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Rural–urban differences in substance use during pregnancy

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Abstract

Purpose: Drug overdoses are now a leading cause of pregnancy-related deaths in the United States. Despite evidence of rural–urban disparities in substance use, there has not yet been a nationally representative examination of rural–urban differences in perinatal substance use. This study provides a comprehensive examination of rural–urban disparities in perinatal substance use.

Methods: This study uses cross-sectional data to examine 3499 pregnant women from the 2015–2019 National Survey on Drug Use and Health (NSDUH). Rural (nonmetro)–urban (metro) differences in past-month tobacco use, alcohol use, binge drinking, illicit drug use, and marijuana use were examined using Rao–Scott chi-square tests and multivariable logistic regression using complex survey weights.

Findings: In 2015–2019, past-month tobacco use varied geographically, as rural pregnant participants were more likely to have used tobacco than those in small and large urban areas (24.7% vs. 15.2% and 8.2%, respectively, $p < 0.0001$). After controlling for sociodemographic and health care needs, rural pregnant women were more likely to report tobacco use (adjusted odds ratio [aOR]: 2.32, 95% confidence interval [CI]: 1.66, 3.25) but were less likely to report alcohol use (aOR: 0.58, 95% CI: 0.34, 0.98) than their large urban counterparts. There were no rural–urban differences in the odds of binge drinking, illicit drug use, or marijuana-only use in the past month.

Conclusions: Geographic variations in perinatal substance use highlight the need for tailored interventions targeting substance use prevention during pregnancy, prioritizing tobacco in rural areas and alcohol in urban areas.

KEYWORDS
alcohol use, perinatal health, pregnancy, substance use, tobacco use

INTRODUCTION

Maternal mortality rates in the United States have risen in recent years,[1] and now, the United States's maternal mortality rate is three times that of most developed countries.[2] When looking at maternal mortality rates among rural and urban areas in the United States, this gap widens as 37.9 pregnancy-related deaths per 100,000 in rural areas compared to 31.2 pregnancy-related deaths in urban areas.[2] Currently, approximately 18 million women of reproductive age live in rural communities throughout the United States, and nearly 500,000 rural women give birth every year.[3,4] The experiences and outcomes of rural pregnant women are significantly different than

those of their urban counterparts. In general, rural residents have higher poverty rates and lower educational attainment. Moreover, evidence has shown that pregnant women in rural areas are more likely to have adverse outcomes compared to urban pregnant women.[5,6] Rural pregnant women are more likely to delay initiation of prenatal care, experience perinatal depression,[3,7] and have a higher probability of severe maternal morbidity and admission to intensive care units.[8] Residents in rural areas are also more likely to have a higher abbreviated preconception health risk index, which assesses risk factors for poor nutrition, influenza vaccination rates, and prepregnancy weight.[9] Therefore, the risk of pregnancy-related mortality is greater in rural populations when compared to urban.[8,10,11]

Substance use among pregnant women is a growing concern in the United States as drug overdoses are now one of the leading causes of pregnancy-related deaths in the United States.[12] From 2010 to 2021, there have been significant increases in both opioid-related diagnoses in perinatal populations and in pregnancy-associated overdose mortality rates.[13,14] Substance use during pregnancy and breastfeeding has health implications for both mother and infant; infants with mothers who used substances during pregnancy are more likely to be admitted to the neonatal intensive care unit, be stillborn, have neonatal abstinence syndrome (NAS), and experience Sudden Infant Death Syndrome.[15–17] Additionally, individuals who use substances during pregnancy are at an increased risk of dying or experiencing pregnancy-related complications, such as cardiac arrest, placental abruption, and preterm births.[16–18]

Rural–urban disparities in substance use and substance use disorders (SUDs) in the overall population have been well documented, with rural residents disproportionately affected by drug overdose deaths.[19] Several studies conducted on a single state or single region have shown a continued increase in both maternal opioid use disorder (OUD) and NAS among rural residents,[20] where NAS rates in rural areas have increased by more than double those in urban, non-Appalachian counties.[21] In addition to existing rural–urban differences in NAS rates, rural pregnant women were more likely to report tobacco use but less likely to report alcohol use than their urban counterparts.[22] While these studies highlight rural–urban differences in maternal substance use, their focus on a single state or region limits their generalizability to the entire nation. Given the increasing number of states reporting overdose as a leading cause of pregnancy-related death, an updated study of data from all 50 states is needed.[11,21–26]

An established body of evidence has documented negative consequences of substance use during pregnancy and an increase in polysubstance use[27] and opioid use[20,28] in rural pregnant women. Yet, there has not been a nationally representative study examining rural–urban differences in the prevalence and correlates of multiple types of substance use during pregnancy in recent years. Understanding geographic differences in these outcomes is essential for targeting programming and resources aimed at reducing perinatal substance use. Therefore, this study aims to analyze rural–urban differences in perinatal substance use using data from 5 years (2015–2019) of the National Survey on Drug Use and Health (NSDUH).

METHODS

Data source and sample population

Data for this study consist of five years (2015–2019) of survey responses from the NSDUH, a yearly, nationally representative, cross-sectional survey.[29–33] NSDUH collects data on mental health, substance use, and health care service utilization from noninstitutionalized civilians aged 12 years and older across all 50 US states and Washington, D.C.[29–33] Respondents consist of household members, those living in noninstitutional group homes, and civilians living on military bases.[29–33] Active duty military personnel, unhoused people who do not use shelters, and those living in jails or hospitals are not included.[29–33] Given the focus on a small subset of this population (rural pregnant women and pregnant women who use substances during pregnancy), the sample size of individual years was limited.[34–38] Therefore, data from multiple years were combined to ensure a sufficiently large sample size for complex analysis. Data from 2020 onward are not able to be pooled with older data due to changes in data collection methods due to restrictions imposed by the COVID-19 pandemic.[39]

Between 2015 and 2019, 227,519 people participated in NSDUH. Of these participants, 132,182 were excluded from the sample because they identified as male; NSDUH only asks participants who identify as female about their pregnancy status (Figure 1). A further 141,744 respondents were removed from the sample because they were not pregnant. Of the pregnant participants, 116 were removed because they were adolescents; certain variables of interest for this study are only asked of participants who are at least 18 years old. Thirty-three adult pregnant participants were removed from the sample due to missing responses on self-reported health status, leaving a final total of 3444 pregnant adult women with complete information for all variables of interest in the main analytic sample.

Measures

The independent variable for this study is rural residence defined at the county level using assigned variables from NSDUH (large metro, small metro, or nonmetro), which are based on the 2013 Rural/Urban Continuum codes.[34–38] Large and small metro are referred to as large and small urban, respectively, and nonmetro is referred to as rural. Participants were classified as living in a large urban, small urban, or rural county. The dependent variables for this study include past-month tobacco use, alcohol use, illicit drug use (including all illicit drug use and marijuana only use), and binge drinking. While SUD in adults is typically diagnosed based on a 12-month period, given small sample sizes in SUD measures for this population of interest, past-month use measures were selected in accordance with guidelines published by the American College of Obstetricians and Gynecologists (ACOG) to discontinue any use during pregnancy based on potential adverse health outcomes for the mother and child.[40,41] Past-month use also aligns with recommendations to use lower thresholds for screening

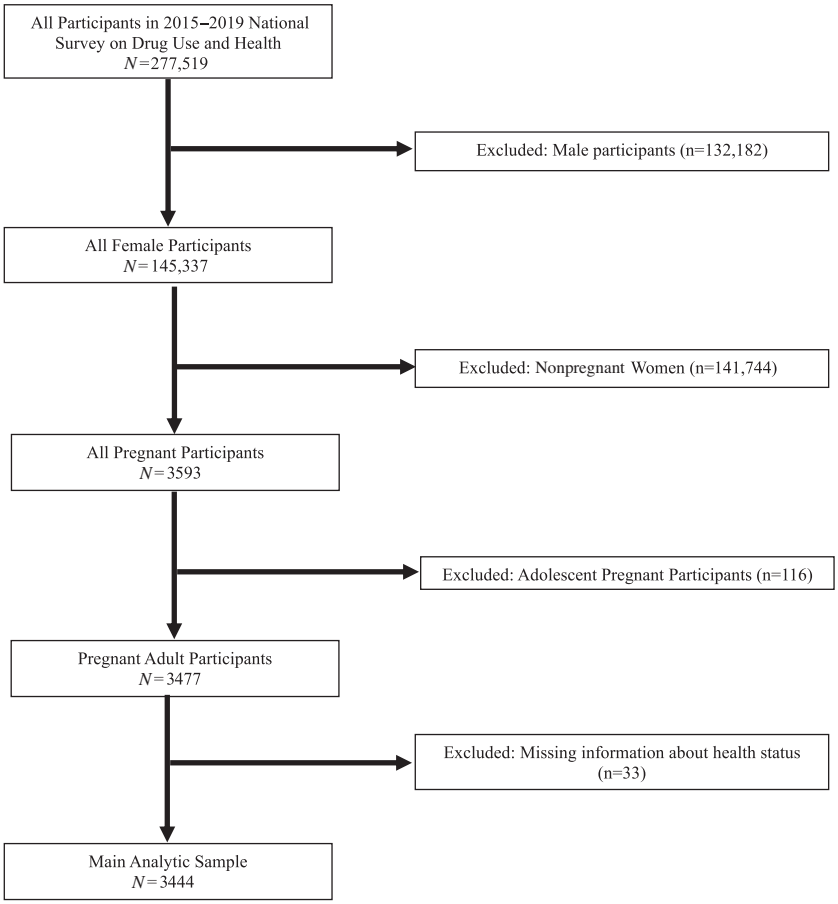

FIGURE 1 Derivation of the main analytic sample.

pregnant women as compared to nonpregnant women.[42] Participants were identified as using these substances if they reported using them at least once within the past month. Binge drinking was defined as having four or more drinks on the same occasion at least one time in the past 30 days.[34–38] Given small sample sizes for individual illicit drugs, this study included the illicit drug use variable, which was defined as the use of marijuana, cocaine (including crack), heroin, hallucinogens, inhalants, and methamphetamine, as well as the misuse of prescription stimulants, tranquilizers, sedatives, and pain relievers.[29–33] Participants were identified as having only used marijuana in the past month if marijuana was the only illicit drug that they reported using in the past 30 days.[34–38] All dependent variables were captured as a dichotomous yes/no variable.

Covariates

Covariates were selected according to Andersen's Model of Healthcare Utilization and were identified to be predisposing (demographic), need (health conditions), or enabling (resource availability).[43] Predisposing factors include race/ethnicity, age, educational attainment, and marital status. Need factors include past year mental illness, general health status, and trimester of pregnancy. Enabling factors include perceived unmet need for mental health care, insurance status, employment status, and annual household income. All covariates were self-reported.[34–38]

Analysis

In order to mitigate the impact of sampling and nonresponse biases and to ensure a nationally representative data set, NSDUH utilizes design weighting.[29–33] All guidelines regarding design, sample weights, and using multiple years of data were followed for all analyses. Statistical analyses were completed using SAS 9.4 and a significance level of 0.05.

To evaluate differences in sample characteristics and substance use between respondents, bivariate analysis and Rao–Scott chi-square tests were used. To assess the odds of each type of past-month substance use, multivariable logistic regressions were used. All models were adjusted for the survey year and the previously discussed predisposing, need, and enabling factors. This research was deemed exempt by the IRB at the University of South Carolina.

RESULTS

Of the 3444 pregnant respondents analyzed in this study, 1463 lived in large urban counties, 1255 lived in small urban counties, and 726 lived in rural counties. Urban and rural did not differ by survey year, employment status, marital status, health status, past year mental illness, or trimester of pregnancy (Table 1). The majority of respondents were employed (61.1%), were unmarried (51.4%), had good, very good, or excellent health (94.7%), and had no mental illness in the

TABLE 1 Rural–urban differences in the sample characteristics of adult pregnant participants, 2015–2019 National Survey on Drug Use and Health ($n = 3444$).

	Rurality				
	Overall	Large urban	Small urban	Rural	
Characteristic	3444	1463	1255	726	
Total (*N*)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*p*-value
Survey year					0.15
2015	738 (19.9)	323 (20.3)	251 (16.9)	164 (25.0)	
2016	678 (19.7)	289 (20.0)	252 (19.3)	137 (18.9)	
2017	693 (20.4)	293 (20.4)	254 (21.6)	146 (17.4)	
2018	717 (21.8)	317 (22.1)	259 (22.6)	141 (18.7)	
2019	618 (18.2)	241 (17.1)	239 (19.6)	138 (19.9)	
Race/ethnicity					<0.0001
Non-Hispanic White	1841 (55.7)	618 (47.9)	719 (61.6)	504 (75.2)	
Non-Hispanic Black	542 (15.3)	299 (17.6)	182 (13.1)	61 (10.4)	
Hispanic	687 (19.6)	370 (22.7)	240 (18.8)	77 (8.4)	
Non-Hispanic other races	374 (9.4)	176 (11.9)	114 (6.5)	84 (5.9)	
Age					<0.0001
18–25 years old	1673 (31.6)	619 (26.5)	642 (36.0)	412 (43.6)	
26–44 years old	1771 (68.4)	844 (73.5)	613 (64.0)	314 (56.4)	
Education					<0.0001
Less than high school	497 (11.8)	200 (10.5)	179 (12.9)	118 (15.0)	
High school graduate	964 (23.3)	367 (20.4)	369 (26.3)	228 (28.6)	
Some college or associate's degree	1072 (30.3)	420 (28.8)	416 (31.5)	236 (34.0)	
College graduate	911 (34.6)	476 (40.3)	291 (29.4)	144 (22.3)	
Health insurance status					0.005
Insured	3209 (93.3)	1375 (94.7)	1167 (92.2)	667 (89.9)	
Uninsured	235 (6.7)	88 (5.3)	88 (7.8)	59 (10.1)	
Annual household income					<0.0001
Less than $20,000	794 (18.2)	302 (15.4)	289 (21.1)	203 (23.7)	
$20,000–$49,000	1213 (31.0)	471 (28.5)	469 (32.4)	273 (38.6)	
$50,000–$74,999	515 (16.7)	214 (16.9)	195 (16.9)	106 (15.1)	
$75,000 or more	922 (34.1)	476 (39.1)	302 (29.6)	144 (22.6)	
Employment status					0.24
Employed	2007 (61.1)	878 (62.4)	705 (58.7)	424 (61.2)	
Unemployed	1437 (38.9)	585 (37.6)	550 (41.3)	302 (38.8)	
Marital status					0.09
Married	1445 (48.6)	617 (49.8)	550 (49.2)	278 (42.2)	
Unmarried	1999 (51.4)	846 (50.2)	705 (50.8)	448 (57.8)	
Perceived unmet mental health care needs					0.002
Yes	265 (7.4)	92 (6.2)	106 (8.1)	67 (11.0)	
No	3179 (92.6)	1371 (93.8)	1149 (91.9)	659 989.0)	
General health status					0.16
Good, very good, or excellent	3228 (94.7)	1380 (95.5)	1168 (93.6)	680 (93.3)	
Fair or poor	216 (5.3)	83 (4.5)	87 (6.4)	46 (6.7)	
Past year mental illness					0.30
No mental illness	2746 (80.3)	1189 (81.5)	998 (80.0)	559 (76.1)	

(Continues)

TABLE 1 (Continued)

	Rurality				
	Overall	Large urban	Small urban	Rural	
Characteristic	3444	1463	1255	726	
Total (*N*)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*p*-value
Mild mental illness	319 (8.8)	134 (8.6)	117 (8.6)	68 (9.8)	
Moderate mental illness	190 (8.8)	79 (5.9)	63 (5.8)	48 (6.6)	
Severe mental illness	189 (6.0)	61 (4.0)	77 (5.6)	51 (7.5)	
Trimester					0.07
First trimester	1090 (31.6)	471 (32.9)	387 (29.4)	232 (31.2)	
Second trimester	1256 (36.7)	541 (36.8)	482 (39.0)	233 (31.2)	
Third trimester	1098 (31.7)	451 (30.3)	386 (31.7)	261 (37.6)	

past year (80.3%). Compared to large and small urban participants, rural participants were more likely to be non-Hispanic White, younger, less educated, and uninsured; to have a lower income; and to have a perceived unmet mental health care need.

Overall, tobacco use during pregnancy was the most prevalent, with 12.5% reporting past-month use, followed by alcohol use (9.5%), illicit drug use (6.1%), marijuana-only use (4.6%), and binge drinking (4.3%). By residence, rural participants were more likely to have used tobacco in the past month than small and large urban participants (24.7% vs. 15.2% and 8.2%, respectively; Table 2). There were no differences in past-month alcohol use, binge drinking, illicit drug use, or marijuana-only use by rurality.

After adjusting for other participant characteristics (Table 3), rural–urban differences in tobacco use and alcohol use remain. There were no rural–urban differences in binge drinking, illicit drug use, or marijuana-only use in adjusted models. Compared to large urban residents, both small (adjusted odds ratio [aOR]: 1.54, 95% confidence interval [CI]: 1.09, 2.18) and rural (aOR: 2.32, 95% CI: 1.66, 3.25) residents had greater odds of tobacco use. Rural residents had lower odds (aOR: 0.58, 95% CI: 0.34, 0.98) of past-month alcohol use than large urban residents, but there was no difference between large and small urban residents (aOR: 0.76, 95% CI: 0.51, 1.15). When looking at differences among survey years, participants had greater odds of tobacco use in 2017 and 2018 compared to earlier years (aOR: 2.04, 95% CI: 1.32, 3.14 and aOR: 1.74, 95% CI: 1.07, 2.84, respectively) and a lower odds of illicit drug use and marijuana-only use in 2015 (aOR: 0.32, 95% CI: 0.15, 0.67 and aOR: 0.27, 95% CI: 0.12, 0.61, respectively). There were no differences over time for alcohol use and binge drinking.

There were no racial/ethnic differences in the odds of past-month alcohol use or binge drinking, but when compared to non-Hispanic White participants, all racial/ethnic minority participants had lower odds of tobacco use. Hispanic participants had lower odds of illicit drug (aOR: 0.37, 95% CI: 0.19, 0.73) and marijuana-only use (aOR: 0.24, 95% CI: 0.11, 0.54), but there were no other racial/ethnic differences in these outcomes.

Younger participants had greater odds of binge drinking (aOR: 1.65, 95% CI: 1.01, 2.69) and marijuana-only use in the past month (aOR: 1.80, 95% CI: 1.14, 2.84) than older participants, but there were no other differences by age category. Higher educational attainment was associated with lower odds of some forms of substance use; participants with some college or an associate's degree had lower odds of tobacco use (aOR: 0.50, 95% CI: 0.30, 0.82) than participants with less than a high school education. College graduates also had lower odds of tobacco use (aOR: 0.17, 95% CI: 0.08, 0.36). Compared to married participants, unmarried participants had greater odds of tobacco use (aOR: 2.92, 95% CI: 1.95, 4.35), binge drinking (aOR: 2.04, 95% CI: 1.11, 3.75), illicit drug use (aOR: 3.07, 95% CI: 1.85, 5.08), and marijuana-only use (aOR: 3.14, 95% CI: 1.84, 5.38).

Health insurance status was not associated with any type of past-month substance use, and annual household income was only associated with past-month tobacco use. The odds of tobacco use were inversely related to household income; compared to those with a household income of $75,000 or more a year, those with an income of less than $20,000 per year had more than 2.5 times the odds of using tobacco (aOR: 2.51, 95% CI: 1.56, 3.73). Similarly, current employment status was only associated with tobacco use. Unemployed participants had greater odds (aOR: 1.44, 95% CI: 1.07, 1.92) of past-month tobacco use than employed participants.

Participants who reported a perceived unmet mental health care need had greater odds of tobacco use (aOR: 1.89, 95% CI: 1.16, 3.09) and illicit substance use (aOR: 2.10, 95% CI: 1.23, 3.61) than those without a perceived unmet need. General health status was not associated with any type of past-month substance use. Compared to those with no past year mental illness, participants with moderate mental illness had greater odds of tobacco use (aOR: 2.70, 95% CI: 1.71, 4.27), illicit drug use (aOR: 2.37, 95% CI: 1.25, 4.47), and marijuana-only use (aOR: 1.84, 95% CI: 1.01, 3.34). Similarly, those with severe mental illness had greater odds of tobacco use (aOR: 2.03, 95% CI: 1.24, 3.32), illicit drug use (aOR: 3.55, 95% CI: 2.00, 6.29), and marijuana-only use (aOR: 2.65, 95% CI: 1.34, 5.21) than those with no mental illness in the past year. Being in the first trimester of pregnancy was associated with all forms of substance use; compared to those in the third trimester, participants in the first trimester had greater odds of tobacco use (aOR: 1.97, 95% CI: 1.38, 2.80), alcohol use (aOR: 5.52, 95% CI: 3.43, 8.89), binge

TABLE 2 Rural–urban differences in the prevalence of substance use among pregnant adults, 2015–2019 National Survey on Drug Use and Health ($n = 3444$).

	Rurality				
	Overall	Large urban	Small urban	Rural	
Characteristic	3444	1690	1408	806	
Total (*N*)	*N* (%)	*N* (%)	*N* (%)	*N* (%)	*p*-value
Past-month tobacco use					<0.0001
Yes	518 (12.5)	141 (8.2)	207 (15.2)	170 (24.7)	
No	2926 (87.5)	1322 (91.8)	1048 (84.8)	556 (75.3)	
Past-month alcohol use					0.18
Yes	320 (9.5)	147 (10.5)	117 (8.6)	56 (7.3)	
No	3124 (90.5)	1316 (89.5)	1138 (91.4)	670 (92.7)	
Past-month binge drinking[a]					0.54
Yes	163 (4.3)	68 (4.0)	58 (4.3)	37 (5.4)	
No	3281 (95.7)	1395 (96.0)	1197 (95.7)	689 (94.6)	
Past-month illicit drug use[b]					0.31
Yes	248 (6.1)	91 (5.6)	99 (6.8)	58 (7.0)	
No	3196 (93.9)	1372 (94.4)	1156 (93.2)	668 (93.0)	
Past-month marijuana-only use[c]					0.36
Yes	198 (4.6)	74 (4.2)	77 (4.8)	47 (5.8)	
No	3246 (95.4)	1389 (95.8)	1178 (95.2)	679 (94.2)	

[a]Past-month binge drinking was defined as having four or more drinks on the same occasion at least once in the past 30 days.
[b]Illicit drug use is defined as the use of marijuana, cocaine (including crack), heroin, hallucinogens, inhalants, and methamphetamine, as well as the misuse of prescription stimulants, tranquilizers, sedatives, and pain relievers.
[c]Participants were identified as having only used marijuana in the past month if marijuana was the only illicit drug that they reported using in the past 30 days.

drinking (aOR: 12.70, 95% CI: 5.74, 28.11), illicit drug use (aOR: 2.28, 95% CI: 1.52, 3.42), and marijuana-only use (aOR: 2.30, 95% CI: 1.49, 3.56).

DISCUSSION

This national cross-sectional study extends previous statewide literature and uncovered that one in six US pregnant women used tobacco, one in 10 drank alcohol, and one in 13 used an illicit drug in the past month. By residence, rural pregnant residents had greater odds of any past-month tobacco use, with tobacco use increasing over time, whereas urban pregnant women had higher odds of past-month alcohol use. Binge drinking, illicit drug use, or marijuana-only use in the past month was less common among pregnant women than tobacco and alcohol use, with no significant differences between urban and rural residents. Our findings on the rural–urban differences in tobacco and alcohol use at the national level are consistent with previous state-level literature for both the general population and for pregnant populations. Prior studies have found higher rates of smoking and lower rates of alcohol use among rural residents in general.[44,45] A Maine-based study examining substance use among pregnant women also found higher rates of tobacco use and lower rates of alcohol use in rural communities.[22]

We found that there were greater odds of any past-month tobacco use in rural pregnant women than urban pregnant women and that tobacco use in pregnant women increased during this time period. These findings have implications on the health and well-being of rural children as studies have shown both short- and long-term associations between maternal tobacco use during pregnancy and adverse health outcomes for the child; some of these adverse outcomes include an increased risk of low birth weights,[46] a reduction in brain sizes and functions,[47] lower heart rate variability in utero,[48] an increased risk of childhood obesity,[49] and deficits in childhood neurocognitive development seen with a decreased language and memory development.[50] Given these short- and long-term health effects, providers should implement recommendations by the ACOG related to tobacco cessation during pregnancy that include advising patients of the risks of tobacco use during pregnancy and providing screening and intervention to connect patients with necessary individualized treatment.[41,51]

When examining rural–urban differences in tobacco cessation treatment, previous research has emphasized that tobacco cessation programs and interventions that have worked in urban settings do not always work as effectively in rural settings.[52] These findings, in combination with the rural–urban disparities in perinatal tobacco use noted in this study, highlight the need for interventions targeted toward and tailored for rural birthing people. Additionally, interventions must be safe for both the mother and the child; certain nicotine replacement

TABLE 3 Adjusted odds ratios of substance use among adult pregnant women.

	Past-month substance use				
Characteristic	Tobacco use aOR (95% CI)	Alcohol use aOR (95% CI)	Binge drinking[a] aOR (95% CI)	Illicit drug use[b] aOR (95% CI)	Marijuana-only use[c] aOR (95% CI)
Residence					
Large urban	Reference	Reference	Reference	Reference	Reference
Small urban	1.54 (1.09, 2.18)	0.76 (0.51, 1.15)	1.03 (0.62, 1.71)	0.99 (0.69, 1.42)	0.91 (0.60, 1.38)
Rural	2.32 (1.66, 3.25)	0.58 (0.34, 0.98)	1.21 (0.58, 2.52)	0.77 (0.44, 1.35)	0.86 (0.44, 1.65)
Survey year					
2015	1.10 (0.64, 1.60)	0.77 (0.46, 1.31)	0.65 (0.31, 1.35)	0.32 (0.15, 0.67)	0.27 (0.12, 0.61)
2016	1.38 (0.81, 2.35)	0.88 (0.53, 1.49)	0.83 (0.43, 1.62)	1.11 (0.57, 2.16)	0.85 (0.42, 1.74)
2017	2.04 (1.32, 3.14)	1.03 (0.58, 1.84)	0.84 (0.40, 1.77)	1.45 (0.78, 2.67)	1.27 (0.65, 2.49)
2018	1.74 (1.07. 2.84)	1.10 (0.70, 1.73)	1.06 (0.52, 2.18)	0.89 (0.46, 1.71)	0.79 (0.40, 1.57)
2019	Reference	Reference	Reference	Reference	Reference
Race/ethnicity					
Non-Hispanic White	Reference	Reference	Reference	Reference	Reference
Non-Hispanic Black	0.33 (0.21, 0.52)	1.55 (1.00, 2.39)	1.49 (0.80, 2.78)	0.90 (0.54, 1.51)	0.98 (0.56, 1.69)
Hispanic	0.19 (0.11, 0.35)	0.68 (0.39, 1.20)	1.09 (0.51, 2.34)	0.37 (0.19, 0.73)	0.24 (0.11, 0.54)
Non-Hispanic other races	0.54 (0.33, 0.89)	0.75 (0.39, 1.46)	0.93 (0.39, 2.24)	0.83 (0.34, 1.99)	0.81 (0.30, 2.19)
Age					
18–25 years old	0.89 (0.62, 1.28)	1.14 (0.79, 1.64)	1.65 (1.01, 2.69)	1.42 (0.97, 2.09)	1.80 (1.14, 2.84)
26–44 years old	Reference	Reference	Reference	Reference	Reference
Education					
Less than high school	Reference	Reference	Reference	Reference	Reference
High school graduate	0.88 (0.56, 1.37)	0.85 (0.49, 1.50)	0.77 (0.39, 1.50)	0.77 (0.47, 1.28)	0.84 (0.48, 1.47)
Some college or associate's degree	0.50 (0.30, 0.82)	0.89 (0.45, 1.76)	0.69 (0.36, 1.30)	0.88 (0.55, 1.42)	0.85 (0.48, 1.49)
College graduate	0.17 (0.08, 0.36)	1.03 (0.53, 2.00)	1.38 (0.60, 3.14)	0.67 (0.34, 1.34)	0.57 (0.28, 1.17)
Health insurance status					
Insured	Reference	Reference	Reference	Reference	Reference
Uninsured	1.13 (0.66, 1.92)	1.03 (0.57, 1.84)	1.24 (0.58, 2.62)	1.49 (0.77, 2.87)	1.23 (0.60, 2.53)
Annual household income					
Less than $20,000	2.51 (1.56, 3.73)	0.70 (0.41, 1.18)	0.81 (0.44, 1.50)	0.97 (0.58, 1.62)	0.97 (0.63, 1.49)
$20,000–$49,000	2.41 (1.56, 3.73)	0.82 (0.49, 1.37)	0.79 (0.44, 1.40)	1.01 (0.60, 1.70)	0.94 (0.60, 1.48)
$50,000–$74,999	2.19 (1.14, 4.23)	0.86 (0.55, 1.36)	0.54 (0.27, 1.09)	1.10 (0.60, 2.04)	1.35 (0.73, 2.52)
$75,000 or more	Reference	Reference	Reference	Reference	Reference
Employment status					
Employed	Reference	Reference	Reference	Reference	Reference
Unemployed	1.44 (1.07, 1.92)	0.83 (0.58, 1.19)	0.90 (0.53, 1.52)	1.32 (0.92, 1.91)	1.36 (0.93, 1.99)
Marital status					
Married	Reference	Reference	Reference	Reference	Reference
Unmarried	2.92 (1.95, 4.35)	1.39 (0.97, 1.99)	2.04 (1.11, 3.75)	3.07 (1.85, 5.08)	3.14 (1.84, 5.38)
Perceived unmet mental health care needs					
Yes	1.89 (1.16, 3.09)	1.79 (0.97, 1.99)	1.42 (0.76, 2.68)	2.10 (1.23, 3.61)	1.61 (0.96, 2.70)
No	Reference	Reference	Reference	Reference	Reference
General health status					
Good, very good, or excellent	Reference	Reference	Reference	Reference	Reference

(Continues)

TABLE 3 (Continued)

	Past-month substance use				
	Tobacco use	Alcohol use	Binge drinking[a]	Illicit drug use[b]	Marijuana-only use[c]
Characteristic	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Fair or poor	1.67 (0.91, 3.05)	1.87 (0.99, 3.52)	1.95 (0.93, 4.07)	1.37 (0.78, 2.40)	1.87 (0.99, 3.52)
Past year mental illness					
No mental illness	Reference	Reference	Reference	Reference	Reference
Mild mental illness	1.25 (0.75, 2.09)	1.21 (0.76, 1.95)	1.70 (0.91, 3.18)	1.39 (0.71, 2.70)	1.30 (0.67, 2.55)
Moderate mental illness	2.70 (1.71, 4.27)	1.36 (0.65, 2.88)	1.37 (0.57, 3.30)	2.37 (1.25, 4.47)	1.84 (1.01, 3.34)
Severe mental illness	2.03 (1.24, 3.32)	2.00 (0.87, 4.60)	2.14 (0.83, 5.51)	3.55 (2.00, 6.29)	2.65 (1.34, 5.21)
Trimester					
First trimester	1.97 (1.38, 2.80)	5.52 (3.43, 8.89)	12.70 (5.74, 28.11)	2.28 (1.52, 3.42)	2.30 (1.49, 3.56)
Second trimester	1.34 (0.92, 1.93)	1.24 (0.72, 2.14)	2.01 (0.96, 4.23)	1.00 (0.69, 1.70)	0.91 (0.54, 1.54)
Third trimester	Reference	Reference	Reference	Reference	Reference

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval.
[a]Past-month binge drinking was defined as having four or more drinks on the same occasion at least once in the past 30 days.
[b]Illicit drug use is defined as the use of marijuana, cocaine (including crack), heroin, hallucinogens, inhalants, and methamphetamine, as well as the misuse of prescription stimulants, tranquilizers, sedatives, and pain relievers.
[c]Participants were identified as having only used marijuana in the past month if marijuana was the only illicit drug that they reported using in the past 30 days.

therapies/medications have not been conclusively proven to meet this criteria.[53] Previous research has found that both poverty and educational attainment are associated with smoking during pregnancy[54]; rural participants in this study had lower household incomes and were less educated than their urban counterparts, which may offer an explanation for geographic disparities in past-month tobacco use. Further research is needed to explore how these structural determinants of health are impacting rural–urban differences in perinatal tobacco use.

We also found that there were lower odds of any past-month alcohol use for rural pregnant women when compared to urban pregnant women. However, it is possible that alcohol use may be underreported in household surveys such as NSDUH, particularly among rural respondents who may have greater concerns about perceived stigma.[55] Rural–urban differences in willingness to report alcohol consumption may contribute to the geographic disparities in past-month alcohol use noted in this study. Despite the risk of underreporting, this study's findings on rural–urban differences in alcohol use during pregnancy have health implications for both the pregnant woman and the child living in urban areas, given the risk of poor pregnancy outcomes for the mother[56] and the increased risks of being stillborn, developmental deficits, and fetal alcohol spectrum disorder for the child.[57]

Therefore, providers should continue to screen their patients for alcohol use during pregnancy so they can refer patients to treatment if needed. While alcohol screening has proven to be cost-effective and evidence based to provide early identification,[58] there are significant barriers that may prevent pregnant individuals from disclosing their alcohol use to their health providers. Particularly concerning barriers include stigma and fear of detection by health or criminal justice authorities, which could result in losing custody of their children or being imprisoned; as a result, pregnant rural women may be less likely to report illicit substance use or seek care.[59,60]

Individuals are often highly motivated to quit their substance use during pregnancy; prior studies have shown that of women who smoked, nearly 45% quit smoking during their pregnancy,[61] and one of the biggest motivators for engaging in treatment or quitting altogether is the health and well-being of their baby.[42] While treatment for substance use during pregnancy is associated with better perinatal outcomes, pregnant women face obstacles that often prevent them from ever seeking treatment and receiving this care.[62] Prior research has shown that pregnant women with SUD are less likely to be accepted for treatment than nonpregnant women and that pregnant women often face stigma, lack of suitable treatment options, and fear of detection.[59,60]

While this study found no rural–urban differences in the odds of past-month binge drinking, illicit drug use, or marijuana use among pregnant women, rural pregnant women face greater challenges in accessing substance use treatment when compared to their urban counterparts.[62–65] In addition to the existing barriers to substance use treatment for pregnant individuals, rural residents also have less access to available treatment.[63] Indeed, rural peripartum women with OUD have lower odds of receiving medication treatment than their urban counterparts.[62] Thus, the findings on no rural–urban differences in the odds of past-month binge drinking, illicit drug use, or marijuana use among pregnant women still have important implications, given the limited access to treatment for pregnant women living in a rural area. Additionally, previous studies have shown that rural hospitals are less likely to offer medication for OUD or addiction consulting services in emergency department or inpatient settings than urban hospitals, and physicians working in rural areas report higher levels of

bias toward patients with OUD than urban physicians.[64,65] As a result, rural pregnant women often face layered barriers around access, service availability, and stigma in initiating and engaging in substance treatment, which should be considered when targeting efforts to improve rural perinatal substance use.[66]

Recent federal legislation holds promise for improving access to substance use care for rural pregnant women.[67] Now, health care practitioners must undergo an 8-h training on the treatment of SUD and no longer are required to have a waiver to prescribe buprenorphine, the gold standard of treatment for perinatal SUD.[67] While these recent legislative changes may help improve access to medication treatment for peripartum individuals with SUD, rural providers are often limited in whom they can refer patients to within a reasonable driving distance; therefore, other efforts that can assist rural perinatal populations in accessing treatment given these limitations, such as providing transportation to and from care, providing childcare support services, or having mobile treatment units within the rural communities,[68] may be possible considerations for rural perinatal populations needing substance use treatment.

Strengths and limitations

This study's strengths include the nationally representative design of NSDUH, which ensures that this study is generalizable to the noninstitutionalized civilian population of the United States.[29–33] The study extends previous literature by its national scope.[21,22] There are several limitations to this study. First, this study focuses on rural pregnant women who use substances, which resulted in a small sample size for the years of interest, and as a result, we were unable to look at SUD treatment through the NSDUH data. Additionally, given small sample sizes in some individual substances, illicit drug use was pooled together. Drug and alcohol use were examined, rather than SUD, due to small sample sizes. While organizations such as ACOG highlight that there is no safe limit for substance use during pregnancy,[40,41] it is possible that this study captures those who use substances minimally or very infrequently, rather than those who meet the formal diagnostic criteria for SUD. While the focus of this study is on rural–urban differences in substance use during pregnancy, it is possible that there are differences in initiation and engagement to SUD treatment that we were unable to account for. Small sample sizes also resulted in the need to pull from multiple years of older data.

Because of changes in data collection methods, pre- and peri-COVID-19 NSDUH data cannot be compared[39]; therefore, it was not possible to examine trends since COVID-19. Given the increasing rates of substance use during the pandemic,[69] it is likely that this study underestimates the current use and associated risks, yet it is unknown whether the increasing rates and trends in substance use following the pandemic are similar for rural and urban areas; this limitation highlights the need for ongoing surveillance and future studies incorporating temporal trends. NSDUH is a cross-sectional survey, so causality and temporality cannot be examined.[29–33] All NSDUH data are self-reported and subject to recall and social desirability biases.[29–33] This is of particular concern for this study, as substance use during pregnancy is likely to be underreported due to concerns about the consequences of disclosure.[60] Additionally, pregnant people may misclassify their substance use, particularly tobacco use, even when biochemical measures are used to validate self-reported responses.[70] Future studies should consider using a biochemical measurement of substance use, such as urine or blood testing, to validate self-reported substance use and to calculate a more accurate estimate of substance use. Finally, state-level identifiers are not included in publicly available NSDUH data, so there can be no adjustment for states in analyses, nor can state-level estimates be created.[29–33] Future research that can adjust for states in analyses may be able to explore how state legislative changes may be impacting rural–urban differences in maternal tobacco or marijuana use, for example.

CONCLUSION

Between 2015 and 2019, rural pregnant women were more likely to have used tobacco in the past month but were less likely to have consumed alcohol in the past month when compared to their urban counterparts. These findings highlight the need for targeted intervention aimed at preventing or decreasing perinatal tobacco use among rural pregnant women and alcohol use among urban pregnant women. Particular emphasis should be placed on the promotion of evidence-based programs that are known to be effective for tobacco cessation in rural communities and alcohol cessation in urban communities. Rural residents, and in particular, rural pregnant women, continue to face unique challenges when attempting to access substance use treatment. Ongoing surveillance is needed to investigate geographic disparities in perinatal substance use treatment to better inform community efforts. More importantly, given the prevalent tobacco and alcohol use during pregnancy, preventive efforts, screening, treatment, and recovery services should be a priority for public health and behavioral health stakeholders to help ensure healthy outcomes for mothers and their babies.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data are publicly available for download from the CDC's National Health Interview Survey.

ETHICS STATEMENT

Informed consent was not required as this study was based on publicly available data. The Institutional Review Board at the University of South Carolina approved this research.

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