporting increased drug use than adolescents who experienced parental job loss during the pandemic but did not report poor MH.

Discussion

Experiences of individual and cumulative ACEs during the pandemic were strongly associated with current or increased use of substances among U.S. adolescents. Experiencing even 1–2 ACEs during the pandemic doubled or tripled the prevalence of substance use; experiencing 4+ ACEs during the pandemic increased prevalence of current or increased substance use by a factor of 5–9. Similar to previous studies, we found that adolescents experiencing ACEs during the pandemic had a greater prevalence of reporting poor MH compared to those who did not experience ACEs during the pandemic [27]. We observed a striking multiplicative effect on substance use for adolescents who experienced ACEs during the pandemic and also reported poor MH compared to those without these exposures; this suggests that prevention and mitigation of the effects of ACEs on MH may help to reduce adolescent substance use. Alcohol and marijuana use were especially prevalent among adolescents who experienced sexual violence or physical dating violence, alone and in combination with poor MH. Consistent with previous studies [35], we found different substance use patterns emerged for individual ACE types and categories (e.g., experiencing abuse by a parent, other violence, family economic challenges), with resultant implications for clinicians and public health officials working to prevent and mitigate harms related to substance use.

Study results for food insecurity and cyberbullying during the pandemic lacked consistent associations between these ACEs and substance use, when controlling for other ACEs. Although both food insecurity and cyberbullying during the pandemic had some significant associations with substance use when controlling for demographic characteristics, the associations were no longer significant after controlling for other ACEs during the pandemic. These results suggest that food insecurity and cyberbullying experienced during the pandemic were not independently associated with substance use but may be antecedents of other variables that contributed directly to substance use. In addition, poor MH influenced the association between both food insecurity and cyberbullying during the pandemic and substance use. Taken together, the pattern of findings for food insecurity and cyberbullying during the pandemic suggest that they do not play a direct role in increasing risk for substance use, but may interact with other factors—such as other ACEs and poor MH—to contribute to risk. These results warrant further exploration of the role that food insecurity and cyberbullying may play in exacerbating the influence of ACEs and poor MH.

Our findings that ACEs during the pandemic were strongly associated with current or increased substance use are consistent with other studies conducted among adolescents [5,6,36] and adults [37,38]. Few studies have assessed ACEs in adolescent populations, and the striking association between ACEs during the pandemic and substance use, especially when coupled with poor MH, highlights a crucial opportunity for prevention and intervention [39]. Most ACEs studies have examined MH outcomes and substance use as separate [40,41] or co-occurrent [42,43] outcomes; few studies exist looking at the moderating or mediating role of poor MH on ACEs' associations with substance use [29–31,35]. Douglas et al.'s study of adults found that, after exposure to ACEs, the development of mood and anxiety disorders usually preceded the onset of a substance use disorder by approximately 3 years [13]. The associations found during our study's shorter timeframe suggest that there may not always be a long delay between experiences of ACEs, poor MH, and substance use. A 2020 study of U.S. adults reporting high-intensity binge drinking found that the association between ACEs and extreme binge drinking was only partially mediated through psychiatric disorders [29]. Similarly, Tang et al. found that internalizing and, particularly, externalizing symptoms partially mediated the association between ACEs and prescription opioid misuse in U.S. adults [31]. Taken together, these findings suggest a complex relationship between ACEs, poor MH, and increased risk for substance use or use disorders. While adolescents who reported ACEs during the pandemic and poor MH often had higher rates of substance use in this analysis, substance use was also common among those who experienced ACEs during the pandemic without reporting poor MH. This suggests there are also unique contributors to the relationship between ACEs and substance use beyond MH.

Clinicians and others who work with adolescents are uniquely poised to recognize and mitigate the impact of ACEs on both MH and substance use. Over 50% of young adults with substance use disorders have at least one co-occurring MH condition [17], and the presence of comorbid disorders worsens substance use outcomes [44]. The strong associations and comorbid occurrence of ACEs with poor MH and substance use reinforces the need for appropriate, trauma-informed responses in clinical and nonclinical settings [39]. Delivery of

services, however, requires appropriate knowledge and training of providers, awareness of ACEs, and minimization of barriers for disclosure of events.

This constellation of problems shares risk and protective factors, meaning that upstream strategies can prevent and mitigate the impact of ACEs, substance use, and poor MH. Foundationally, establishing safe, stable, nurturing relationships and environments (SSNREs) for all children prevents ACEs [1], decreases the impact of ACEs on health risk behaviors when they occur [45], and reduces prevalence of substance use [46] or experiencing poor MH [47]. CDC has developed a suite of technical packages and resources to share evidence-based strategies that prevent ACEs and promote SSNREs [1,48]. Such strategies include strengthening economic supports to families, changing social norms to support parents and encourage positive parenting, provision of quality childcare and early education, enhanced parenting skills to promote healthy child development, and intervening to lessen harms and prevent future risk [1,48]. Preventing ACEs can prevent substance use and MH problems in the current generation; treating substance use and MH problems can prevent ACEs for the next generation.

This study was subject to several limitations. First, because ABES is a cross-sectional survey, causal inferences cannot be made. Second, the response rate (18%) for ABES is lower than other school-based surveys [32]. However, nonresponse bias analyses revealed that weighting adjustments minimized the potential for nonresponse bias in the ABES sample [32]. Third, this study included only 7 ACEs experienced during the pandemic [49]; inclusion of more ACEs might have resulted in a different score distribution and differential results for which ACEs are most associated with substance use behaviors. Moreover, the use of count or dichotomous ACE variables does not capture the complexity and nuances of experiences that individuals may encounter during childhood. This limitation arises from the fact that ACEs can follow latent patterns or exhibit nonadditive characteristics, which are not adequately captured by binary categorization methods. Fourth, this analysis did not have the ability to directly assess experiences or impact of the pandemic, and instead included available ACE measures that adolescents commonly experience. Lastly, ACE measures available in the ABES were of past 12 months or during the timeframe of the pandemic; measures for lifetime childhood exposure to ACEs were not available. Examination of ACEs over the lifetime may have differential results on substance use behaviors among youth exposed to ACEs earlier in childhood. Associations between ACEs experienced during the pandemic and outcomes may reflect the impact of both ACEs during the pandemic and the cumulative toll of lifetime ACEs; given the survey contents, we were unable to account for lifetime ACEs to tease apart the specific impact of ACEs during the pandemic versus ACEs experienced prior to the pandemic.

Conclusions

ACEs, substance use, and poor MH were common among U.S. adolescents during the COVID-19 pandemic. Experiences of individual and cumulative ACEs during the pandemic were strongly associated with current or increased use of substances, particularly among adolescents experiencing poor MH. The strong associations and comorbid occurrence of ACEs with poor MH and substance use emphasize the need for trauma-informed care in

all health care settings, particularly for adolescents experiencing co-occurrent poor MH and substance use. Targeting shared risk factors for ACEs, substance use, and poor MH—through primary prevention of ACEs and promotion of SSNREs—is a critical public health priority for improving adolescent and adult health.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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IMPLICATIONS AND CONTRIBUTION

This study enhances the understanding of how poor mental health (MH) exacerbates the relationships between recent ACEs and substance use during the pandemic. Substance use was higher among adolescents with ACEs during the pandemic compared to adolescents without these ACEs. Adolescents experiencing ACEs and poor MH during the pandemic had higher prevalence of substance use compared to adolescents experiencing ACEs or poor MH alone.

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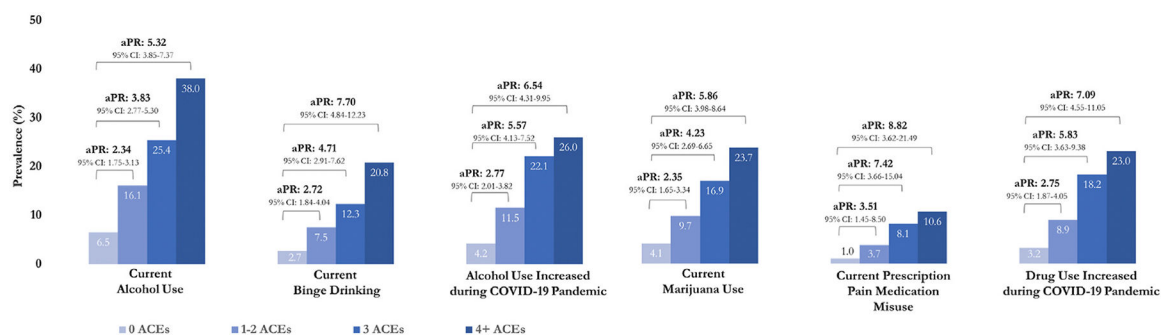


Figure 1. Prevalence of substance use and adjusted associations among U.S. adolescents exposed to cumulative adverse childhood experiences (ACEs) during the COVID-19 pandemic, Adolescent Behavior and Experiences Survey, January–June 2021.

Table 1

Individual and relative associations between specific adverse childhood experiences (ACEs) and substance use among U.S. adolescents during the COVID-19 pandemic, Adolescent Behavior and Experiences Survey, January—June 2021

	Current alcohol use				Current binge drinking				Alcohol use increased during COVID-19				Current marijuana use				Current prescription pain medication misuse				Drug use increased during COVID-19			
	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b
Physical abuse during COVID-19																								
Yes (n = 481)	23.0% (17.8–28.2)	77.0% (71.8–82.3)	1.54 (1.20–1.97)	1.02 (0.77–1.35)	12.1% (7.9–16.2)	87.9% (83.8–92.1)	1.92 (1.36–2.71)	1.24 (0.85–1.82)	21.5% (15.9–27.2)	78.5% (72.8–84.1)	2.09 (1.61–2.70)	1.32 (1.00–1.75)	17.0% (12.6–21.3)	83.0% (78.7–87.4)	1.92 (1.50–2.47)	1.21 (0.92–1.60)	9.1% (6.3–11.9)	90.9% (88.1–93.7)	2.5 (1.64–3.81)	1.57 (1.02–2.44)	16.3% (11.9–20.8)	83.7% (79.2–88.1)	1.93 (1.51–2.48)	1.16 (0.88–1.53)
No (n = 3893)	15.2% (12.8–17.6)	84.8% (82.4–87.2)			7.2% (5.0–9.3)	92.8% (90.7–95.0)			10.6% (9.3–11.9)	89.4% (88.1–90.7)			9.1% (7.3–10.9)	90.9% (89.1–92.7)			3.3% (2.4–4.2)	96.7% (95.8–97.6)			8.6% (7.1–10.0)	91.4% (90.0–92.9)		
Emotional abuse during COVID-19																								
Yes (n = 2424)	22.0% (19.3–24.7)	78.0% (75.3–80.7)	2.32 (1.87–2.87)	1.96 (1.54–2.49)	10.6% (7.7–13.4)	89.4% (86.6–92.3)	2.4 (1.78–3.24)	1.84 (1.30–2.61)	16.4% (14.5–18.3)	83.6% (81.7–85.5)	2.68 (2.10–3.42)	2.17 (1.63–2.89)	13.8% (11.2–16.4)	86.2% (83.6–88.8)	2.73 (2.12–3.51)	2.26 (1.66–3.07)	5.8% (4.4–7.2)	94.2% (92.8–95.6)	3.25 (2.00–5.27)	2.54 (1.52–4.24)	13.6% (11.4–15.8)	86.4% (84.2–88.6)	3.17 (2.40–4.19)	2.58 (1.85–3.61)
No (n = 1950)	8.7% (6.4–10.9)	91.3% (89.1–93.6)			4.1% (2.7–5.6)	95.9% (94.4–97.3)			6.0% (4.5–7.5)	94.0% (92.5–95.5)			5.2% (3.7–6.6)	94.8% (93.4–96.3)			1.6% (0.9–2.3)	98.4% (97.7–99.1)			4.2% (2.9–5.4)	95.8% (94.6–97.1)		
Any sexual violence in the past 12 months																								
Yes (n = 424)	44.7% (39.0–50.5)	55.3% (49.5–61.0)	2.67 (2.16–3.29)	2.02 (1.54–2.63)	26.6% (20.2–33.0)	73.4% (67.0–79.8)	3.59 (2.58–4.99)	2.58 (1.76–3.70)	29.3% (23.5–35.1)	70.7% (64.9–76.5)	2.72 (2.13–3.47)	1.92 (1.36–2.72)	30.5% (23.8–37.3)	69.5% (62.7–76.2)	3.5 (2.79–4.38)	2.68 (2.11–3.41)	9.7% (6.6–12.8)	90.3% (87.2–93.4)	2.26 (1.60–3.18)	1.41 (0.93–2.12)	30.1% (24.7–35.6)	69.9% (64.4–75.3)	3.63 (2.86–4.59)	2.67 (2.02–3.54)
No (n = 3950)	13.1% (11.1–15.1)	86.9% (84.9–88.9)			5.8% (4.0–7.5)	94.2% (92.5–96.0)			9.9% (8.6–11.2)	90.1% (88.8–91.4)			7.8% (6.5–9.2)	92.2% (90.8–93.5)			3.3% (2.6–4.1)	96.7% (95.9–97.4)			7.3% (6.1–8.4)	92.7% (91.6–93.9)		
Physical dating violence in the past 12 months																								
Yes (n = 128)	47.6% (35.8–59.4)	52.4% (40.6–64.2)	2.42 (1.76–3.32)	1.39 (0.96–2.02)	29.6% (20.4–38.8)	70.4% (61.2–79.6)	3.04 (1.86–4.97)	1.56 (0.93–2.61)	36.2% (23.6–48.8)	63.8% (51.2–76.4)	2.83 (1.89–4.26)	1.55 (0.92–2.62)	32.7% (23.3–42.2)	67.3% (57.8–76.7)	2.82 (1.79–4.46)	1.45 (0.88–2.39)	15.2% (7.4–22.9)	84.8% (77.1–92.6)	3.32 (1.92–5.76)	1.99 (0.89–4.47)	29.6% (19.7–39.5)	70.4% (60.5–80.3)	2.69 (1.70–4.26)	1.27 (0.78–2.08)
No (n = 4246)	15.1% (12.9–17.3)	84.9% (82.7–87.1)			7.1% (5.0–9.2)	92.9% (90.8–95.0)			11.0% (9.7–12.4)	89.0% (87.6–90.3)			9.3% (7.5–11.2)	90.7% (88.8–92.5)			3.6% (2.8–4.4)	96.4% (95.6–97.2)			8.8% (7.3–10.3)	91.2% (89.7–92.7)		
Cyberbullying in the past 12 Mmonths																								
Yes (n = 569)	26.8% (21.9–31.6)	73.2% (68.4–78.1)	1.66 (1.41–1.95)	1.12 (0.93–1.34)	15.1% (10.3–19.9)	84.9% (80.1–89.7)	2.08 (1.63–2.66)	1.28 (0.97–1.68)	18.0% (13.6–22.4)	82.0% (77.6–86.4)	1.6 (1.22–2.09)	1.00 (0.74–1.33)	15.6% (10.9–20.2)	84.4% (79.8–89.1)	1.66 (1.28–2.16)	1.00 (0.73–1.35)	6.2% (2.8–9.7)	93.8% (90.3–97.2)	1.56 (0.85–2.86)	0.95 (0.46–1.95)	16.7% (12.3–21.1)	83.3% (78.9–87.7)	1.87 (1.45–2.40)	1.11 (0.82–1.51)
No (n = 3805)	14.4% (12.3–16.5)	85.6% (83.5–87.7)			6.6% (4.8–8.4)	93.4% (91.6–95.2)			10.8% (9.3–12.3)	89.2% (87.7–90.7)			9.1% (7.4–10.8)	90.9% (89.2–92.6)			3.6% (2.7–4.5)	96.4% (95.5–97.3)			8.3% (6.9–9.6)	91.7% (90.4–93.1)		
Parent lost job during COVID-19																								

	Current alcohol use				Current binge drinking				Alcohol use increased during COVID-19				Current marijuana use				Current prescription pain medication misuse				Drug use increased during COVID-19			
	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b	% Yes, 95% CI	%No, 95% CI	aPR ^a	aPR ^b
Yes (n = 1195)	20.2% (16.6–23.9)	79.8% (76.1–83.4)	1.45 (1.25–1.69)	1.33 (1.15–1.54)	10.1% (7.1–13.0)	89.9% (87.0–92.9)	1.59 (1.22–2.08)	1.44 (1.13–1.83)	13.9% (11.2–16.6)	86.1% (83.4–88.8)	1.35 (1.09–1.66)	1.19 (0.95–1.49)	12.5% (9.8–15.3)	87.5% (84.7–90.2)	1.48 (1.28–1.71)	1.36 (1.15–1.61)	4.8% (3.2–6.4)	95.2% (93.6–96.8)	1.29 (0.88–1.88)	1.08 (0.74–1.58)	10.7% (7.9–13.6)	89.3% (86.4–92.1)	1.29 (0.97–1.70)	1.15 (0.86–1.54)
No (n = 3179)	14.3% (12.0–16.5)	85.7% (83.5–88.0)			6.7% (4.6–8.8)	93.3% (91.2–95.4)			10.8% (9.3–12.3)	89.2% (87.7–90.7)			8.9% (7.2–10.6)	91.1% (89.4–92.8)			3.5% (2.6–4.5)	96.5% (95.5–97.4)			8.8% (7.2–10.4)	91.2% (89.6–92.8)		
Food Insecurity during COVID-19																								
Yes (n = 942)	20.2% (15.7–24.8)	79.8% (75.2–84.3)	1.48 (1.17–1.86)	1.08 (0.85–1.37)	8.6% (5.7–11.5)	91.4% (88.5–94.3)	1.36 (0.99–1.87)	0.88 (0.65–1.20)	17.0% (13.3–20.7)	83.0% (79.3–86.7)	1.81 (1.41–2.32)	1.31 (1.02–1.67)	12.2% (8.8–15.6)	87.8% (84.4–91.2)	1.33 (0.98–1.80)	0.91 (0.67–1.22)	6.5% (4.4–8.7)	93.5% (91.3–95.6)	1.97 (1.37–2.84)	1.39 (0.94–2.04)	12.9% (9.7–16.0)	87.1% (84.0–90.3)	1.57 (1.24–2.00)	1.09 (0.85–1.39)
No (n = 3432)	14.8% (12.2–17.4)	85.2% (82.6–87.8)			7.4% (5.1–9.8)	92.6% (90.2–94.9)			10.2% (8.7–11.7)	89.8% (88.3–91.3)			9.3% (7.4–11.2)	90.7% (88.8–92.6)			3.2% (2.4–3.9)	96.8% (96.1–97.6)			8.4% (6.8–10.0)	91.6% (90.0–93.2)		

ACEs = adverse childhood experiences; aPR = adjusted prevalence ratio; CI = confidence interval.

^a Adjusted for sex, race/ethnicity, age, sexual identity, and method of school instruction.

^b Adjusted for sex, race/ethnicity, age, sexual identity, method of school instruction, and all other individual ACEs.

^c To ensure model convergence due to small sample sizes, the racial and ethnic categories were recoded to minimize small sample sizes for these analyses adjusted specifically for differences for non-Hispanic Black, Hispanic, non-Hispanic Multiracial, non-Hispanic White, and another race/ethnicity.

Table 2

Adjusted associations between thematic adverse childhood experience (ACE) category exposure and substance use among U.S. adolescents during the COVID-19 pandemic, Adolescent Behavior and Experiences Survey, January—June 2021

Current alcohol use					Current binge drinking					Alcohol use increased during COVID-19					Current marijuana use					Current prescription pain medication misuse					Drug use increased during COVID-19																																																																																									
% Yes, 95% CI					% No, 95% CI					% Yes, 95% CI					% No, 95% CI					% Yes, 95% CI					% No, 95% CI					% Yes, 95% CI																																																																																				
aPR ^d					aPR ^d					aPR ^d					aPR ^d					aPR ^d					aPR ^d					aPR ^d																																																																																				
aPR ^b					aPR ^b					aPR ^b					aPR ^b					aPR ^b					aPR ^b					aPR ^b																																																																																				
%No, 95% CI					%Yes, 95% CI					%No, 95% CI					%Yes, 95% CI					%No, 95% CI					%Yes, 95% CI					%No, 95% CI					%Yes, 95% CI																																																																															
Experiencing abuse by a parent ^d																																																																																																																		
Yes (n = 2440)					21.8% (19.1–24.5)					78.2% (75.5–80.9)					2.3 (1.86–2.85)					1.93 (1.53–2.43)					10.5% (7.7–13.3)					89.5% (86.7–92.3)					2.4 (1.78–3.24)					1.88 (1.37–2.59)					16.4% (14.4–18.4)					83.6% (81.6–85.6)					2.78 (2.14–3.62)					2.34 (1.75–3.16)					2.72 (2.12–3.49)					2.22 (1.69–2.93)					5.8% (4.4–7.2)					94.2% (92.8–95.6)					3.2 (1.97–5.20)					2.73 (1.62–4.58)					13.5% (11.4–15.7)					86.5% (84.3–88.6)					3.15 (2.39–4.16)					2.58 (1.89–3.53)				
No (n = 1934)					8.7% (6.5–11.0)					91.3% (89.0–93.5)															4.1% (2.7–5.6)					95.7% (94.4–97.3)																				5.2% (3.7–6.6)					94.8% (93.4–96.3)					1.6% (0.9–2.3)					98.4% (97.7–99.1)					4.2% (2.9–5.4)					95.8% (94.6–97.1)																																							
Experiencing other violence ^e																																																																																																																		
Yes (n = 878)					31.9% (27.5–36.4)					68.1% (63.6–72.5)					2.26 (1.93–2.66)					1.88 (1.59–2.23)					17.9% (13.4–22.5)					82.1% (77.5–86.6)					2.9 (2.23–3.77)					2.42 (1.82–3.20)					22.0% (18.5–25.5)					78.0% (74.5–81.5)					2.3 (1.82–2.90)					1.83 (1.43–2.33)					2.74 (2.23–3.37)					2.23 (1.79–2.77)					7.3% (4.6–9.9)					92.7% (90.1–95.4)					1.98 (1.37–2.88)					1.53 (1.07–2.20)					20.2% (16.8–23.7)					79.8% (76.3–83.2)					2.74 (2.18–3.44)					2.17 (1.71–2.75)				
No (n = 3496)					12.2% (10.3–14.1)					87.8% (85.9–89.7)															5.2% (3.6–6.9)					94.8% (93.1–96.4)																				7.3% (5.9–8.7)					92.7% (91.3–94.1)					3.1% (2.4–3.8)					96.9% (96.2–97.6)					6.8% (5.6–8.0)					93.2% (92.0–94.4)																																							
Family economic challenges ^f																																																																																																																		
Yes (n = 1766)					19.2% (15.9–22.4)					80.8% (77.6–84.1)					1.46 (1.24–1.73)					1.24 (1.06–1.46)					9.1% (6.5–11.8)					90.9% (88.2–93.5)					1.52 (1.21–1.91)					1.24 (0.98–1.57)					14.5% (12.1–16.9)					85.5% (83.1–87.9)					1.59 (1.30–1.94)					1.32 (1.07–1.64)					1.5 (1.28–1.75)					1.22 (1.04–1.44)					5.4% (3.7–7.0)					94.6% (93.0–96.3)					1.79 (1.21–2.65)					1.47 (0.98–2.21)					11.5% (9.3–13.7)					88.5% (86.3–90.7)					1.52 (1.22–1.91)					1.24 (0.97–1.57)				
No (n = 2608)					13.7% (11.3–16.1)					86.3% (83.9–88.7)															6.6% (4.5–8.7)					93.4% (91.3–95.5)																				8.3% (6.7–10.0)					91.7% (90.4–93.3)					2.9% (2.1–3.6)					97.1% (96.4–97.9)					7.9% (6.2–9.5)					92.1% (90.5–93.8)																																							

ACEs = adverse childhood experiences; aPR = adjusted prevalence ratio; CI = confidence interval.

^a Adjusted for sex, race or ethnicity, age, sexual identity, and method of school instruction.

^b Adjusted for sex, race or ethnicity, age, sexual identity, method of school instruction, and other ACEs categories.

^c To ensure model convergence due to small sample sizes, the racial and ethnic categories were recoded to minimize small sample sizes for some groups. The racial and ethnic variable coding for these analyses adjusted specifically for differences for non-Hispanic Black, Hispanic, non-Hispanic Multiracial, non-Hispanic White, and another race/ethnicity.

^d Category includes physical abuse by a parent, emotional abuse by a parent.

^e Category includes any sexual violence, physical dating violence, cyberbullying.

^f Category includes parent lost job, food insecurity.

Table 3

Mean number of recent adverse childhood experiences (ACEs) during the COVID-19 pandemic reported by adolescents and substance use, among adolescents with and without poor mental health, Adolescent Behavior and Experiences Survey, January—June 2021

ACE Count	Current alcohol use			Current binge drinking			Alcohol use increased during COVID-19			Current marijuana use			Current prescription Pain medication misuse			Drug use increased during COVID-19		
	Yes, Mean (SE)	No, Mean (SE)		Yes, Mean (SE)	No, Mean (SE)		Yes, Mean (SE)	No, Mean (SE)		Yes, Mean (SE)	No, Mean (SE)		Yes, Mean (SE)	No, Mean (SE)		Yes, Mean (SE)	No, Mean (SE)	
Poor MH	2.61 (0.09) ^a	1.91 (0.06)		2.55 (0.12) ^a	2.01 (0.06)		2.61 (0.10) ^a	1.85 (0.05)		2.57 (0.09) ^a	1.99 (0.06)		2.66 (0.16) ^a	2.03 (0.06)		2.63 (0.09) ^a	1.88 (0.05)	
Not Poor MH	1.65 (0.11) ^a	1.05 (0.03)		1.83 (0.18) ^a	1.08 (0.03)		1.50 (0.10) ^a	1.02 (0.03)		1.76 (0.13) ^a	1.07 (0.03)		1.86 (0.17) ^a	1.10 (0.03)		1.60 (0.16) ^a	1.03 (0.03)	

ACE = adverse childhood experience; MH = mental health; SE = standard error.

^aSignificantly different at $p < .001$; mean ACE counts compared using t-tests.

Table 4

Among adolescents who experienced each adverse childhood experience (ACE), crude and adjusted associations between mental health (MH) status and substance use, Adolescent Behavior and Experiences Survey, January—June 2021

Current alcohol use										Current binge drinking					Alcohol use increased during COVID-19					Current marijuana use					Current prescription pain medication misuse					Drug use increased during COVID-19				
	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d		% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d					
Physical abuse during COVID-19																																		
Poor MH (n = 253)	30.4% (22.2–38.6)	69.6% (61.4–77.8)	2.03 (1.32–3.13)	1.63 (1.03–2.60)	15.5% (8.9–22.2)	84.5% (77.8–91.1)	1.87 (1.07–3.26)	1.32 (0.68–2.53)	1.53 (0.92–2.54)	25.3% (17.8–32.8)	74.7% (67.2–82.2)	1.53 (0.92–2.54)	1.37 (0.79–2.37)	22.4% (15.6–29.1)	77.6% (70.9–84.4)	2.00 (1.21–3.32)	1.58 (0.88–2.82)	1.90 (1.00–3.58)	1.65 (0.90–3.02)	11.8% (7.9–15.6)	88.2% (84.4–92.1)	1.90 (1.00–3.58)	1.65 (0.90–3.02)	21.9% (15.0–28.9)	78.1% (71.1–85.0)	2.47 (1.34–4.40)	2.19 (1.14–4.22)							
Not Poor MH (n = 228)	14.9% (10.0–19.9)	85.1% (80.1–90.0)			8.3% (4.7–11.9)	91.7% (88.1–95.3)				16.5% (9.2–23.8)	83.5% (76.2–90.8)			11.2% (7.0–15.4)	88.8% (84.6–93.0)					6.2% (2.8–9.6)	93.8% (90.4–97.2)			8.9% (4.6–13.2)	91.1% (86.8–95.4)									
Emotional abuse during COVID-19																																		
Poor MH (n = 1,018)	27.9% (23.7–32.1)	72.1% (67.9–76.3)	1.59 (1.32–1.91)	1.41 (1.20–1.67)	14.9% (10.1–19.7)	85.1% (80.3–89.9)	2.01 (1.46–2.78)	1.81 (1.35–2.44)	1.92 (1.50–2.44)	21.4% (18.9–23.9)	78.6% (76.1–81.1)	1.92 (1.50–2.44)	1.90 (1.50–2.39)	18.2% (13.7–22.7)	81.8% (77.3–86.3)	1.72 (1.23–2.41)	1.62 (1.16–2.26)	2.26 (1.61–3.19)	2.03 (1.46–2.82)	8.5% (6.2–10.9)	91.5% (89.1–93.8)	2.26 (1.61–3.19)	2.03 (1.46–2.82)	18.5% (15.6–21.4)	81.5% (78.6–84.4)	2.18 (1.70–2.80)	2.03 (1.54–2.67)							
Not Poor MH (n = 1,406)	17.6% (14.9–20.2)	82.4% (79.8–85.1)			7.4% (5.4–9.3)	92.6% (90.7–94.6)				11.2% (8.8–13.5)	88.8% (86.5–91.2)			10.6% (7.9–13.2)	89.4% (86.8–92.1)					3.8% (2.6–5.0)	96.2% (97.4)			8.5% (6.4–10.6)	91.5% (89.4–93.6)									
Any sexual violence in the past 12 months																																		
Poor MH (n = 267)	51.7% (44.0–59.5)	48.3% (40.5–56.0)	1.53 (1.14–2.06)	1.47 (1.05–2.05)	30.7% (22.1–39.2)	69.3% (60.8–77.9)	1.51 (1.00–2.29)	1.73 (1.14–2.64)	1.62 (0.98–2.90)	32.8% (25.8–39.8)	67.2% (60.2–74.2)	1.62 (0.98–2.90)	1.59 (1.00–2.52)	12.2% (8.1–16.2)	87.9% (83.8–91.9)	2.06 (1.01–4.21)	2.39 (1.25–4.56)							31.1% (24.7–37.5)	68.9% (62.5–75.3)	1.13 (0.67–1.92)	1.09 (0.64–1.86)							
Not Poor MH (n = 157)	33.7% (25.5–41.9)	66.3% (58.1–74.5)			20.3% (12.5–28.0)	79.7% (72.0–87.5)				20.2% (10.7–29.7)	79.8% (70.3–89.3)			25.0% (15.0–35.0)	75.0% (65.0–85.0)					5.9% (1.9–9.9)	94.1% (90.1–98.1)			27.5% (14.5–40.6)	72.5% (59.4–85.5)									
Physical dating violence in the past 12 months																																		
Poor MH (n = 74)	53.0% (38.2–67.8)	47.0% (32.2–61.8)	1.35 (0.81–2.25)	1.33 (0.80–2.23)	32.7% (18.8–46.6)	67.3% (53.4–81.2)	1.31 (0.58–2.99)	1.53 (0.63–3.70)	1.27 (0.66–2.46)	38.5% (23.9–53.1)	61.5% (46.9–76.1)	1.27 (0.66–2.46)	1.24 (0.58–2.69)	27.6% (14.5–40.7)	72.4% (59.3–85.5)	0.68 (0.35–1.32)	0.60 (0.28–1.30)	2.90 (0.79–10.63)	-	20.5% (8.6–32.4)	79.5% (67.6–91.4)	2.90 (0.79–10.63)	-	29.4% (17.4–41.4)	70.6% (58.6–82.6)	0.97 (0.43–2.20)	0.81 (0.36–1.84)							
Not Poor MH (n = 54)	39.3% (20.8–57.9)	60.7% (49.8–71.5)			24.9% (8.3–41.5)	75.1% (58.5–91.7)				30.3% (11.0–49.6)	69.7% (50.4–89.0)			40.5% (24.0–57.0)	59.5% (43.0–76.0)					7.1% (0.0–15.5)	92.9% (84.5–100)			30.2% (9.3–51.1)	69.8% (48.9–90.7)									
Cyberbullying in the past 12 months																																		
Poor MH (n = 318)	33.4% (27.3–39.5)	66.6% (60.5–72.7)	1.75 (1.23–2.49)	1.54 (1.08–2.19)	20.7% (13.5–27.9)	79.3% (72.1–86.5)	2.40 (1.41–4.08)	2.18 (1.30–3.64)	2.62 (1.41–4.88)	24.3% (18.7–29.8)	75.7% (70.2–81.3)	3.14 (1.73–5.71)	2.62 (1.41–4.88)	18.8% (13.3–24.2)	81.2% (75.8–86.7)	1.59 (0.94–2.67)	1.21 (0.71–2.07)	3.40 (1.27–9.15)	-	9.3% (3.7–14.8)	90.7% (85.2–96.3)	3.40 (1.27–9.15)	-	20.4% (15.7–25.0)	79.6% (75.0–84.3)	1.89 (1.15–3.12)	1.59 (0.95–2.65)							
Not Poor MH (n = 251)	19.1% (12.7–25.4)	80.9% (74.6–87.3)			8.6% (4.7–12.5)	91.4% (87.5–95.3)				7.7% (3.6–11.9)	92.3% (88.1–96.4)			11.8% (5.3–18.4)	88.2% (81.6–94.7)					2.7% (0.3–5.2)	97.3% (94.8–99.7)			10.8% (4.6–16.9)	89.2% (83.1–95.4)									
Parent lost job during COVID-19																																		

	Current alcohol use				Current binge drinking				Alcohol use increased during COVID-19				Current marijuana use				Current prescription pain medication misuse				Drug use increased during COVID-19			
	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d	% Yes, 95% CI	%No, 95% CI	cPR	aPR ^d
Poor MH (n = 441)	27.0% (20.5–33.4)	73.0% (66.6–79.5)	1.67 (1.15–2.42)	1.53 (1.09–2.13)	15.5% (10.0–21.0)	84.5% (79.0–90.0)	2.30 (1.36–3.89)	2.07 (1.21–3.54)	19.6% (15.5–23.8)	80.4% (76.2–84.5)	2.28 (1.65–3.15)	2.39 (1.73–3.30)	17.9% (12.1–23.7)	82.1% (76.3–87.9)	1.94 (1.29–2.90)	1.89 (1.32–2.71)	7.3% (4.2–10.5)	92.7% (89.5–95.8)	2.22 (1.22–4.06)	1.86 (1.06–3.30)	17.3% (12.0–22.6)	82.7% (77.4–88.0)	3.73 (2.17–6.40)	3.52 (1.97–6.31)
Not Poor MH (n = 754)	16.2% (11.7–20.7)	83.8% (79.3–88.3)			6.7% (3.9–9.5)	93.3% (90.5–96.1)			8.6% (6.3–10.9)	90.4% (89.1–93.7)			9.3% (6.9–11.6)	90.7% (88.4–93.1)			3.3% (1.7–4.9)	96.7% (95.1–98.3)			4.6% (2.8–6.5)	95.4% (93.5–97.2)		
Food insecurity during COVID-19																								
Poor MH (n = 393)	27.1% (21.1–33.2)	72.9% (66.8–78.9)	1.80 (1.23–2.63)	1.53 (1.07–2.19)	10.6% (6.4–14.8)	89.4% (85.2–93.6)	1.50 (0.85–2.64)	1.26 (0.73–2.17)	22.2% (17.0–27.5)	77.8% (72.5–83.0)	1.92 (1.30–2.81)	1.83 (1.27–2.64)	14.8% (10.7–18.9)	85.2% (81.1–89.3)	1.43 (0.90–2.28)	1.30 (0.79–2.12)	10.2% (5.9–14.6)	89.8% (85.4–94.1)	2.73 (1.51–4.94)	2.06 (1.13–3.76)	16.6% (12.5–20.7)	83.4% (79.3–87.5)	1.84 (1.27–2.67)	1.62 (1.10–2.41)
Not Poor MH (n = 549)	15.1% (9.5–20.6)	84.9% (79.4–90.5)			7.1% (3.7–10.5)	92.9% (89.5–96.3)			11.6% (7.5–15.7)	88.4% (84.4–92.5)			10.3% (5.8–14.9)	89.7% (85.1–94.2)			3.8% (2.1–5.5)	96.2% (94.5–97.9)			9.0% (5.5–12.5)	91.0% (87.5–94.5)		

Several adjusted models were unable to converge with selected covariates due to issues with non-coverage. These are marked with “,” “—”.

Poor mental health is measured by “poor current mental health” for “current alcohol use”, “current binge drinking”, “current marijuana use”, and “current prescription opioid misuse”. Each of these measures uses a past 30-day window for response. Poor mental health for “alcohol use increased during COVID-19” and “drug use increased during COVID-19” is measured by poor mental health during the COVID-19 pandemic. Each of these measures uses a “during the COVID-19 pandemic” reference frame.

ACEs = adverse childhood experiences; aPR = adjusted prevalence ratio; CI = confidence interval; cPR = crude prevalence ratio; MH = mental health (MH).

^a Adjusted for sex, race/ethnicity, age, sexual identity, and method of school instruction. To ensure model convergence due to small sample sizes, the racial and ethnic categories were recoded to minimize small sample sizes for some groups. The racial and ethnic variable coding for these analyses adjusted specifically for differences for non-Hispanic Black, Hispanic, non-Hispanic Multiracial, non-Hispanic White, and another race/ethnicity.