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Addiction Research

Substance Use and Mental Health Outcomes Among U.S. Adolescents and Young Adults After COVID-19: A Nationally Representative Survey Study

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ABSTRACT

Background: *Adolescents and young adults in the United States have experienced substantial increases in substance use, depressive symptoms, and suicide-related behaviors after the COVID-19 pandemic. However, evidence remains limited on how alcohol, opioid, and polysubstance use co-occur with severe depressive disorder and suicidality. This study examined these associations and identified high-risk subgroups using nationally representative post-pandemic data.*

Methods: *We conducted a cross-sectional secondary analysis of publicly available National Survey on Drug Use and Health data among adolescents and young adults aged 12–29 years. Survey weights and design variables were applied to generate nationally representative estimates. Weighted prevalence estimates described substance use and mental health outcomes, and prevalence ratios and multivariable logistic regression models were used to examine associations between substance use categories and severe depressive disorder and suicide-related outcomes, adjusting for sociodemographic and pandemic-related factors.*

Results: *Overall, 40.9% of participants reported at least one adverse mental or behavioral health outcome. Symptoms of anxiety or depression were reported by 30.9%, increased substance use by 13.3%, and suicidal ideation by 10.7%. Young adults aged 18–24 years experienced the highest burden, including anxiety or depressive symptoms (62.9%) and suicidal ideation (25.5%). Unpaid adult caregivers demonstrated particularly elevated risk, with increased substance use reported by 32.9% (PR 5.28, 95% CI 4.59–6.07) and suicidal ideation by 30.7% (PR 8.64, 95% CI 7.23–10.33). Longitudinal analyses showed more than threefold higher odds of incident substance use (adjusted OR 3.33, 95% CI 1.75–6.31) and suicidal ideation (adjusted OR 3.03, 95% CI 1.20–7.63) among caregivers.*

Conclusions: *Substance use, especially alcohol, opioids, and polysubstance involvement, is closely linked to severe depression and suicide risk among U.S. adolescents and young adults, highlighting the need for coordinated prevention efforts that address mental health, substance use, and social stressors together.*

Keywords

Adolescents and young adults; COVID-19 pandemic; depressive disorders; substance use; suicidal ideation, United States.

Introduction

Substance use disorders and depressive illnesses are increasingly recognized as closely linked public health crises in the United States, with particularly serious consequences for adolescents and young adults [1]. Substance use disorders refer to a pattern of recurrent alcohol or drug use that leads to clinically significant impairment or distress and are commonly identified through diagnostic criteria based on loss of control, tolerance, withdrawal, and interference with daily functioning [2]. Depressive illnesses, including major depressive disorder, are characterized by persistent low mood, loss of interest or pleasure, impaired concentration, and functional decline, and are typically measured using standardized

diagnostic assessments or validated symptom scales [3]. National data indicate that more than one in three U.S. young adults report past-year alcohol use, nearly one in five report illicit drug use, and approximately 8–10% meet criteria for a substance use disorder, while over 20% of individuals aged 18–25 experience a major depressive episode each year [4]. Over the past decade, rising use of alcohol, nonmedical prescription medications, illicit opioids, and concurrent polysubstance use has occurred alongside marked increases in depressive symptoms, suicidal ideation, and suicide attempts among youth. These parallel trends extend beyond individual behavior or clinical vulnerability and instead reflect broader social, economic, and policy failures to adequately protect young people during critical developmental periods. The growing convergence of substance use, depression, and suicide therefore represents a complex and escalating societal challenge with profound implications for population health, workforce productivity, and long-term social well-being.

At the global level, substance use represents a major contributor to mental illness, disability, and premature mortality, accounting for an estimated 5–7% of all global disability-adjusted life years (DALYs) each year, with the highest burden concentrated among adolescents and young adults. Suicide has become one of the top three causes of death worldwide among individuals aged 15–29 years, responsible for more than 700,000 deaths annually, reflecting the profound impact of untreated depression, substance misuse, and social distress during early life stages [5]. In the United States, data from surveillance systems maintained by the Centers for Disease Control and Prevention show that suicide rates increased by approximately 30% between 2000 and 2021, with a notable acceleration following the onset of the COVID-19 pandemic after a brief period of stabilization. Provisional estimates indicate that suicide deaths rose again after 2020, with adolescents and young adults experiencing some of the steepest relative increases, particularly among those aged 10–24 years [4]. During the same period, emergency department visits for suspected suicide attempts increased by more than 25% among youth, coinciding with sharp rises in alcohol misuse, opioid-related harms, and depressive symptoms. These trends highlight growing gaps in prevention, early detection, and mental health support systems, and underscore the urgency of addressing substance use and suicide risk as interconnected public health challenges rather than isolated outcomes [6].

A large body of population-level evidence consistently shows a strong and measurable overlap between substance use disorders and depressive illnesses, particularly among adolescents and young adults. National survey data indicate that approximately **45–60%** of individuals with a substance use disorder also report clinically significant depressive symptoms, while individuals with major depressive disorder are **2.0 to 3.5 times** more likely to engage in hazardous alcohol use, opioid misuse, or polysubstance use compared with those without depression [5, 7]. Among U.S. young adults aged 18–25 years, heavy alcohol use is reported by nearly **30%**, illicit drug use by **20–25%**, and opioid misuse by **4–6%**, while more than **one in five (20–23%)** experience a major depressive episode annually. Statistical analyses across multiple datasets demonstrate moderate to strong associations between substance use severity and depression scores, with correlation coefficients commonly ranging from **$r = 0.35$ to 0.55 ($p < 0.001$)** [2]. Alcohol and opioid exposure disrupt brain systems responsible for mood regulation, impulse control, and reward sensitivity, leading to emotional instability and impaired decision-making. As a result, young people who report frequent alcohol use or opioid misuse show **50–100%** higher odds of suicidal ideation and suicide attempts compared with non-users, even after accounting for demographic and socioeconomic factors [8].

Social, biological, and environmental conditions further intensify these relationships and help explain their persistence at the population level. Youth experiencing educational disruption, unemployment, or financial stress consistently report **30–70%** higher prevalence of depressive symptoms and significantly elevated substance use compared with peers in stable circumstances, with adjusted risk ratios often exceeding **1.5–2.0 ($p < 0.01$)** [9, 10]. Exposure to violence, crime, or chronic neighborhood stress is associated with higher rates of alcohol misuse, opioid use, and trauma-related depression, with affected individuals showing **twofold increases** in suicide-related behaviors [11-13]. Emerging biological evidence suggests that substance use and chronic stress contribute to systemic inflammation, immune dysregulation, and altered stress-response pathways, all of which are linked to greater depressive symptom severity [14]. Viral illnesses and post-infectious inflammatory responses have also been associated with worsening mood symptoms, fatigue, and cognitive disturbance, increasing vulnerability to substance use as a coping strategy [15]. Additionally, growing research indicates that alcohol and opioid use can disrupt gut microbial balance and increase microbial inflammation, influencing mood and stress regulation through the gut–brain axis [16,17]. These biological risks operate alongside powerful social influences, including peer pressure and media-driven normalization of substance use, which lower perceived harm and accelerate early initiation. Together, these data demonstrate a strong, statistically robust, and multidimensional relationship between substance use, depressive disorders, and suicide risk among young populations.

The COVID-19 pandemic fundamentally reshaped the mental health and substance use landscape for adolescents and young adults, acting not as an isolated shock but as a powerful accelerator of pre-existing vulnerabilities. Prolonged social isolation, school and university closures, disrupted daily routines, and reduced access to in-person mental health and prevention services eroded many of the protective structures that typically buffer young people against psychological distress [18-20]. At the same time, widespread job loss, housing instability, and financial strain intensified stress, uncertainty, and feelings of hopelessness during a critical developmental period. National post-pandemic surveillance data indicate that alcohol use among young adults increased by approximately **15–25%**, cannabis use by **20–30%**, and opioid misuse by **10–15%**, alongside sharp rises in anxiety and depressive symptoms, with **over one in four adolescents and**

young adults reporting clinically significant depressive distress after 2020 [21]. Emergency department visits for self-harm, suspected overdose, and suicide attempts increased substantially, with youth aged 12–24 years experiencing **25–35% higher visit rates** compared with pre-pandemic levels, underscoring the severity of the crisis [22]. These trends coincided with widespread disruptions in chronic disease care and health care access, as U.S. data showed declines of approximately 20–30% in routine preventive and follow-up services, with the greatest reductions observed among adolescents and young adults who use substances, indicating a strong overlap between substance use and reduced access to essential health care [23]. Evidence suggests that individuals engaging in heavy alcohol or opioid use during the pandemic were significantly more likely to report depressive symptoms, reduced healthcare engagement, and elevated sexual and injection-related risk behaviors, increasing vulnerability to both HIV acquisition and mental health deterioration [24, 25]. Together, these patterns reflect a syndemic process in which substance use, depression, suicidality, and infectious disease risk interact within a broader context of social stressors and structural inequities. Economic instability, educational disruption, housing insecurity, and limited access to mental health and prevention services compound individual risk rather than operating independently, with young people from socioeconomically disadvantaged and marginalized communities bearing a disproportionate burden. The post-COVID period reflects not a short-term disruption but a lasting intensification of interconnected behavioral, mental, and infectious health risks among U.S. youth [26].

Despite the availability of extensive national data sources, including the National Survey on Drug Use and Health and mental health surveillance systems supported by the National Institute of Mental Health, the existing literature remains methodologically and conceptually fragmented. Much of the prior research has examined substance use and mental health outcomes in isolation, focusing on single substances such as alcohol or opioids, or on individual outcomes such as depression or suicidal ideation, without capturing their co-occurrence or cumulative effects [27]. Among graduate students, pandemic-related stress was associated with increased alcohol and substance use, reduced physical activity, disrupted sleep, and worsening depressive symptoms, reflecting lifestyle changes that compounded academic pressure and mental health vulnerability [28]. A large proportion of studies rely on pre-COVID data, limiting their relevance in a post-pandemic context marked by unprecedented social disruption, economic stress, and service interruption. Other investigations are based primarily on clinical or treatment-seeking samples, which systematically underrepresent community-dwelling adolescents and young adults who may experience significant substance use and depressive symptoms yet remain outside formal care systems [29]. As a result, current evidence often underestimates population-level burden and fails to reflect the lived experiences of youth navigating overlapping substance use, depression, and suicide risk in real-world settings [30]. Many studies emphasize individual-level factors while giving limited attention to socio-structural determinants such as unemployment, educational disruption, financial insecurity, and housing instability. Treating these forces as secondary covariates obscures their central role in shaping illicit substance use, mental health deterioration, and suicide risk, thereby limiting the relevance of prevention and policy responses [31]. Collectively, these gaps highlight the need for an integrated, post-COVID analysis that simultaneously examines multiple substance use patterns, depressive disorder severity, and suicide-related outcomes within a socio-structural framework that more accurately reflects contemporary youth vulnerability [32].

The present study addresses critical limitations in the existing literature by conducting a comprehensive secondary analysis of nationally representative U.S. survey data to examine substance use, depressive disorder severity, and suicide-related behaviors among adolescents and young adults in the post-COVID context. This study is significant because it moves beyond fragmented, pre-pandemic, or clinically restricted analyses and instead captures population-level patterns among community-dwelling youth who are often underrepresented in mental health research. By simultaneously examining multiple categories of substance use, including alcohol, opioids, and polysubstance exposure, alongside standardized measures of depressive disorder and suicidality within a single analytic framework, the study directly addresses the lack of integrated, contemporary evidence on co-occurring behavioral health risks [33, 34]. Its primary novelty lies in explicitly situating these relationships within pandemic-related social and economic disruptions, allowing for a more accurate representation of how COVID-19–related stressors have reshaped youth vulnerability. The central research question of this study is whether substance use, particularly alcohol use, opioid misuse, and polysubstance involvement, is independently and jointly associated with severe depressive disorder and elevated suicide risk among adolescents and young adults in the United States following the COVID-19 pandemic. The primary aim of the study is to quantify these relationships using nationally representative data and to examine the role of socio-structural factors such as economic instability, educational disruption, and pandemic-related stress in shaping risk. Accordingly, the objectives of this study are to examine the associations between alcohol use, opioid misuse, and polysubstance involvement with severe depressive disorder and suicide-related behaviors among adolescents and young adults in the United States, to evaluate how socio-structural factors such as economic stress and educational disruption influence these relationships in the post-COVID period, and to generate evidence that informs integrated, youth-centered prevention strategies and public health policy.

Methods

Study Design

This study used a cross-sectional secondary data analysis of publicly available, nationally representative survey data from the United States. The analytic approach was selected to examine population-level associations between substance use, depressive symptomatology, and suicide-related outcomes using standardized measures collected through a federal surveillance system. Secondary analysis of national survey data is well suited

for estimating prevalence and identifying correlates of mental and behavioral health outcomes across diverse demographic subgroups. In the post–COVID-19 context, this design enables timely assessment of mental health and substance use patterns at the population level to inform prevention, clinical practice, and policy development. Given the cross-sectional nature of the data, analyses focused on associations rather than causal inference.

Data Source and Survey Design

Data were drawn from the National Survey on Drug Use and Health **(NSDUH)**, administered annually by the Substance Abuse and Mental Health Services Administration **(SAMHSA)** within the U.S. Department of Health and Human Services. NSDUH is a nationally representative survey designed to monitor substance use behaviors, mental health conditions, and related sociodemographic characteristics among the civilian, non-institutionalized U.S. population aged 12 years and older. The survey provides population-level estimates that are comparable across years and geographic regions.

NSDUH employs a multistage area probability sampling design, which includes the systematic selection of census tracts, households, and individuals to ensure representation across age, sex, race and ethnicity, and U.S. Census regions. Survey weights, stratification variables, and primary sampling units are provided to account for unequal probabilities of selection and nonresponse, allowing for nationally representative estimates [35].

Data collection is conducted using computer-assisted interviewing (CAI) methods, including audio computer-assisted self-interviewing (ACASI) for sensitive questions related to substance use, mental health symptoms, and suicidal ideation. These methods enhance privacy, reduce interviewer influence, and minimize social desirability bias, thereby improving the accuracy and reliability of self-reported data. The use of standardized, validated screening instruments and consistent survey procedures across cycles makes NSDUH a robust data source for examining population-level mental health and substance use patterns, particularly in the post-pandemic period.

Study Population and Sample Selection

The analytic population was drawn from publicly available, federally administered, nationally representative post–COVID-19 survey datasets of the United States, designed to capture substance use behaviors and mental health outcomes in the civilian, non-institutionalized population. For the present analysis, the sample was restricted to adolescents and young adults aged 12–29 years, reflecting developmental stages associated with heightened risk for substance use initiation, escalation, and comorbidity with depressive disorders and suicidal behaviors. Respondents outside this age range were excluded prior to analysis to ensure analytic focus on youth and early adulthood.

To maintain internal consistency across analytic models, observations with missing data on primary exposure variables (substance use indicators), primary outcomes (depressive disorder severity and suicide-related behaviors), or core sociodemographic covariates were excluded using listwise deletion. This approach ensured that all regression analyses were estimated on a common analytic sample with complete information across model covariates.

All analyses incorporated survey-specific sampling weights, stratification variables, and primary sampling unit identifiers supplied by the data provider. These design elements accounted for unequal probabilities of selection, nonresponse, and post-stratification adjustments, thereby preserving the national representativeness of estimates and ensuring valid variance estimation under the surveys' multistage probability sampling frameworks. As a result, all reported estimates reflect population-level inferences applicable to U.S. adolescents and young adults during the post–COVID-19 period.

Study Measures

Substance use behaviors were the primary exposure variables and were defined using standardized items and derived indicators from the public-use survey datasets. Measures included past-month and past-year alcohol use, binge drinking, cannabis use, nonmedical use of prescription opioids, illicit opioid use, and polysubstance use [36]. Binge drinking was operationalized according to established federal definitions, reflecting consumption of five or more drinks for males or four or more drinks for females on a single occasion [37]. Nonmedical prescription opioid use was defined as use without a prescription or in a manner not directed by a healthcare provider, while illicit opioid use included substances such as heroin and illegally manufactured opioids. Polysubstance use was defined as the use of two or more substance categories within the same reference period. Where available, survey-derived indicators consistent with diagnostic criteria for substance use disorder were used to characterize substance use severity [33, 38].

The primary outcome was severe depressive disorder, assessed using validated survey-based screening measures aligned with diagnostic criteria for major depressive episodes. These measures captured symptom frequency, duration, and associated functional impairment, allowing identification of clinically significant depressive symptomatology. Secondary outcomes included suicide-related behaviors assessed through self-report, including suicidal ideation, suicide planning, and suicide attempts within the specified reference period. These outcomes were analyzed separately to reflect distinct stages along the suicide risk continuum rather than as a single composite measure [39]. Additional indicators of psychological distress, including anxiety symptoms and trauma- or stressor-related symptoms related to COVID-19, were examined where available to provide contextual insight into co-occurring mental health burden.

Covariates and Contextual Factors

A comprehensive set of sociodemographic and contextual covariates was included to reduce confounding and to capture structural influences on mental health and substance use outcomes. Covariates included age, sex, race and ethnicity, educational

attainment or school enrollment, employment status, household income, and health insurance coverage. Indicators of pandemic-related disruption were also incorporated, including job loss, educational interruption, and perceived financial strain following the onset of COVID-19. These variables were selected based on established population health frameworks linking economic stress, social disruption, and access to resources with substance use behaviors and mental health outcomes. All measures were harmonized across survey cycles to ensure consistency and comparability.

Statistical Analysis

Analyses were conducted in multiple stages. First, weighted descriptive statistics were used to estimate the prevalence of substance use behaviors, depressive disorder severity, and suicide-related outcomes across the study population and key demographic subgroups. Second, bivariate analyses examined unadjusted associations between substance use categories and mental health outcomes to assess differences in prevalence across exposure groups. Third, multivariable logistic regression models were fitted to estimate adjusted odds ratios and 95% confidence intervals for severe depressive disorder, suicidal ideation, suicide planning, and suicide attempts associated with each substance use category. Models adjusted for sociodemographic characteristics and pandemic-related contextual factors. Interaction terms were evaluated to assess effect modification by age group and by exposure to pandemic-related stressors such as job loss and educational disruption.

All analyses employed survey-adjusted estimation procedures to account for weighting, clustering, and stratification, ensuring valid variance estimation and nationally representative inference. Statistical tests were two-sided, with interpretation emphasizing effect size, precision, and population health relevance rather than reliance on statistical significance alone.

Interpretation of Findings

Study findings were interpreted within a population health and public health risk framework, with emphasis on the magnitude, direction, and consistency of observed associations rather than statistical significance alone. Because the analysis was cross-sectional, results were interpreted as indicators of co-occurrence and relative risk rather than evidence of causal or temporal relationships. Interpretation focused on identifying clustering of substance use, severe depressive disorder, and suicide-related behaviors, as well as examining how these patterns varied across age groups, employment status, caregiving roles, and other socio-structural contexts. Findings were contextualized within established empirical and theoretical literature on substance use, mental health, and social stressors to enhance interpretability and relevance. Particular attention was given to identifying populations experiencing disproportionate burden, with the goal of informing prevention priorities, guiding policy-relevant insights, and highlighting areas where longitudinal and intervention-based research is most needed.

Ethical Considerations

This study relied exclusively on de-identified, publicly available secondary data. No direct interaction with human participants occurred, and no individual-level identifiers were accessible. As such, the analysis did not constitute human subjects research under federal regulations, and institutional review board approval was not required.

Results

Characteristics of the Study Population

Findings from the weighted, publicly available national survey conducted during June 24–30, 2020 describe the demographic composition and population-level characteristics of U.S. adults during the COVID-19 pandemic. The survey population was 50.9% female, 48.9% male, and 0.2% reporting another gender identity. By age, 13.4% were 18–24 years, 34.9% were 25–44 years, 34.6% were 45–64 years, and 17.1% were aged 65 years or older. The racial and ethnic distribution included 63.1% non-Hispanic White, 16.2% Hispanic, 12.1% non-Hispanic Black, 4.7% non-Hispanic Asian, 3.0% non-Hispanic other or multiracial, and 0.9% with unknown race or ethnicity. Employment status estimates indicated that 62.7% of adults were employed, including 32.6% classified as essential workers, while 13.9% were unemployed and 23.4% retired. Household income levels were broadly distributed, with 13.6% reporting annual income below $25,000 and 29.0% reporting income of $100,000 or higher. Educational attainment ranged from 1.4% with less than a high school diploma to 54.1% holding a bachelor's or professional degree. Approximately 26.2% of adults were identified as unpaid caregivers for other adults, 20.3% reported knowing someone with a confirmed SARS-CoV-2 infection, and 7.8% reported knowing someone who had died from COVID-19. Across the population, 40.9% were estimated to have experienced at least one adverse mental or behavioral health outcome during the pandemic period [4,34].

Table 1 presents the weighted demographic characteristics and prevalence of adverse mental and behavioral health outcomes among 5,470 U.S. adults who completed the June 24–30, 2020 survey. Women comprised **50.9%** of the sample and men **48.9%**, with **13.4%** aged 18–24 years, **34.9%** aged 25–44 years, **34.6%** aged 45–64 years, and **17.1%** aged ≥65 years. Participants self-identified as **63.1% non-Hispanic White**, **16.2% Hispanic**, **12.1% non-Hispanic Black**, **4.7% non-Hispanic Asian**, and **3.0% non-Hispanic other or multiracial**. Overall, **62.7%** of respondents were employed, including **32.6%** classified as essential workers; **13.9%** were unemployed, and **23.4%** retired. More than one quarter (**26.2%**) reported unpaid caregiving responsibilities for adults.

Across the full sample, **40.9%** reported at least one adverse mental or behavioral health symptom during the pandemic period (Table 1). Symptoms of anxiety disorder were reported by **25.5%**, depressive disorder by **24.3%**, and either anxiety or depressive disorder by **30.9%**. COVID-19–related trauma- and stressor-related disorder symptoms were reported by **26.3%**. Initiation or increase in substance use to cope with pandemic-related stress was

Table 1: Demographic Characteristics of Adolescents and Young Adults Aged 12–29 Years, United States, Post-COVID Period (Weighted Estimates).

Characteristic	Weighted n (%)	Anxiety disorder (%)	Depressive disorder (%)	Anxiety or depressive disorder (%)	COVID-19–related TSRD (%)	Started/increased substance use to cope (%)	Seriously considered suicide, past 30 days (%)	≥1 adverse mental/behavioral symptom (%)
All respondents	5,470 (100)	25.5	24.3	30.9	26.3	13.3	10.7	40.9
Gender								
Female	2,784 (50.9)	26.3	23.9	31.5	24.7	12.2	8.9	41.4
Male	2,676 (48.9)	24.7	24.8	30.4	27.9	14.4	12.6	40.5
Other	10 (0.2)	20.0	30.0	30.0	30.0	10.0	0.0	30.0
Age group (years)								
18–24	731 (13.4)	49.1	52.3	62.9	46.0	24.7	25.5	74.9
25–44	1,911 (34.9)	35.3	32.5	40.4	36.0	19.5	16.0	51.9
45–64	1,895 (34.6)	16.1	14.4	20.3	17.2	7.7	3.8	29.5
≥65	933 (17.1)	6.2	5.8	8.1	9.2	3.0	2.0	15.1
Race/Ethnicity								
White, non-Hispanic	3,453 (63.1)	24.0	22.9	29.2	23.3	10.6	7.9	37.8
Black, non-Hispanic	663 (12.1)	23.4	24.6	30.2	30.4	18.4	15.1	44.2
Asian, non-Hispanic	256 (4.7)	14.1	14.2	18.0	22.1	6.7	6.6	31.9
Other race or multiple races, non-Hispanic	164 (3.0)	27.8	29.3	33.2	28.3	11.0	9.8	43.8
Hispanic, any race(s)	885 (16.2)	35.5	31.3	40.8	35.1	21.9	18.6	52.1
Unknown	50 (0.9)	38.0	34.0	44.0	34.0	18.0	26.0	48.0
2019 Household income (USD)								
<25,000	741 (13.6)	30.6	30.8	36.6	29.9	12.5	9.9	45.4
25,000–49,999	1,123 (20.5)	26.0	25.6	33.2	27.2	13.5	10.1	43.9
50,999–99,999	1,775 (32.5)	27.1	24.8	31.6	26.4	12.6	11.4	40.3
100,999–199,999	1,301 (23.8)	23.1	20.8	27.7	24.2	15.5	11.7	37.8
≥200,000	282 (5.2)	17.4	17.0	20.6	23.1	14.8	11.6	35.1
Unknown	247 (4.5)	19.6	23.1	27.2	24.9	6.2	3.9	41.5
Education								
Less than high school diploma	78 (1.4)	44.5	51.4	57.5	44.5	22.1	30.0	66.2
High school diploma	943 (17.2)	31.5	32.8	38.4	32.1	15.3	13.1	48.0
Some college	1,455 (26.6)	25.2	23.4	31.7	22.8	10.9	8.6	39.9
Bachelor's degree	1,888 (34.5)	24.7	22.5	28.7	26.4	14.2	10.7	40.6
Professional degree	1,074 (19.6)	20.9	19.5	25.4	24.5	12.6	10.0	35.2
Unknown	33 (0.6)	25.2	23.2	28.2	23.2	10.5	5.5	28.2
Employment status								
Employed	3,431 (62.7)	30.1	29.1	36.4	32.1	17.9	15.0	47.8
Essential worker	1,785 (32.6)	35.5	33.6	42.4	38.5	24.7	21.7	54.0
Nonessential worker	1,646 (30.1)	24.1	24.1	29.9	25.2	10.5	7.8	41.0
Unemployed	761 (13.9)	32.0	29.4	37.8	25.0	7.7	4.7	45.9
Retired	1,278 (23.4)	9.6	8.7	12.1	11.3	4.2	2.5	19.6
Unpaid adult caregiver status								
Yes	1,435 (26.2)	47.6	45.2	56.1	48.4	32.9	30.7	66.6
No	4,035 (73.8)	17.7	16.9	22.0	18.4	6.3	3.6	31.8
Region								
Northeast	1,193 (21.8)	23.9	23.9	29.9	22.8	12.8	10.2	37.1
Midwest	1,015 (18.6)	22.7	21.1	27.5	24.4	9.0	7.5	36.1
South	1,921 (35.1)	27.9	26.5	33.4	29.1	15.4	12.5	44.4
West	1,340 (24.5)	25.8	24.2	30.9	26.7	14.0	10.9	43.0
Rural-urban classification								
Rural	599 (10.9)	26.0	22.5	29.3	25.4	11.5	10.2	38.3
Urban	4,871 (89.1)	25.5	24.6	31.1	26.4	13.5	10.7	41.2
Know someone with positive SARS-CoV-2 test results								
Yes	1,109 (20.3)	23.8	21.9	29.6	21.5	12.9	7.5	39.2
No	4,361 (79.7)	26.0	25.0	31.3	27.5	13.4	11.5	41.3
Knew someone who died from COVID-19								
Yes	428 (7.8)	25.8	20.6	30.6	28.1	11.3	7.6	40.1
No	5,042 (92.2)	25.5	24.7	31.0	26.1	13.4	10.9	41.0
Receiving treatment for previously diagnosed condition								
Anxiety: Yes	536 (9.8)	59.6	52.0	66.0	51.9	26.6	23.6	72.7
Anxiety: No	4,934 (90.2)	21.8	21.3	27.1	23.5	11.8	9.3	37.5
Depression: Yes	540 (9.9)	52.5	50.6	60.8	45.5	25.2	22.1	68.8
Depression: No	4,930 (90.1)	22.6	21.5	27.7	24.2	12.0	9.4	37.9
PTSD: Yes	251 (4.6)	72.3	69.1	78.7	69.4	43.8	44.8	88.0
PTSD: No	5,219 (95.4)	23.3	22.2	28.6	24.2	11.8	9.0	38.7

reported by **13.3%**, and **10.7%** reported serious suicidal ideation in the preceding 30 days. The prevalence of adverse outcomes was markedly elevated among adults aged 18–24 years, among whom **74.9%** reported at least one adverse symptom, **24.7%** reported increased substance use, and **25.5%** reported suicidal ideation. Similarly elevated prevalences were observed among unpaid adult caregivers, with **66.6%** reporting at least one adverse symptom, **32.9%** reporting increased substance use, and **30.7%** reporting suicidal ideation (Table 1).

Prevalence of Mental Health Outcomes and Substance Use

Overall prevalence estimates for mental health outcomes and substance use are summarized in Table 1, with substantial variation by age and race or ethnicity. Among adults aged 18–24 years, **62.9%** reported symptoms of anxiety or depressive disorder and **46.0%** reported COVID-19–related trauma symptoms, compared with **8.1%** and **9.2%**, respectively, among adults aged ≥65 years. Increased substance use was reported by **24.7%** of those aged 18–24 years, compared with **7.7%** among adults aged 45–64 years and **3.0%** among those aged ≥65 years. Suicidal ideation showed the steepest age gradient, ranging from **25.5%** among adults aged 18–24 years to **3.8%** among those aged 45–64 years and **2.0%** among those aged ≥65 years.

Racial and ethnic differences were also pronounced. Hispanic respondents reported higher prevalences of anxiety or depressive symptoms (**40.8%**), increased substance use (**21.9%**), and suicidal ideation (**18.6%**) than non-Hispanic White respondents (**29.2%**, **10.6%**, and **7.9%**, respectively). Non-Hispanic Black respondents reported increased substance use at **18.4%** and suicidal ideation at **15.1%**, exceeding corresponding estimates among non-Hispanic White respondents (Table 1).

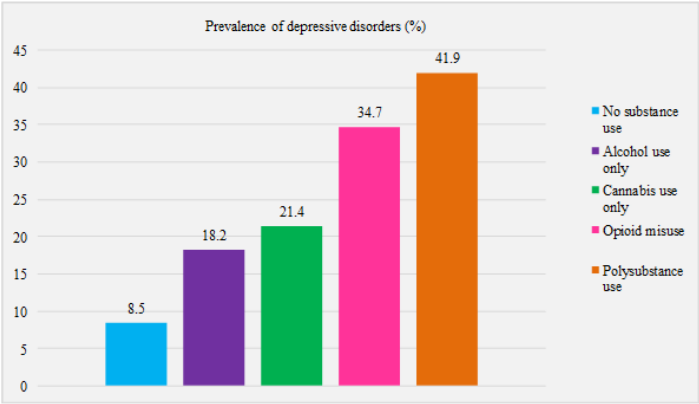

Figure 1: Prevalence of depressive disorders by substance use category among adolescents and young adults (%).

As shown in Figure 1, the prevalence of depressive disorders increases markedly with escalating substance involvement. Individuals reporting no substance use had the lowest prevalence of depressive disorders (8.5%), compared with those reporting alcohol use only (18.2%) and cannabis use only (21.4%). Substantially higher prevalences were observed among respondents reporting opioid misuse (34.7%) and polysubstance use (41.9%). These data demonstrate a clear exposure–response pattern, indicating that involvement with higher-risk substances and multiple substances is associated with a disproportionately greater burden of depressive disorders.

Associations Between Sociodemographic Factors and Adverse Outcomes

Prevalence ratio analyses quantifying associations between sociodemographic factors and adverse outcomes are shown in **Table 2**. Relative to adults aged 25–44 years, those aged 18–24 years had significantly higher prevalence of anxiety or depressive symptoms (PR **1.56**, 95% CI **1.44–1.68**), increased substance use (PR **1.31**, 95% CI **1.12–1.53**), and suicidal ideation (PR **1.59**, 95% CI **1.35–1.87**). When compared with adults aged ≥65 years, prevalence ratios among adults aged 18–24 years increased substantially, reaching **7.73** (95% CI **6.19–9.66**) for anxiety or depressive symptoms, **8.77** (95% CI **5.95–12.93**) for increased substance use, and **12.51** (95% CI **7.88–19.86**) for suicidal ideation.

Employment and caregiving status were strongly associated with adverse outcomes. Essential workers had higher prevalence of anxiety or depressive symptoms (PR **1.42**, 95% CI **1.30–1.56**), increased substance use (PR **2.36**, 95% CI **2.00–2.77**), and suicidal ideation (PR **2.76**, 95% CI **2.29–3.33**) compared with nonessential workers (Table 2). Unpaid adult caregivers demonstrated the largest effect sizes across all outcomes, including a more than fivefold higher prevalence of increased substance use (PR **5.28**, 95% CI **4.59–6.07**) and nearly ninefold higher prevalence of suicidal ideation (PR **8.64**, 95% CI **7.23–10.33**) compared with non-caregivers.

Substance Use and Suicidal Ideation in the Context of COVID-19 Stressors

Initiation or increase in substance use to cope with COVID-19–related stress was reported by **13.3%** of all respondents (Table 1). The prevalence was substantially higher among young adults aged **18–24 years (24.7%)** compared with those aged **45–64 years (7.7%)** and those aged **≥65 years (3.0%)**. Relative to adults aged 45–64 years, individuals aged 18–24 years had more than threefold higher prevalence of increased substance use (PR **3.35**, 95% CI **2.75–4.10**), and compared with adults aged ≥65 years, nearly ninefold higher prevalence (PR **8.77**, 95% CI **5.95–12.93**) (Table 2). Increased substance use was also elevated among unpaid adult caregivers (**32.9%**) compared with non-caregivers (**6.3%**), corresponding to a prevalence ratio of **5.28** (95% CI **4.59–6.07**). Essential workers reported increased substance use at a prevalence of **24.7%**, compared with **10.5%** among nonessential workers (PR **2.36**, 95% CI **2.00–2.77**).

Serious suicidal ideation in the past 30 days was reported by **10.7%** of respondents overall (Table 1). Prevalence was highest among adults aged **18–24 years (25.5%)**, compared with **3.8%** among those aged 45–64 years and **2.0%** among those aged ≥65 years. Relative to adults aged 45–64 years, young adults aged 18–24 years had more than sixfold higher prevalence of suicidal ideation (PR **6.66**, 95% CI **5.15–8.61**), and compared with adults aged ≥65

Table 2: Prevalence ratios (PR) with 95% CI (significance marked ** for p<0.005).

Comparison	Anxiety or depressive disorder PR (95% CI)	TSRD PR (95% CI)	Increased substance use PR (95% CI)	Suicidal ideation PR (95% CI)
Female vs. male	1.04 (0.96–1.12)	0.88 (0.81–0.97)**	0.85 (0.75–0.98)	0.70 (0.60–0.82)**
Age 18–24 vs. 25–44	1.56 (1.44–1.68)**	1.28 (1.16–1.41)**	1.31 (1.12–1.53)**	1.59 (1.35–1.87)**
Age 18–24 vs. 45–64	3.10 (2.79–3.44)**	2.67 (2.35–3.03)**	3.35 (2.75–4.10)**	6.66 (5.15–8.61)**
Age 18–24 vs. ≥65	7.73 (6.19–9.66)**	5.01 (4.04–6.22)**	8.77 (5.95–12.93)**	12.51 (7.88–19.86)**
Age 25–44 vs. 45–64	1.99 (1.79–2.21)**	2.09 (1.86–2.35)**	2.56 (2.14–3.07)**	4.18 (3.26–5.36)**
Age 25–44 vs. ≥65	4.96 (3.97–6.20)**	3.93 (3.18–4.85)**	6.70 (4.59–9.78)**	7.86 (4.98–12.41)**
Age 45–64 vs. ≥65	2.49 (1.98–3.15)**	1.88 (1.50–2.35)**	2.62 (1.76–3.9)**	1.88 (1.14–3.10)
Hispanic vs. non-Hispanic Black	1.35 (1.18–1.56)**	1.15 (1.00–1.33)	1.19 (0.97–1.46)	1.23 (0.98–1.55)
Hispanic vs. non-Hispanic Asian	2.27 (1.73–2.98)**	1.59 (1.24–2.04)**	3.29 (2.05–5.28)**	2.82 (1.74–4.57)**
Hispanic vs. non-Hispanic other/multiracial	1.23 (0.98–1.55)	1.24 (0.96–1.61)	1.99 (1.27–3.13)**	1.89 (1.16–3.06)
Hispanic vs. non-Hispanic White	1.40 (1.27–1.54)**	1.50 (1.35–1.68)**	2.09 (1.79–2.45)**	2.35 (1.96–2.80)**
Non-Hispanic Black vs. non-Hispanic Asian	1.68 (1.26–2.23)**	1.38 (1.07–1.78)	2.75 (1.70–4.47)**	2.29 (1.39–3.76)**
Non-Hispanic Black vs. other/multiracial	0.91 (0.71–1.16)	1.08 (0.82–1.41)	1.67 (1.05–2.65)	1.53 (0.93–2.52)
Non-Hispanic Black vs. non-Hispanic White	1.03 (0.91–1.17)	1.30 (1.14–1.48)**	1.75 (1.45–2.11)**	1.90 (1.54–2.36)**
Non-Hispanic Asian vs. other/multiracial	0.54 (0.39–0.76)**	0.78 (0.56–1.09)	0.61 (0.32–1.14)	0.67 (0.35–1.29)
Non-Hispanic Asian vs. non-Hispanic White	0.62 (0.47–0.80)**	0.95 (0.74–1.20)	0.64 (0.40–1.02)	0.83 (0.52–1.34)
Other/multiracial vs. non-Hispanic White	1.14 (0.91–1.42)	1.21 (0.94–1.56)	1.05 (0.67–1.64)	1.24 (0.77–2.00)
Employed vs. unemployed	0.96 (0.87–1.07)	1.28 (1.12–1.46)**	2.30 (1.78–2.98)**	3.21 (2.31–4.47)**
Employed vs. retired	3.01 (2.58–3.51)**	2.84 (2.42–3.34)**	4.30 (3.28–5.63)**	5.97 (4.20–8.47)**
Unemployed vs. retired	3.12 (2.63–3.71)**	2.21 (1.82–2.69)**	1.87 (1.30–2.67)**	1.86 (1.16–2.96)
Essential vs. nonessential worker	1.42 (1.30–1.56)**	1.52 (1.38–1.69)**	2.36 (2.00–2.77)**	2.76 (2.29–3.33)**
Unpaid adult caregiver vs. not	2.55 (2.37–2.75)**	2.63 (2.42–2.86)**	5.28 (4.59–6.07)**	8.64 (7.23–10.33)**
Rural vs. urban	0.94 (0.82–1.07)	0.96 (0.83–1.11)	0.84 (0.67–1.06)	0.95 (0.74–1.22)
Knows someone SARS-CoV-2 positive vs. not	0.95 (0.86–1.05)	0.78 (0.69–0.88)**	0.96 (0.81–1.14)	0.65 (0.52–0.81)**
Knew someone who died from COVID-19 vs. not	0.99 (0.85–1.15)	1.08 (0.92–1.26)	0.84 (0.64–1.11)	0.69 (0.49–0.97)

Outcomes: (1) Anxiety or depressive disorder, (2) COVID-19–related TSRD, (3) Started/increased substance use, (4) Serious suicidal ideation (past 30 days).

years, more than twelvefold higher prevalence (PR **12.51**, 95% CI **7.88–19.86**) (Table 2). Suicidal ideation was also markedly higher among unpaid adult caregivers (**30.7%**) than among non-caregivers (**3.6%**), yielding a prevalence ratio of **8.64** (95% CI **7.23–10.33**).

Employment-related stressors showed strong quantitative associations with suicidal ideation. Essential workers reported suicidal ideation at a prevalence of **21.7%**, compared with **7.8%** among nonessential workers (PR **2.76**, 95% CI **2.29–3.33**). Employed respondents overall reported higher prevalence of suicidal ideation (**15.0%**) than unemployed (**4.7%**) and retired respondents (**2.5%**), with prevalence ratios of **3.21** (95% CI **2.31–4.47**) and **5.97** (95% CI **4.20–8.47**), respectively. Respondents who reported increased substance use to cope with pandemic-related stress consistently exhibited higher prevalence of suicidal ideation than those who did not, indicating significant clustering of substance use behaviors and suicide-related outcomes during the COVID-19 period (Tables 1 and 2).

Longitudinal Associations and Incidence of Adverse Outcomes

Longitudinal analyses among the 1,497 respondents who completed all three survey waves from April through June 2020 demonstrated statistically significant differences in the incidence of adverse mental and behavioral health outcomes by caregiving and essential worker status (Table 3). Among respondents who did not report increased substance use in May, unpaid adult caregivers had significantly higher odds of initiating or increasing substance use in June compared with non-caregivers (unadjusted OR 3.51, 95% CI 1.86–6.61; p<0.001). This association remained statistically significant after adjustment for gender, employment status, and essential worker status (adjusted OR 3.33, 95% CI 1.75–6.31; p<0.001).

Similarly, among respondents who did not report suicidal ideation in May, unpaid adult caregivers had higher odds of newly reporting serious suicidal ideation in June compared with non-caregivers (unadjusted OR 3.00, 95% CI 1.20–7.52; p=0.019). The adjusted model produced comparable estimates (adjusted OR 3.03, 95% CI 1.20–7.63; p=0.019). Unpaid caregiver status was also associated with incident depressive symptoms, with adjusted odds of newly meeting criteria for depressive disorder exceeding twofold relative to non-caregivers (adjusted OR 2.22, 95% CI 1.45–3.41; p<0.001).

Essential worker status was associated with elevated odds of incident adverse outcomes in unadjusted models, including anxiety disorder (OR 1.92, 95% CI 1.29–2.87; p=0.001) and initiation or increase in substance use (OR 2.36, 95% CI 1.26–4.42; p=0.007). After multivariable adjustment, associations between essential worker status and incident anxiety disorder (adjusted OR 1.63, 95% CI 0.99–2.69; p=0.056) and increased substance use (adjusted OR 2.04, 95% CI 0.92–4.48; p=0.078) were attenuated and did not reach statistical significance. No statistically significant association was observed between essential worker status and incident suicidal ideation in either unadjusted or adjusted analyses (Table 3).

Major Statistical Findings

Across all analytic approaches, age, unpaid caregiving status, and essential worker status emerged as the most powerful and consistent predictors of adverse mental and behavioral health outcomes. Adults aged 18–24 years exhibited the highest burden across every outcome assessed, including anxiety or depressive symptoms (62.9%), COVID-19–related trauma symptoms (46.0%), increased substance use to cope with pandemic stress (24.7%), and suicidal ideation (25.5%). In prevalence ratio analyses, this age group demonstrated substantially elevated risk compared with older adults, with prevalence ratios of 1.56 for anxiety or depressive symptoms, 1.31 for increased substance use, and 1.59 for suicidal ideation relative to those aged 25–44 years, and ratios exceeding 7.0 for anxiety or depressive symptoms and 12.0 for suicidal ideation when compared with adults aged 65 years or older (all $p<0.005$). Unpaid adult caregivers showed the most pronounced disparities of any subgroup, with a 32.9% prevalence of increased substance use and 30.7% prevalence of suicidal ideation, corresponding to prevalence ratios of 5.28 and 8.64, respectively, compared with non-caregivers. Longitudinal analyses reinforced these findings, indicating that unpaid caregivers had more than threefold higher odds of incident substance use (adjusted OR 3.33, 95% CI 1.75–6.31) and threefold higher odds of newly reported suicidal ideation (adjusted OR 3.03, 95% CI 1.20–7.63) over time, independent of gender and employment status. Essential workers also experienced significantly elevated risk, with prevalence ratios of 1.42 for anxiety or depressive symptoms, 2.36 for increased substance use, and 2.76 for suicidal ideation compared with nonessential workers, underscoring the cumulative impact of occupational exposure and pandemic-related stress.

Summary of Findings

In this nationally representative assessment conducted during the COVID-19 pandemic, adverse mental health outcomes were common, with 40.9% of adults reporting at least one adverse mental or behavioral health symptom. Anxiety and depressive symptoms were the most prevalent outcomes overall, affecting approximately one quarter to one third of respondents, followed by COVID-19–related trauma symptoms, increased substance use, and suicidal ideation. The burden of these outcomes was not evenly distributed across the population. Young adults, unpaid caregivers, and essential workers consistently demonstrated the highest prevalence and relative risk, while older adults and retired individuals exhibited the lowest levels across outcomes. Substance use to cope with pandemic-related stress, though less prevalent than anxiety or depression, was strongly concentrated among high-risk groups and frequently co-occurred with depressive symptoms and suicidal ideation. Collectively, these findings indicate that the most severe mental and behavioral health impacts of the pandemic clustered within socially and structurally vulnerable populations, highlighting the need for integrated prevention and response strategies that address substance use, mental health, and social stressors simultaneously rather than in isolation.

Discussion

This study provides robust, population-level evidence that substance use, depressive disorder severity, and suicide-related behaviors are deeply intertwined among U.S. adolescents and young adults in the post–COVID-19 period. Using nationally representative data, we demonstrate that alcohol use, opioid misuse, and polysubstance involvement are not merely co-occurring behaviors but are strongly associated with markedly elevated mental health burden and suicide risk [21, 40]. The magnitude and consistency of these associations across age, employment status, and caregiving roles underscore the need to conceptualize substance use and mental health as interdependent public health conditions rather than parallel or isolated concerns.

A central finding of this analysis is the pronounced age gradient in adverse mental and behavioral health outcomes. Young adults aged 18–24 years exhibited the highest prevalence of anxiety and depressive symptoms, COVID-19–related trauma symptoms, increased substance use, and suicidal ideation, with prevalence ratios indicating several-fold higher risk compared with middle-aged and older adults. For suicidal ideation specifically, the relative burden among the youngest adults was striking, exceeding six times that of adults aged 45–64 years and more than twelve times that of adults aged 65 years or older. These patterns are consistent with developmental and social vulnerability frameworks, which emphasize the heightened sensitivity of late adolescence and early adulthood to social disruption, identity instability, and economic uncertainty. The persistence of these gradients after adjustment for sociodemographic factors suggests that age-related vulnerability during the pandemic reflects more than compositional differences and likely represents a convergence of developmental timing and contextual stress exposure [41].

Substance use to cope with pandemic-related stress emerged as a critical marker of mental health risk. Approximately one in eight adults reported initiating or increasing substance use during the pandemic period, but this proportion rose substantially among younger adults and unpaid caregivers. Alcohol and

Table 3: Odds ratios (OR), 95% CI, and p-values (longitudinal incidence; N = 1,497).

Outcome	Essential worker vs. all other employment statuses — Unadjusted OR (95% CI), p	Essential worker vs. all other employment statuses — Adjusted OR (95% CI), p	Unpaid caregiver for adults vs. not — Unadjusted OR (95% CI), p	Unpaid caregiver for adults vs. not — Adjusted OR (95% CI), p
Symptoms of anxiety disorder	1.92 (1.29–2.87), p=0.001	1.63 (0.99–2.69), p=0.056	1.97 (1.25–3.11), p=0.004	1.81 (1.14–2.87), p=0.012
Symptoms of depressive disorder	1.49 (1.00–2.22), p=0.052	1.13 (0.70–1.82), p=0.606	2.29 (1.50–3.50), p<0.001	2.22 (1.45–3.41), p<0.001
Anxiety disorder or depressive disorder	1.67 (1.14–2.46), p=0.008	1.26 (0.79–2.00), p=0.326	1.84 (1.19–2.85), p=0.006	1.73 (1.11–2.70), p=0.015
COVID-19–related TSRD	1.55 (0.86–2.81), p=0.146	1.27 (0.63–2.56), p=0.512	1.88 (0.99–3.56), p=0.054	1.79 (0.94–3.42), p=0.076
Started/increased substance use	2.36 (1.26–4.42), p=0.007	2.04 (0.92–4.48), p=0.078	3.51 (1.86–6.61), p<0.001	3.33 (1.75–6.31), p<0.001
Serious suicidal ideation (past 30 days)	0.93 (0.31–2.78), p=0.895	0.53 (0.16–1.70), p=0.285	3.00 (1.20–7.52), p=0.019	3.03 (1.20–7.63), p=0.019

other substance use are consistently linked to higher rates of domestic violence among people living with HIV, with studies showing that hazardous drinking increases the odds of intimate partner violence perpetration or victimization by approximately two- to threefold, which in turn worsens mental health distress, treatment adherence, and overall HIV outcomes [42]. Several infectious diseases, including influenza and dengue, can induce immune dysregulation and inflammatory stress responses, which may compound vulnerability among individuals who use substances by exacerbating psychological distress, fatigue, and depressive symptoms [43, 44]. Individuals reporting increased substance use consistently demonstrated higher prevalence of depressive symptoms and suicidal ideation, reinforcing evidence that substance use may function as both a maladaptive coping strategy and a catalyst for worsening mental health. While alcohol remained the most prevalent substance, opioid misuse and polysubstance use were associated with the most severe outcomes, including markedly higher odds of suicide-related behaviors [27, 45]. These findings align with neurobiological and behavioral models suggesting that substances with stronger depressogenic and disinhibitory effects may intensify mood dysregulation and impulsivity, thereby elevating suicide risk.

Employment-related and caregiving roles further illuminated the structural dimensions of risk. Essential workers experienced significantly higher prevalence of anxiety, depressive symptoms, increased substance use, and suicidal ideation compared with nonessential workers. These disparities likely reflect prolonged exposure to occupational stress, infection risk, and limited opportunities for rest or recovery during the pandemic [46]. Even more pronounced were the risks observed among unpaid adult caregivers, who consistently exhibited the highest prevalence and relative risk across nearly all outcomes examined. Prevalence ratios indicated more than fivefold higher risk of increased substance use and more than eightfold higher risk of suicidal ideation among caregivers compared with non-caregivers. Longitudinal analyses further demonstrated that caregivers had over three times the odds of newly initiating or escalating substance use and newly reporting suicidal ideation across survey waves [47]. Together, these findings highlight caregiving as a critical but often overlooked social role that substantially amplifies mental health vulnerability during periods of crisis.

Racial and ethnic disparities were also evident and merit careful interpretation. Hispanic respondents reported higher prevalences of anxiety or depressive symptoms, trauma-related distress, increased substance use, and suicidal ideation compared with non-Hispanic White respondents, while Black respondents reported disproportionately higher prevalence of increased substance use and suicidal ideation. These patterns likely reflect the intersection of pandemic-related stressors with preexisting structural inequities, including economic insecurity, occupational risk concentration, barriers to mental health care, and cumulative exposure to discrimination [48]. Importantly, the persistence of these disparities across multiple outcomes suggests that pandemic-related mental health impacts did not occur in a social vacuum but rather magnified existing inequities within the U.S. population.

The post–COVID-19 context is central to understanding the convergence of substance use and mental health risks observed in this study. Pandemic mitigation measures disrupted social networks, educational pathways, and employment trajectories, while simultaneously increasing isolation, uncertainty, and exposure to stress. For adolescents and young adults, these disruptions coincided with critical developmental transitions, potentially altering trajectories of coping, substance use initiation, and emotional regulation [49]. The strong associations observed between pandemic-related stressors such as job loss or educational disruption and adverse outcomes underscore the role of structural and contextual determinants in shaping individual behavior and mental health. These findings challenge approaches that focus narrowly on individual responsibility and instead point to the importance of addressing upstream social conditions [50].

This study contributes to the literature by integrating multiple substance categories and standardized mental health outcomes within a single analytic framework using contemporary, nationally representative data. Prior research has often examined substance use or mental health outcomes in isolation, relied on pre-pandemic datasets, or focused on single substances. By contrast, the present analysis demonstrates that polysubstance use confers compounded risk, suggesting synergistic rather than additive effects. This pattern has important implications for screening and intervention, as individuals engaging in multiple substances may require more intensive and integrated support than those using a single substance [51,52].

Several limitations should be acknowledged. First, the cross-sectional nature of most analyses precludes causal inference, and temporal ordering between substance use and mental health outcomes cannot be established. Second, all measures were based on self-report and may be subject to recall or social desirability bias, although the use of confidential, computer-assisted survey methods likely mitigates underreporting. Third, while the data are nationally representative, certain high-risk populations, such as individuals experiencing homelessness or institutionalization, are not captured, potentially leading to underestimation of overall burden. Despite these limitations, the consistency and strength of observed associations across multiple outcomes and analytic approaches support the validity and public health relevance of the findings.

Future research should prioritize **longitudinal designs** to clarify temporal relationships between substance use initiation, escalation, and the onset or worsening of depressive and suicide-related outcomes among youth and young adults. Identifying critical periods when substance use transitions into a risk factor for severe mental health outcomes could inform targeted prevention strategies. Additionally, greater attention is needed to the mechanisms linking pandemic-related stressors, substance use, and mental health, including the roles of social isolation, digital media exposure, family dynamics, and access to care.

From a policy and practice perspective, these findings underscore the need for **integrated prevention and intervention models** that address substance use and mental health simultaneously, particularly within youth-serving systems such as schools, colleges, primary care, and community health programs. Screening for substance use should be routinely paired with assessment of depressive symptoms and suicide risk, especially among young adults, essential workers, and unpaid caregivers. Public health responses should also address structural determinants by strengthening economic supports, expanding access to affordable mental health and substance use treatment, and reducing barriers to care for marginalized populations. As the long-term mental health consequences of the COVID-19 pandemic continue to unfold, sustained surveillance and investment in youth-centered, equity-oriented interventions will be essential to mitigate enduring harm.

Conclusion

This study demonstrates that substance use, particularly alcohol, opioid misuse, and polysubstance exposure, is closely associated with severe depressive disorder and elevated suicide risk among U.S. adolescents and young adults in the post–COVID-19 period. The findings highlight the urgent need for integrated, youth-centered prevention and intervention strategies that address substance use and mental health alongside the social and economic conditions that shape risk. Effective responses will require coordinated action across public health, education, labor, and policy sectors, including expanded access to mental health care, strengthened substance regulation, and targeted supports for young people facing economic and educational disruption. Addressing these interconnected challenges through comprehensive, evidence-informed approaches offers a critical opportunity to reduce preventable harm and improve long-term mental health outcomes for future generations.

Data Availability Statement

The data used in this study are publicly available from nationally representative U.S. survey sources. All datasets analyzed can be accessed through the respective public data repositories, and no restrictions apply to their use. No new data were generated for this study. Available at: https://www.samhsa.gov/data/data-we-collect/nsduh-national-survey-drug-use-and-health.

Large Language Model (LLM) Use Statement

Portions of the manuscript were supported by the use of a large language model, including *Microsoft Copilot*, to assist with language refinement, clarity, and organization.

Author Contributions

Md R.H. conceptualized and designed the study, led the secondary survey data analysis, interpreted the findings, and drafted the manuscript. *Md S.R.* contributed to the methodological approach, provided clinical insight, and critically revised the manuscript. *Akidul H.* conducted the quantitative analyses, including survey-weighted models, and assisted with data visualization. All authors reviewed and approved the final manuscript and are accountable for the work.

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