



Co-occurrence of mental illness and substance use among US pregnant individuals, 2012-2021

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ARTICLE INFO

Keywords:

Pregnant individuals
Mental illness
Substance use
Alcohol
Tobacco
Marijuana

ABSTRACT

Aim: Substance use disorders are increasingly prevalent among pregnant individuals, with evident risks of adverse perinatal outcomes. This study examines substance use (tobacco, alcohol and marijuana) among pregnant individuals with mental illness.

Methods: A national representative sample of pregnant individuals were derived from 2012 to 2021 National Survey of Drug Use and Health data. Associations of past-year mental illness with past-month polysubstance use and each substance use were analyzed by logistic regression models, with complex sampling weights and survey year.

Results: Among 6801 pregnant individuals, 16.4% reported having any mental illness (AMI) in 2012 and 2013, increasing to 23.8% in 2020–2021; and SMI increased from 3.3% to 9.4%. Polysubstance use increased disproportionately among those with severe mental illness (SMI), from 14.0% to 18.6%. Pregnant individuals with greater severity of mental illness had higher odds of polysubstance use (Adjusted Odds Ratio, 95% CI: AMI but no SMI vs. without AMI: 1.59 [1.04, 2.44]; SMI vs. without AMI: 5.48 [2.77, 10.82]).

Conclusions: Pregnant individuals with greater severity of mental illness were more likely to engage in substance use. Evidence-based educational, screening and treatment services, and public policy changes are warranted to mitigate the harmful health outcomes of substance use among US pregnant individuals with mental illness.

1. Introduction

Mental health illness, a leading cause of death for pregnant individuals, accounts for 23% of pregnancy-related deaths in the US (Centers for Disease Control and Prevention, 2022). Despite substantial quality improvement initiatives to address unmet perinatal mental healthcare needs, only 60.7% of reproductive-age individuals in need of depression treatment received care from 2007 to 2014 (Martin et al., 2020). Such unmet mental healthcare needs may predispose individuals to greater likelihood of substance use (Han et al., 2022). However, it is unclear to what extent historical mental illness intersect with present patterns of substance use during pregnancy.

Tobacco, alcohol and marijuana, among all substances, were

relatively legally acquirable among US pregnant individuals (Smid and Terplan, 2022); yet, prior research on substance use among pregnant individuals largely focused on opioid use and stimulant use (Charron et al., 2023; Jarlenski et al., 2020; Meinhofer et al., 2023; Kozhimannil et al., 2017). Noteworthy, tobacco, alcohol and marijuana are the most commonly used substances during pregnancy (Emery et al., 2016). From 2005 to 2014, 8.7% and 14.9% adult pregnant women reported drinking alcohol and using tobacco, respectively (Oh et al., 2017). And marijuana use was associated with even higher rates of alcohol and tobacco use among these individuals (Kitsantas et al., 2021). While these highly accessible substances were often used to cope with mental illness in general populations (Substance Abuse and Mental Health Services Administration, 2023), how pregnant individuals, especially those with

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<https://doi.org/10.1016/j.psychres.2024.115820>

Received 1 November 2023; Received in revised form 19 February 2024; Accepted 23 February 2024

Available online 24 February 2024

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a history of mental illness, were engaged in the use of these substances types over time have remained largely unexplored.

In 2015, the American College of Obstetricians and Gynecologists (ACOG) raised concerns about alcohol and marijuana use and recommended that pregnant individuals should discontinue alcohol and marijuana consumption due to increased risk of poor pregnancy and birth outcomes (American College of Obstetricians and Gynecologists, 2015). In 2017, the ACOG also recommended smoking cessation among pregnant individuals (Guerby et al., 2020).¹⁴ However, a growing number of pregnant individuals consider marijuana a safe, natural remedy for stress and anxiety, pain (Ko et al., 2020) and morning sickness management (Swenson, 2023).¹⁶ Perceived harm from marijuana use once or twice a week among women has decreased from 50.4% in 2002 to 33.3% in 2014 (Compton et al., 2016). As many states legalized the marijuana use, marijuana access increased and attitudes became more permissive (Hasin et al., 2015), pregnant individuals face more frequent exposure to marijuana and risk for polysubstance use (Brown et al., 2017). This could disproportionately affect certain groups of pregnant individuals. Indeed, marijuana use has been reported to be more common among rural pregnant individuals (Jumah et al., 2016), pregnant individuals with disabilities that were younger, non-Hispanic Black, had lower educational attainment, were non-married, those in the first trimester of gestation (Alshaarawy et al., 2019), especially those reported past-month use of alcohol and tobacco (Kitsantas et al., 2022).

Given the prevalent co-use of these substances (tobacco, alcohol and marijuana), legalized movement of marijuana use across states (The American College of Obstetricians and Gynecologists, 2015), and adverse maternal and birth outcomes, understanding the patterns of polysubstance use can help identify at-risk populations. This understanding can also help tailor intervention programs and policy design to safeguard maternal and fetal health. Therefore, this study examines the patterns of polysubstance use among US pregnant individuals from 2012 to 2021 by sociodemographic characteristics and mental illness severity, aiming to identify critical gaps and inform policy efforts to support pregnant individuals at-risk of polysubstance use and mental illness.

2. Methods

2.1. Data source

This multi-year, cross-sectional study derived data from the 2012–2021 National Survey of Drug Use and Health (NSDUH). NSDUH is a nationally representative survey administrated by the Substance Abuse and Mental Health Services Administration and collects data on the sociodemographic characteristics, mental illness, substance use, receipt of treatment and unmet needs of care among noninstitutionalized US civilians aged ≥ 12 years. Approximately 67,500 individuals were interviewed through web-based platform or in-person visits each year, and only the NSDUH has annual information on drug use for the overall US adult population. NSDUH uses an Audio Computer Assisted Self-Interview system (ACASI) to improve quality of self-report data by providing respondents with a private, confidential way to record answers. We identified pregnant individuals if they answered “yes” to “are you currently pregnant?” and then asked them “how many months pregnant are you?” (Substance Abuse and Mental Health Services Administration, 2021).²⁴ In total, our analysis included 6801 respondents aged from 18 to 44 years old, representing a weighted total of 10,804,587 pregnant individuals over 2012–2021.

2.2. Measures

Self-reported past-year mental illness status is the key exposure; and past-month polysubstance use is our primary outcome. Any mental illness (AMI) was defined as experiencing any diagnosable condition (excluding developmental and substance use disorders) within the previous year preceding survey interview, meeting the duration criteria

specified in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (Substance Abuse and Mental Health Services Administration, 2021).²⁵ Serious mental illness (SMI) was defined as those with these conditions that “resulted in substantial functional impairment”.²⁵ Past-year mental illness status was then categorized into three groups: 1) without AMI, 2) AMI but no SMI, and 3) SMI. Three dichotomous variables were created to capture whether a pregnant individuals used tobacco, alcohol or marijuana during the past month or not. For example, past-month marijuana use was defined as responding “within the past 30 days” to the question “how long has it been since you last used marijuana or hashish?” Past-month polysubstance use was defined as the use of two or more types of these substances.

Per prior studies (Brown et al., 2017; Compton et al., 2016; Hasin et al., 2015, 2019; Oh et al., 2017, 2018; Kitsantas et al., 2021), the following covariates related to substance use and mental illness were included: residency rurality (rural, urban); race/ethnicity (non-Hispanic Black, Hispanic, non-Hispanic White and other); pregnancy age (18–25 and 26–44 years); health insurance (private, uninsured, Medicaid/Children’s Health Insurance Program (CHIP)/Medicare, other); family income (<\$20,000, \$20,000–\$49,999, \$50,000–\$74,999, \geq \$75,000); education (less than high school, high school graduate, some college, college graduate and higher); marital status (married or not); employment (full-time, part-time, unemployed, and other [not in labor force]); self-reported health status (fair or poor and excellent/very good/good); trimester of pregnancy (first, second, third trimester); and number of children in household to indicate parenting status.

2.3. Statistical analysis

Data were pooled into 2-year epochs to allow sufficient observations within smaller groups and improve the precision of estimates. All survey-weights were pooled and divided by 2, per NSDUH guidance (Substance Abuse and Mental Health Services Administration, 2021). Within each epoch, we calculated prevalence of past-year AMI, SMI and past-month polysubstance use among pregnancy individuals from 2012 to 2021. Descriptive statistics were reported to present sample characteristics. *P* values for linear trends over time were calculated with weighted logistic regression models. Chi-squared tests were used to examine differences in pregnant individuals characteristics by mental illness status. Then weighted regression models were performed to compare prevalence of polysubstance use between pregnant individuals with different status of mental illness, controlling for the aforementioned covariates and survey year. Complex survey weights were also used in the analyses to generate nationally representative estimates with *svy* packages. The study was deemed exempt by the institutional review board at the [authors’] University as we used publicly available, de-identified data. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline was followed. A 2-tailed *p*-value less than 0.05 was set as the test of statistical significance; and all analyses were performed using Stata 15.0 (StataCorp).

3. Results

3.1. Sample characteristics

Of 6801 pregnant individuals aged 18 to 44 years, representing 10,804,587 US pregnant individuals, 1526 (14.7%, weighted) lived in rural areas, over half (3738 [55.3%]) self-reported as non-Hispanic White, nearly one-third (3237 [32.0%]) were 18–25 years, and 2917 (50.0%) were privately insured. 1722 [20.1%] reported family income \leq \$20,000, 996 (12.8%) without high-school diploma, and nearly 40% (3177) unmarried. About 2059 (30.2%) were in the first trimester when surveyed; and 2510 (35.2%) did not have any children in their household (Supplemental Table 1).

In 2012 and 2013, the prevalence of polysubstance use among pregnant individuals was similar by residence rurality, race/ethnicity,

Table 1
Participant characteristics by past-month polysubstance use among US pregnant individuals, 2012–13 and 2020–21.

Characteristics	2012–2013		P value	2020–2021		P value
	Yes (N = 74) Number (Weighted%)	No (N = 1355) Number (Weighted%)		Yes (N = 47) Number (Weighted%)	No (N = 1050) Number (Weighted%)	
Residency rurality			0.625			0.888
Rural	16 (14)	343 (16.5)		10 (17)	215 (16.1)	
Urban	58 (86)	1012 (83.5)		37 (83)	835 (83.9)	
Race/ethnicity			0.108			0.189
White	48 (38)	747 (56.8)		20 (29)	637 (53.9)	
Black	16 (20)	210 (15.6)		7 (18)	120 (16.3)	
Hispanic	5 (11)	272 (17.4)		8 (39)	186 (17.9)	
Others ^a	5 (2) (10.2)	126 (10.2)		12 (13)	107 (11.9)	
Pregnancy Age			0.102			0.969
18–25	58 (51)	965 (36.7)		26 (26)	385 (26.4)	
26–44	16 (49)	390 (63.3)		21 (74)	665 (73.6)	
Health Insurance			0.002			0.280
Private health insurance	12 (18)	501 (51.6)		11 (30)	533 (46.5)	
Medicare/Medicaid/CHIP	40 (42)	637 (34.3)		27 (56)	385 (41.7)	
Uninsured	16 (22)	125 (7.7)		8 (15)	72 (7.9)	
Others ^b	6 (18)	92 (6.4)		1 (0)	60 (4.0)	
Family income, \$			0.013			0.115
no more than 20,000	34 (31)	444 (22.0)		24 (46)	199 (19.9)	
20,000–49,999	28 (49)	499 (32.8)		12 (22)	297 (29.3)	
50,000–74,999	5 (3) (16.9)	189 (16.9)		4 (5) (13.2)	137 (13.2)	
no less than 75,000	7 (17)	223 (28.3)		7 (27)	417 (37.7)	
Education			0.004			0.041
Less than high school	21 (17)	231 (14.6)		11 (17)	112 (12.7)	
High school graduate	27 (28)	474 (24.6)		20 (37)	233 (21.2)	
Some college	22 (47)	381 (23.5)		13 (42)	297 (28.7)	
College graduate and higher	4 (8) (37.4)	269 (37.4)		3 (4) (37.4)	408 (37.4)	
Being Married			< 0.001			0.125
No	62 (79)	680 (36.8)		35 (64)	386 (40.1)	
Yes	12 (21)	675 (63.2)		12 (36)	664 (59.9)	
Employment Status			0.177			0.043
Full time	26 (31)	506 (45.1)		14 (48)	454 (44.7)	
Part time	13 (19)	252 (16.0)		9 (9) (15.1)	179 (15.1)	
Unemployed	12 (16)	126 (7.0)		7 (20)	51 (4.9)	
Others ^c	23 (33)	471 (31.9)		17 (23)	366 (35.3)	
Health Status			0.897			0.251
Excellent/Very Good/Good	70 (93)	1281 (93.7)		40 (87)	998 (93.7)	
Fair/Poor	4 (7) (6.3)	74 (6.3)		7 (13)	52 (6.3)	
Current Trimester			< 0.001			0.004

Table 1 (continued)

Characteristics	2012–2013		P value	2020–2021		P value
	Yes (N = 74) Number (Weighted%)	No (N = 1355) Number (Weighted%)		Yes (N = 47) Number (Weighted%)	No (N = 1050) Number (Weighted%)	
First	41 (66)	381 (32.1)		31 (59)	285 (21.6)	
Second	23 (29)	495 (35.5)		6 (37)	382 (38.2)	
Third	8 (5) (32.4)	466 (32.4)		9 (4) (40.2)	375 (40.2)	
Number of Children in Household			0.442			0.015
0	33 (44)	518 (34.5)		24 (56)	414 (40.7)	
1	22 (36)	408 (31.4)		7 (7) (28.5)	331 (28.5)	
2	15 (13)	266 (21.0)		5 (5) (17.3)	196 (17.3)	
three or more	4 (8) (13.1)	163 (13.1)		11 (32)	109 (13.5)	

Notes: number (weighted%) was reported. AMI, any mental illness; SMI, serious mental illness. CHIP, Children’s Health Insurance Program. a, including Asian, Native Hawaiian or Other Pacific Islander, American Indian or Alaska individuals, and people of 2 or more races; b, Charity, Indian Health Insurance; c, including not in labor force. Percentages may not sum to 100 due to rounding. P values were calculated using Chi-squared tests.

age group, employment status, and number of children in household (Table 1). However, publicly-insured or uninsured pregnant individuals, those in a family with lower income, lower educational attainment, unmarried, and in the first or second trimester were more likely to report polysubstance use. In 2020–2021, these differences had narrowed. Maternal characteristics by past-year mental illness status and type of past-month substance use during pregnancy were presented in Supplemental Tables 2–5.

3.2. Trends in the prevalence of AMI and SMI and co-occurrence of mental illness and substance use, 2012–2021

As Fig. 1, 254 (16.4%, weighted) pregnant individuals reported past-year AMI in 2012–2013, which significantly increased to 289 (23.8%) in 2020–2021 (p for trend = 0.045). Past-year SMI prevalence increased from 51 (3.3%) pregnant individuals in 2012–2013 to 121 (9.4%) in 2020–2021 (p for trend = 0.002, Supplemental Table 6). In 2012–2013, about 3.7%, 3.3% and 14% of pregnant individuals without AMI, with AMI but no SMI, and with SMI reported polysubstance use (Fig. 2). While polysubstance use among those without AMI decreased to 3.4% in 2020–2021, it increased among those with AMI but no SMI (3.8%) and even more among those with SMI (18.6%). By subtype of substance use, tobacco use decreased between 2012 and 2013 and 2020–2021, from 12.0% to 8.5% for no-AMI group, from 17.5% to 14.3% for AMI but no SMI group, and from 45% to 13.1% for those with SMI. For alcohol use, about 10% of pregnant individuals without AMI (9.1%), with AMI but no SMI (10.8%), and with SMI (13%) reported alcohol use in 2012–2013. While the prevalence of alcohol use decreased to 7.6% for those without AMI and 7.2% for those with AMI but no SMI in 2020–2021, it increased to 26.2% among those with SMI. Marijuana use among those without AMI (3.5% vs. 5.6%) and with AMI but no SMI (5.6% vs. 3.1%) remained similar in 2012–2013 versus 2020–2021, it increased from 19% to 22.6% among those with SMI.

3.3. Disparities in the prevalence of substance use

Pregnant individuals with mental illness were more likely to report polysubstance use (Adjusted Odds Ratio, 95% CI: AMI but no SMI vs.

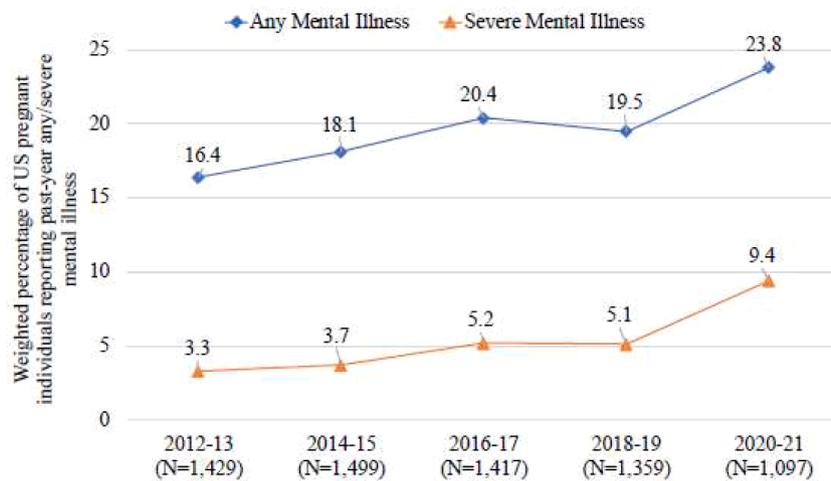


Fig. 1. Trend in Past-year Mental Illness among US Pregnant Individuals, 2012–2021.

Notes: Graphs show temporal prevalence of past-year any mental illness (AMI) and severe mental illness (SMI) among US pregnant individuals from 2012 to 2021. P values for the trend in the rates of AMI and SMI were calculated using weighted logistic regression models with year set as independent variables. AMI was defined as experiencing any diagnosable conditions (excluding developmental and substance use disorders) within the previous year preceding survey interview, meeting the duration criteria specified in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). SMI was defined as those with these conditions that “resulted in substantial functional impairment.” Each was aggregated into every two survey years and illustrated as weighted proportions of pregnant individuals reporting past-year mental illness during any of a given period.

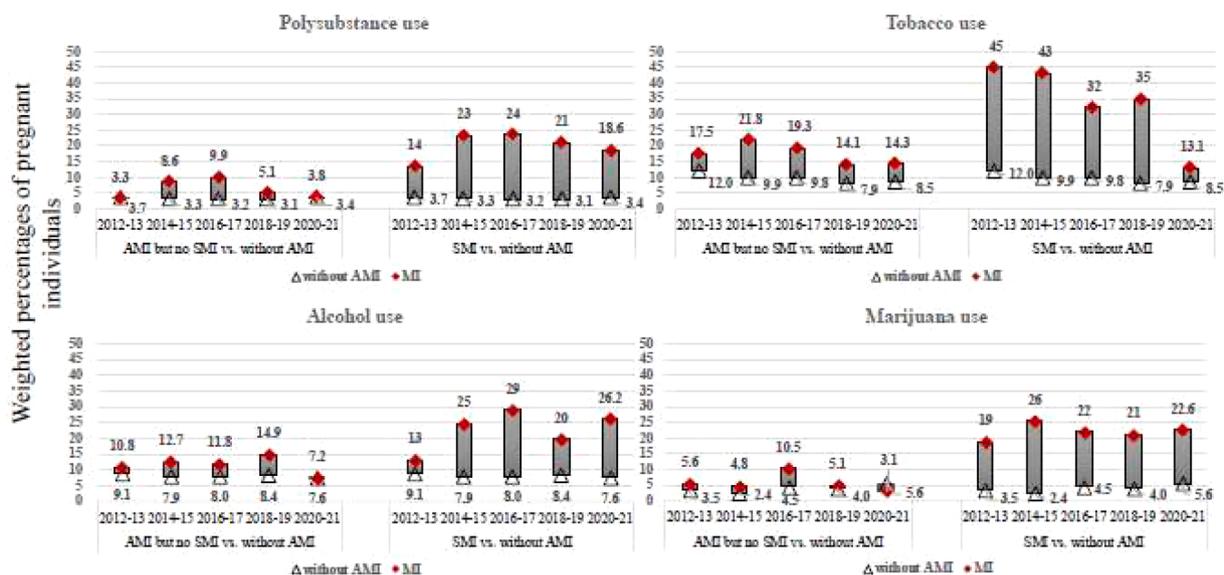


Fig. 2. Trends in Co-occurrence of Past-year Mental Illness and Past-month Substance Use among US Pregnant Individuals, 2012–2021.

Notes: Graph depicts the weighted proportions of pregnant individuals engaging in multiple examined substances (i.e., polysubstance), tobacco use, alcohol use, and marijuana use in the past month for those with any mental illness (AMI) but no severe mental illness (SMI) (reference category: no AMI) in the past year by survey year. Definitions of polysubstance use, tobacco use, alcohol use, and marijuana use, and mental illness status are discussed in the Methods section. Number of pregnant individuals reported polysubstance use, tobacco use, alcohol use, marijuana use by mental illness status were presented in the Supplementary Tables 7–10.

without AMI: 1.59 [1.04, 2.44]; SMI vs. without AMI: 5.48 [2.77, 10.82]) than those pregnant individuals without AMI (Table 2). Pregnant individuals who received higher education attainment (college degree or higher vs. less than high school: 0.28 [0.12, 0.65]), reported being married (0.36 [0.22, 0.60]), reported having one child (0.62 [0.40, 0.98]) or two children in household (0.56 [0.32, 0.98]), and being in the second (0.27 [0.17, 0.41]) or third trimester (0.11 [0.07, 0.17]) were less likely to report polysubstance use than their counterparts did. Differences in the prevalence of tobacco (AMI but no SMI vs. without AMI: 1.71 [1.32, 2.21]; SMI vs. without AMI: 3.01 [2.00, 4.53]), alcohol (AMI but no SMI vs. without AMI: 1.36 [1.01, 1.85]; SMI vs. without AMI: 3.35 [1.89, 5.94]) and marijuana (SMI vs. without AMI: 4.79 [2.62,

9.00) use were also observed between pregnant individuals with mental illness and those without AMI.

Pregnant individuals who live in urban areas (0.65 [0.48, 0.88]), are affluent (family income \geq \$75,000 vs. \leq \$20,000: 0.43 [0.28, 0.68]), have received more years of education (some college vs. less than high school: 0.51 [0.37, 0.70]; college graduate and higher vs. less than high school: 0.16 [0.09, 0.29]), being married (0.33 [0.25, 0.43]), and being in the second (0.57 [0.43, 0.76]) or third trimester (0.48 [0.35, 0.67]) were less likely to report tobacco use than their counterparts did. White (Black vs. White: 0.23 [0.16, 0.34]; Hispanic vs. White: 0.15 [0.11, 0.22]; other vs. White: 0.46 [0.30, 0.71]), unemployed (1.62 [1.17, 2.23]) pregnant individuals, those having public insurance (1.87 [1.29,

Table 2
Adjusted odds ratios of substance use by participant characteristics.

Characteristics	Polysubstance Use Adjusted Odds Ratios (95% Confidence Interval)	Tobacco Use Adjusted Odds Ratios (95% Confidence Interval)	Alcohol Use Adjusted Odds Ratios (95% Confidence Interval)	Marijuana Use Adjusted Odds Ratios (95% Confidence Interval)
Mental illness (ref: Without AMI)				
AMI but no SMI	1.59 (1.04, 2.44) *	1.71 (1.32, 2.21) ***	1.36 (1.01, 1.85) *	1.26 (0.86, 1.85)
SMI	5.48 (2.77, 10.82) ***	3.01 (2.00, 4.53) ***	3.35 (1.89, 5.94) ***	4.79 (2.62, 9.00) ***
Residential Rurality (ref: Rural)				
Urban	1.08 (0.73, 1.60)	0.65 (0.48, 0.88) **	1.40 (1.01, 1.94) *	1.19 (0.82, 1.68)
Race/ethnicity (ref: White)				
Black	0.92 (0.58, 1.49)	0.23 (0.16, 0.34) ***	1.36 (0.92, 2.02)	1.27 (0.80, 2.01)
Hispanic	0.68 (0.33, 1.41)	0.15 (0.11, 0.22) ***	0.81 (0.51, 1.28)	0.50 (0.22, 1.15)
Others ^a	0.86 (0.45, 1.64)	0.46 (0.30, 0.71) **	0.61 (0.36, 1.04)	0.58 (0.28, 1.19)
Pregnancy Age (ref: 18–25)				
26–44	1.15 (0.73, 1.80)	1.28 (0.96, 1.70)	1.41 (1.02, 1.94) *	0.73 (0.47, 1.13)
Health insurance (ref: Private)				
Medicare/Medicaid/CHIP	1.17 (0.71, 1.94)	1.87 (1.29, 2.71) **	0.91 (0.60, 1.39)	1.58 (0.93, 2.69)
Uninsured	1.20 (0.66, 2.20)	1.53 (0.93, 2.50)	1.11 (0.63, 1.97)	2.02 (1.07, 3.82) *
Others ^b	1.75 (0.76, 4.06)	1.25 (0.66, 2.38)	1.16 (0.64, 2.10)	1.36 (0.51, 5.39)
Family income, \$ (ref: No more than 20,000)				
20,000–49,999	0.90 (0.61, 1.33)	0.85 (0.63, 1.15)	1.20 (0.86, 1.68)	1.29 (0.92, 1.82)
50,000–74,999	0.87 (0.47, 1.59)	0.84 (0.53, 1.33)	1.12 (0.72, 1.75)	1.07 (0.62, 1.85)
No less than 75,000	0.89 (0.49, 1.60)	0.43 (0.28, 0.68) ***	1.26 (0.78, 2.03)	1.58 (0.94, 2.64)
Education (ref: Less than high school)				
High school graduate	0.82 (0.51, 1.30)	0.77 (0.57, 1.03)	0.97 (0.60, 1.56)	0.76 (0.48, 1.20)
Some college	0.89 (0.54, 1.44)	0.51 (0.37, 0.70) ***	1.09 (0.63, 1.88)	1.24 (0.80, 1.96)
College graduate and higher	0.28 (0.12, 0.65) **	0.16 (0.09, 0.29) ***	1.04 (0.58, 1.83)	0.41 (0.19, 0.88) *
Being Married (ref: No)	0.36 (0.22, 0.60) ***	0.33 (0.25, 0.43) ***	0.61 (0.42, 0.88) **	0.38 (0.22, 0.66) **
Employment Status (ref: Full time)				
Part time	0.91 (0.54, 1.52)	0.86 (0.61, 1.21)	0.85 (0.62, 1.17)	0.93 (0.57, 1.56)
Unemployed	1.45 (0.87, 2.42)	1.62 (1.17, 2.23) **	0.81 (0.50, 1.33)	1.72 (1.10, 2.70) *
Others ^c	0.85 (0.56, 1.30)	1.12 (0.84, 1.51)	0.64 (0.47, 0.88) **	0.79 (0.51, 1.23)
Number of Children in Household (ref: 0)				
1	0.62 (0.40, 0.98) *	0.92 (0.68, 1.24)	1.01 (0.75, 1.36)	0.79 (0.51, 1.24)

Table 2 (continued)

Characteristics	Polysubstance Use Adjusted Odds Ratios (95% Confidence Interval)	Tobacco Use Adjusted Odds Ratios (95% Confidence Interval)	Alcohol Use Adjusted Odds Ratios (95% Confidence Interval)	Marijuana Use Adjusted Odds Ratios (95% Confidence Interval)
2	0.56 (0.32, 0.98) *	0.95 (0.67, 1.35)	0.95 (0.65, 1.38)	0.57 (0.32, 1.01)
Three or more	0.88 (0.52, 1.48)	1.41 (1.04, 1.93) *	0.87 (0.49, 1.52)	0.70 (0.42, 1.17)
Health Status (ref: Excellent/Very Good/Good)				
Fair/Poor	1.41 (0.83, 2.37)	1.54 (1.06, 2.26) *	1.29 (0.73, 2.28)	1.08 (0.62, 1.85)
Current Trimester (ref: First)				
Second	0.27 (0.17, 0.41) ***	0.57 (0.43, 0.76) ***	0.22 (0.17, 0.30) ***	0.37 (0.22, 0.59) ***
Third	0.11 (0.07, 0.17) ***	0.48 (0.35, 0.67) ***	0.13 (0.09, 0.19) ***	0.29 (0.20, 0.40) ***

Notes: AMI, any mental illness; SMI, serious mental illness. a, including Asian, Native Hawaiian or Other Pacific Islander, American Indian or Alaska individuals, and people of 2 or more races; b, Charity, Indian Health Insurance; c, including not in labor force. P values from weighted logistic regressions were noted as * <0.05 , ** <0.01 , *** <0.001 .

2.71]), those with three or more children in household (1.41 [1.04, 1.93]), and those with self-reported fair/poor health status (1.54 [1.06, 2.26]) were more likely to report tobacco use (Table 2). Pregnant individuals living in urban areas (1.40 [1.01, 1.94]), aged 26–44 years (1.41 [1.02, 1.94]) were more likely to report alcohol use than their counterparts did; while pregnant individuals being married (0.61 [0.42, 0.88]), being in the second (0.22 [0.17, 0.30]) or third (0.13 [0.09, 0.19]) trimester were less likely to report alcohol use (Table 2). Pregnant individuals receiving more years of education (college graduate and higher vs. less than high school: 0.41 [0.19, 0.88]), being married (0.38 [0.22, 0.66]) in the second (0.37 [0.22, 0.59]) or third (0.29 [0.20, 0.40]) trimester were less likely to report marijuna use than their counterparts did. Uninsured (2.02 [1.07, 3.82]) and unemployed (1.72 [1.10, 2.70]) pregnant individuals were more likely to report marijuana use than their peers did (Table 2).

4. Discussion

Using nationally representative data, our study found substantial increases in the prevalence of AMI and SMI among US pregnant individuals from 2012 to 2021; and polysubstance use was more common among pregnant individuals with mental illness. In 2020–2021, about 3.8% of pregnant individuals who experienced past-year AMI but no SMI reported polysubstance use, and this number increased to 18.6% for those with SMI. Polysubstance use was less prevalent in those with higher level of education, married compared to not married, having one or two children in their households vs. none, and in the second or third trimester. Tobacco, alcohol and marijuana use also varied by pregnant individual characteristics. Those results highlight the need to support reproductive-age individuals with mental illness and manage substance use during pregnancy to avoid detrimental neonatal and maternal outcomes.

Our findings on the increased AMI and SMI among pregnant individuals from 2012 to 2021 are consistent to the recent report indicating the alarming trends in maternal depression (Centers for Disease Control and Prevention, 2023) and mental health deaths related to pregnancy (Trost et al., 2021). Our current study further demonstrated the significantly high prevalence of polysubstance use in pregnant individuals with mental illness, especially those with SMI. These findings reinforced the importance of mandated reporting recommended by the ACOG (The American College of Obstetricians and Gynecologists, 2015)

and providing targeted education and supportive environment during preconception or antenatal periods for those suffering from mental illness. However, barriers, such as the fear of offending individuals, stigma, and time constraints during office visits, still exists (Prince et al., 2018); and only a few of states have enacted strategies to address these ethical, legal and social concerns that affect pregnant individuals' engagement in treatment and care (Kroelinger et al., 2019). Worse, pregnant individuals with mental illness were less likely to receive treatment than their non-pregnant counterparts (Salameh et al., 2020); and comorbid psychiatric disorders are associated with low rates of retention in substance use treatment services (Benningfield et al., 2012). Also, pregnant individuals reported substance use initiated prenatal care later than those who did not, which might result from the punitive policies (Austin et al., 2022).

We also found greater likelihood of tobacco, alcohol and marijuana use among pregnant individuals with mental illness, especially those with SMI. These results are consistent with the fact that increased US adults resort to substances as a coping strategy with their mental illness (Substance Abuse and Mental Health Services Administration, 2023). Pregnant individuals in the first trimester were more likely to report using these substances, suggesting substance use was discontinued during the later phase of pregnancy as some individuals know they are pregnant (Thompson et al., 2021). Among all the examined substances, tobacco use was more common, especially in pregnant individuals with lower socioeconomic status. These variations highlight the need to extend the reach and provide smoking cessation services to these low-income and publicly-insured reproductive-age population in order to reduce perinatal tobacco use among pregnant individuals (Wesselink et al., 2015). Similarly, pregnant individuals suffering from SMI, being uninsured, unemployed, and/or not being married were more likely to drink alcohol or use marijuana, indicating the importance of targeting these pregnant people for the evidence-based practice such as Brief intervention and the 12 Step program of Alcoholics Anonymous (Gosdin et al., 2022). Although increasing pregnant individuals are using marijuana to treat pregnant-related symptoms (Ko et al., 2020), obstetrics providers often do not respond or provide counselling services to them (Holland et al., 2016). Policy initiatives and tailored behavioral, psychosocial and pharmacotherapy intervention efforts to bridge the gaps between practice and recommendations, especially in those socioeconomically disadvantaged pregnant individuals, are warranted.

Integrated obstetrics/gynecology and substance use disorder care models, such as the Alliance for Innovation on Maternal Health (AIM) patient safety bundle, Centering Pregnancy group models and the Maternal/Pregnancy Health Home model, has been widely piloted. These initiatives aimed to address pregnant individuals' behavioral health issues in a place comfortably (Julie et al., 2022). Particularly, the AIM patient safety bundle on the care for pregnant and postpartum people with substance use disorder (Alliance for Innovation on Maternal Health, 2022) highlight best practices for caring for these patients with the goal of improving patient outcomes. One of the recommendations in this bundle is to not only screen patients but to connect patients to community resources which have potential to improve the success for substance use treatment. However, most existing models rely on informal professional relationships between providers; and limited reimbursement is one of key barriers to implementing and expanding these models (Julie et al., 2022). Therefore, cross-sector policy initiatives on substance use and multilevel, comprehensive intervention programs should be continuously enacted to improve pregnant individuals' attendance and retention in the substance use screening and treatment.

This study has several limitations. First, the NSDUH is subject to recall and social-desirability bias; and some of pregnant individuals would be unwilling to disclose their use because the substance use might be judged and reported by prenatal providers to Child Protective Services and losing custody of their newborns and older children (Roberts and Nuru-Jeter, 2010). However, use of ACASI helps reduce such biases

(Brown et al., 2013). Second, this study may also underestimate prevalence of polysubstance and specific substance use during pregnancy given the fact that some of respondents being not aware of pregnancy status, and NSDUH excludes incarcerated individuals and homeless individuals not living in shelters, populations who often have more mental illness and substance use than the general population (Compton et al., 2010; Ferguson et al., 2015). Third, self-reported status of mental illness may not correspond with objective clinical assessments. Fourth, as NSDUH data are cross-sectional, although we examined the prevalence of past-month substance use by past-year mental illness status, we could not determine the temporality of mental illness and substance use, and make casual inference.

5. Conclusions

In this 10-year nationwide study, substance use among pregnant individuals are particularly pronounced in those individuals with greater severity of mental illness; and those pregnant individuals with lower educational levels, no experience of having any child in the household or being in the first trimester of pregnancy, were more likely to engage in substance use. As supportive policies and integrated care models have been widely implemented and piloted, in light of the increasing legalization of marijuana use and the changing attitudes towards its use, to curb the substance epidemic among pregnant individuals, multipronged approach that involves both public health, prevention and treatment initiatives is needed to expand access to care and retention to treatment. Such measures are essential to ensure the well-being of both the expectant mother and developing fetus and child. More importantly, a compassionate and supportive environment, such as expansion of health insurance improving coverage of substance use and/or mental health treatment, is warranted to manage and reduce substance use during pregnancy, especially those socioeconomically disadvantaged pregnant individuals.

CRedit authorship contribution statement

Zhong Li: Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Curisa M. Tucker:** Writing – review & editing, Validation, Investigation. **Cassie L. Odahowski:** Writing – review & editing, Validation, Investigation, Conceptualization. **Kacey Y Eichelberger:** Writing – review & editing, Investigation, Funding acquisition, Conceptualization. **Jiajia Zhang:** Writing – review & editing, Validation, Supervision, Project administration, Investigation, Data curation, Conceptualization. **Peiyin Hung:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Investigation, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

We declared no conflicts of interest.

Acknowledgments

This research was supported by the Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (HHS), Rural Health Research Grant Program Cooperative Agreement (grant number: 7U1CRH45498-01). This study is also made possible from the support of the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), National Institutes of Health under the grant number U01HD110062. The contents are those of the author(s) and do not necessarily represent the official views of, nor an endorsement, by HRSA/HHS, NICHD/NIH, or the U.S. Government. The information, conclusions, and opinions expressed in this article are those of the authors, and no endorsement by

any of the aforementioned entities is intended or should be inferred. Dr. Zhong Li was supported by the Excellent Innovation Team of the Philosophy and Social Sciences in the Universities and Colleges of Jiangsu Province, the Public Health Policy and Management Innovation Research Team.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2024.115820](https://doi.org/10.1016/j.psychres.2024.115820).

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