

Differences in outpatient, emergency, and inpatient use among pregnant women with a substance-related diagnosis



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BACKGROUND: As a vulnerable population, pregnant women with a substance-related diagnosis (ie, substance use, misuse, or dependence) may use healthcare disproportionately.

OBJECTIVE: The primary goal of this study was to evaluate the differences in the use of outpatient clinical visits, emergency department visits, and inpatient days in the hospital among women with and without a substance-related diagnosis during the antepartum period.

STUDY DESIGN: This retrospective study retrieved electronic health record data on women (age, 18–44 years) who delivered a single live birth or stillbirth at ≥ 20 weeks of gestation from April 1, 2012, to September 30, 2019. Imbalance in measured maternal sociodemographic and obstetrical characteristics between women with and without a substance-related diagnosis was attenuated using propensity score matching on key demographic characteristics (eg, age), yielding a matched 1:1 sample. Unadjusted and adjusted logistic regressions models were used to determine the association between a substance-related diagnosis and outpatient visits, emergency visits, and inpatient days.

RESULTS: From the total sample ($n=16,770$), the matched cohort consisted of 1986 deliveries. Of these, most were White (51.0%), or mixed or of some other race (31.1%). The mean age was 29.8 (standard deviation, 5.6). A substance-related diagnosis was identified in 993 women (50%) because of matching. Women with a substance-related diagnosis were more likely to have ≤ 10 outpatient visits than women without a substance-related diagnosis (adjusted odds ratio, 1.81 [95% confidence interval, 1.44–2.28]; $P<.0001$). Alcohol-, opioid-, and stimulant-related diagnoses were independently associated with ≤ 10 outpatient visits (adjusted odds ratio, 3.16 [95% confidence interval, 1.67–6.04]; $P=.0005$; adjusted odds ratio, 3.02 [95% confidence interval, 1.79–5.09]; $P<.0001$; adjusted odds ratio, 2.18 [95% confidence interval, 1.39–3.41]; $P=.0007$, respectively). Women with a substance-related diagnosis were more likely to have ≥ 1 emergency visit than women

without a substance-related diagnosis (adjusted odds ratio, 1.36 [95% confidence interval, 1.00–1.85]; $P<.0001$). Opioid-, stimulant-, and nicotine-related diagnoses were independently associated with ≥ 1 emergency visit (adjusted odds ratio, 2.28 [95% confidence interval, 1.09–4.77]; $P=.0287$; adjusted odds ratio, 2.01 [95% confidence interval, 1.07–3.78]; $P=.0301$; adjusted odds ratio, 3.38 [95% confidence interval, 1.90–6.02]; $P<.0001$, respectively). Women with a substance-related diagnosis were more likely to have ≥ 3 inpatient days than women without a substance-related diagnosis (adjusted odds ratio, 1.69 [95% confidence interval, 1.07–2.67]; $P=.0256$). Opioid-, stimulant-, and nicotine-related diagnosis were independently associated with ≥ 3 inpatient days (adjusted odds ratio, 3.52 [95% confidence interval, 1.42–8.75]; $P=.0067$; adjusted odds ratio, 3.51 [95% confidence interval, 1.31–9.34]; $P=.0123$; adjusted odds ratio, 2.74 [95% confidence interval, 1.11–6.73]; $P=.0285$, respectively).

CONCLUSION: Women with a substance-related diagnosis during the antepartum period who delivered a single live birth or stillbirth at ≥ 20 weeks of gestation were experiencing fewer outpatient visits, more emergency department visits, and more inpatient days than women without a substance-related diagnosis. The type of substance-related diagnosis (eg, alcohol, opioids, stimulants, or nicotine) was associated with different patterns of healthcare use. The results from this study have reinforced the need to identify substance-related diagnoses in pregnant women early to minimize disproportionate healthcare service utilization through intervention and treatment.

Key words: alcohol use, cannabis use, electronic health record data, emergency department, healthcare service utilization, inpatient, nicotine use, opioid use, outpatient, pregnancy, stimulant use, substance-related diagnosis, substance use, substance use disorder

Introduction

Use of healthcare services is essential for pregnant women.¹ Pregnant women with a substance-related diagnosis (SRD; ie, substance use,

misuse, or dependence) are a vulnerable population that may disproportionately use healthcare services and resources. Research has suggested that limited and disrupted prenatal care, psychiatric comorbidities (eg, anxiety), prenatal substance use, and environmental stressors (eg, unsteady home) are associated with adverse maternal outcomes (eg, pre-eclampsia, gestational hypertension, and severe maternal morbidity [SMM]).^{2,3} Attending prenatal visits decreases the risk of both adverse obstetrical and birth outcomes (eg, prematurity, fetal demise,

and postneonatal mortality and neuro-psychiatric impairments).^{4–7} Increased emergency department (ED) use and hospitalizations suggest worsening medical needs.

Pregnant women with an SRD face multiple intersecting barriers that can impact their health and healthcare service utilization (HSU). For example, pregnant women who use substances face barriers to seeking prenatal care, including late-term discovery, navigating health insurance and accessing care, physicians unwilling to initiate treatment

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AJOG MFM at a Glance

Why was this study conducted?

This study aimed to evaluate the differences in healthcare service utilization (HSU) among pregnant women with and without substance-related diagnoses (SRDs).

Key findings

Women with an SRD during the antepartum period were more likely to have fewer outpatient visits and more emergency visits and inpatient days than women without an SRD. Alcohol-, opioid-, and stimulant-related diagnoses were associated with ≤ 10 outpatient visits. Opioid-, stimulant-, and nicotine-related diagnoses were associated with ≥ 1 emergency visit and ≥ 3 inpatient days. Cannabis-related diagnosis was not associated with any change in HSU.

What does this add to what is known?

Different types of SRDs (ie, alcohol, opioids, stimulants, and nicotine) were associated with different types of service utilization.

for substance use, fear of involvement with Child Protective Services, and incarceration.⁸ Women presenting for primary or prenatal care may not self-identify as being at risk of SRDs⁹ and may experience concerns of mistrust in their providers.¹⁰ However, when universal screening is adopted, pregnant women tend to disclose more information regarding their substance use.^{11,12} Often, there is minimization, especially with nicotine, but research indicates that they are more likely to disclose their substance use if asked in a nonjudgmental way and in states without mandatory reporting.^{13–15} Even with mandatory reporting, there is evidence of some physician biases toward which patients are reported to the state and for which substances.^{13–15}

Research has shown that patients with a substance use disorder (SUD) have fewer outpatient visits,¹⁶ more ED visits,^{17–20} and more inpatient days in the hospital than patients without an SUD.^{21,22} However, research on the prevalence and association of SRDs by type (eg, alcohol, opioids, stimulants, nicotine, or cannabis) and outpatient visits, ED visits, and inpatient days in the hospital among pregnant women is limited. Pregnant women with an SRD are a vulnerable population who may be experiencing disproportionate HSU compared with pregnant women without an SRD. To address this gap in the literature, a retrospective cohort study of women who delivered their first

single live birth or stillbirth at ≥ 20 weeks of gestation was conducted to evaluate independent associations between SRD and HSU in a large healthcare system. We hypothesized that women who delivered their first single live birth or stillbirth at ≥ 20 weeks of gestation with SRDs, compared with those without, would have fewer outpatient visits, more ED visits, and more inpatient days in the hospital.

Materials and Methods**Study participants and procedures**

This institutional review board –approved retrospective study used deidentified and secure electronic health record (EHR) data on primigravida women (age, 18–44 years) who delivered their first single live birth or stillbirth at ≥ 20 weeks of gestation at a large health system in Southern California from April 1, 2012, to September 30, 2019 (7.5 years of available data). Approximately 3000 deliveries occur here annually. International Classification of Diseases, Tenth Revision (ICD-10) codes were used to identify women for the study (Table A in Supplemental Material).²³ Data were collected from the antepartum (up to 42 weeks before delivery) to the postpartum (4 weeks after delivery) periods (a total of 46 weeks) to complete a thorough assessment of HSU during this time. Only primigravida women were included in this study because of potential differences in HSU among multigravida

women. For example, research has shown that primigravida women may be more likely to experience higher rates of pregnancy-related hypertension,²⁴ preterm labor,²⁴ and cesarean delivery²⁵ than multigravida women, which may result in differences in HSU.

Measures

HSU was defined by the number of outpatient visits, ED visits, and inpatient days during the perinatal period using admissions and discharge dates. Outpatient visits included all ambulatory care, such as primary care, prenatal obstetrical, and psychiatric visits. Laboratory visits (eg, blood draws) were not included. Visits to the ED during labor, which resulted in a delivery, were not included in the ED visits variable. Inpatient hospital visits were measured by the number of days women who presented for delivery stayed in the hospital during the perinatal period at any time.¹⁰ In addition, a dichotomous summary variable was created for outpatient visits (ie, ≤ 10 visits vs > 10 visits), ED visits (ie, ≥ 1 visit vs 0 visit), and inpatient days (ie, ≥ 3 visits vs < 3 visits). These summary variables were determined by existing groups identified in the literature and by reviewing the distribution of the data to establish cutoff points. Although ≤ 10 visits vs > 10 visits variable has been used in previous research,²⁶ an additional group (≤ 15 visits vs > 15 visits) was created on the basis of the distribution of the data and reported in the Supplemental Material.

The primary predictor variable was any SRD (yes or no; ICD-10 codes F10.xx–F19.xx) during the antepartum to intrapartum period. To prevent confounding associated with substance use after delivery, SRDs that were only identified during the postpartum period were excluded from the analysis. The secondary predictor variables included an SRD for alcohol (yes or no), opioids (yes or no), stimulants (ie, cocaine or methamphetamine; yes or no), nicotine (yes or no), and cannabis (yes or no). In the individual analyses by substance type, the groups were not mutually

exclusive. For example, a patient with an alcohol-related diagnosis may also have a co-occurring tobacco-related diagnosis.

Covariates included age at delivery, race (American Indian or Alaskan Native, Native Hawaiian or Other Pacific Islander, Asian, Black, White, and mixed or other race) and Hispanic or Latina ethnicity. Self-reported race (eg, Black or White) and ethnicity (eg, Hispanic or Latina, African American, or White) were separate categories in this EHR. Data of women who selected “unknown or choose not to disclose” were categorized as missing. Other covariate variables included marital status (single; divorced, separated, or widowed; or married) and body mass index (BMI) at delivery. Health insurance type at delivery was identified as private (eg, commercial or managed care), public (eg, Medicaid), and no insurance. The private insurance group could also have public insurance. The public insurance group did not have private insurance.

Serious mental illness (SMI; eg, schizophrenia, bipolar disorder, or major depressive symptoms) is defined by the National Institute of Mental Health as a mental, behavioral, or emotional disorder that results in serious functional impairment.²⁷ Summary variables for SMI (yes or no) and non-SMI (any other mental illness [eg, anxiety] that is not included in the SMI category; yes or no) were created. A summary variable for pre-existing health conditions included anemia, cardiovascular disease, non-gestational diabetes mellitus, cancer, kidney failure, hypertension, lupus erythematosus, epilepsy, pulmonary disease, human immunodeficiency virus infection, acquired immunodeficiency syndrome, hepatitis C virus infection, and tuberculosis.²⁸ ICD-10 codes were available on request.

Statistical analysis

Encounter dates related to pregnancy, diagnoses, and health visits from the EHR were used to calculate the time from a diagnosis to delivery and timing of HSU outcomes. Descriptive and inferential statistics were used to

determine the sample characteristics and the relationship between an ICD-10 code for an SRD (yes or no) and HSU outcomes. The HSU outcome variables were first analyzed as continuous variables (ie, number of outpatient visits, ED visits, and inpatient days) and then as categorical variables (ie, ≤ 10 visits outpatient visits, ≥ 1 visits ED visits, and ≥ 3 inpatient days). Analysis of variance was used for continuous data, and chi-squared (X^2) tests of significance were used for categorical data. To determine the effect and magnitude of the associations, unadjusted odds ratios (ORs) were calculated. Because of the large sample size ($n=16,770$), most comparisons in the bivariate analysis revealed significant differences associated with HSU outcomes. Propensity score matching (PSM) was used to account for the potential imbalance and confounding across maternal sociodemographic and obstetrical characteristics using variables found to impact HSU in pregnant women.¹¹ Women with and without an SRD were matched by age and BMI at delivery, delivery year (2012–2019), and preexisting health condition (yes or no).^{29–31} Although research has shown that mental illness also impacts HSU,³² we explored the roles of SMI and non-SMI as a predictor in the analysis because of the high co-occurrence with SRDs and did not include it in the PSM procedure. The final PSM procedure yielded a matched 1:1 sample of 1986 (993 with an SRD and 993 without an SRD).¹² Standardized mean difference was used to assess the balance of the covariate distributions between the groups. After creating a 1:1 (yes SRD vs no SRD) sample, we controlled for confounders found to be significant with HSU in the bivariate analysis (ie, race, Hispanic ethnicity, health insurance type, and non-SMI) and included them in the multivariable logistic regression models to determine whether SRDs were associated with each HSU continuous variable and each HSU categorical variable. Standardized betas (β s), standard errors (SEs [β]), adjusted ORs (AORs), and the respective confidence intervals (CIs) and P values were reported. All analytical steps were

repeated for each substance type. In addition, individual groups for each categorical HSU outcome (eg, only those with ≤ 10 outpatient visits) and 2 additional groups (ie, only those with ≤ 15 visits or only those with >15 visits) were created to examine the number of visits in each group by SRD (yes or no). The mean, SD, β , SE, and P value were reported for each. The analyses were performed using the Statistical Analysis System (version 9.4; SAS Institute Inc, Cary, NC).

Results

Sample characteristics

There were 16,770 deliveries with an ICD-10 code for a single delivery at ≥ 20 weeks of gestation from April 1, 2012, to September 30, 2019. In the entire unmatched sample, an SRD was identified in 1026 women (6.1%) with a delivery. During the perinatal period, 5538 women (33.0%) had ≤ 10 outpatient clinical visits (all outpatient visits mean, 15.8; standard deviation [SD], 11.1; range, 0–87), 1682 women (10.0%) had ≥ 1 ED visit (all ED visits mean, 0.31; SD, 1.13; range, 0–31), and 405 women (2.4%) had ≥ 3 inpatient days (all inpatient days mean, 0.26; SD, 0.77; range, 0–10) (Table B in Supplemental Material).

In the matched sample ($n=1986$), an SRD was identified in 993 women (50.0%) because of matching (Table 1). Of these, an SRD for alcohol (5.0%), opioids (10.0%), stimulants (13.7%), nicotine (16.1%), and cannabis (16.3%) were reported. Most women were White (51.0%) or mixed or other race (31.1%) (Table 1). Those who reported Hispanic or Latina ethnicity composed 35.7% of the sample. Those who reported Black or Asian race composed 10.0% and 6.6% of the sample, respectively. The mean age was 29.8 years (SD, 5.6; range, 18–44 years). Most women were married (47.4%) or single (48.4%), had a mean BMI of 32.7 kg/m² (SD, 7.5; range, 14.4–74.0 kg/m²), and had private health insurance (66.1%). SMI and non-SMI were documented for 8.2% and 32.7%, respectively. Preexisting health conditions were documented for 49.1% because of matching.

TABLE 1

Demographic and health-related characteristics in a matched sample of women who delivered their first single live birth or stillbirth at ≥ 20 weeks of gestation with and without a substance-related diagnosis from a large healthcare system's electronic health record from April 1, 2012, to September 30, 2019

Parameter	Total	SRD	No SRD
All	1986 (100.0)	993 (50.0)	993 (50.0)
Age at delivery (range, 18–44 y)	29.8 \pm 5.6	29.8 \pm 5.9	29.9 \pm 5.4
Race			
American Indian or Alaska Native	11 (0.6)	7 (0.7)	4 (0.4)
Native Hawaiian or Other Pacific Islander	13 (0.7)	7 (0.7)	6 (0.6)
Asian	127 (6.6)	30 (3.1)	97 (10.1)
Black	194 (10.0)	140 (14.4)	54 (5.6)
Other or mixed race	601 (31.1)	247 (25.5)	354 (36.8)
White	986 (51.0)	539 (55.6)	447 (46.5)
Hispanic or Latina	701 (35.7)	308 (31.5)	393 (39.9)
Marital status			
Single	959 (48.4)	649 (65.6)	310 (31.3)
Divorced, separated, or widowed	82 (4.1)	64 (6.5)	18 (1.8)
Married	939 (47.4)	276 (27.9)	663 (66.9)
Body mass index at delivery	32.7 \pm 7.5	32.6 \pm 7.6	32.7 \pm 7.3
Health insurance			
No insurance	212 (10.7)	98 (9.9)	114 (11.5)
Public	462 (23.3)	236 (23.8)	226 (22.8)
Private	1312 (66.1)	659 (66.4)	653 (65.8)
Serious mental illness	162 (8.2)	140 (14.1)	22 (2.2)
Nonserious mental illness	649 (32.7)	453 (45.6)	196 (19.7)
Preexisting health condition	976 (49.1)	488 (50.0)	488 (50.0)

Data are presented as mean \pm standard deviation or number (percentage). Variable totals may not add up to column totals because of missing data.

SRD, substance-related diagnosis.

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Correlates of healthcare service utilization

In the matched sample, 722 women (36.4%) had ≤ 10 outpatient clinical visits (all outpatient visits mean, 15.4; SD, 11.3; range, 0–87), 264 women (13.3%) had ≥ 1 ED visit (all ED visits mean, 0.48; SD, 1.16; range, 0–31), 100 women (5.0%) had ≥ 3 inpatient days (all inpatient days mean, 0.45; SD, 1.04; range, 0–10) (Table 2). When analyzed by individual HSU groups, the mean number of outpatient visits was significantly lower for those with an SRD who

had ≤ 10 outpatient visits (4.11 \pm 3.69 vs 4.79 \pm 3.68; $P=.0143$) and ≤ 15 outpatient visits (6.68 \pm 5.17 vs 8.18 \pm 5.04; $P<.0001$) (Table C in Supplemental Material). The mean number of inpatient days was significantly higher for those with an SRD who had < 3 inpatient days (0.32 \pm 0.74 vs 0.24 \pm 0.65; $P=.0110$) (Supplemental Table 3).

Compared with women without an SRD, women with an SRD were more likely to have fewer outpatient visits ($\beta=-0.131$; $P<.0001$) (Figure 1) and have ≤ 10 outpatient clinical visits

compared with > 10 outpatient clinical visits (AOR, 1.81 [95% CI, 1.44–2.28]; $P<.0001$). Alcohol-, opioid-, and stimulant-related diagnoses were independently associated with ≤ 10 outpatient clinical visits (AOR, 3.16 [95% CI, 1.67–6.04]; $P=.0005$; AOR, 3.02 [95% CI, 1.79–5.09]; $P<.0001$; AOR, 2.18 [95% CI, 1.39–3.41]; $P=.0007$, respectively) (Table 3).

Compared with women without an SRD, women with an SRD were more likely to have more ED visits (β , 0.049; $P=.0373$) (Figure 2) and ≥ 1 ED visits compared with 0 ED visits (AOR, 1.38 [95% CI, 1.00–1.85]; $P<.0001$). Opioid-, stimulant-, and nicotine-related diagnoses were independently associated with ≥ 1 ED visit (AOR, 2.28 [95% CI, 1.09–4.77]; $P=.0287$; AOR, 2.01 [95% CI, 1.07–3.78]; $P=.0301$; AOR, 3.38 [95% CI, 1.90–6.02]; $P<.0001$, respectively) (Table 3).

Compared with women without an SRD, women with an SRD were more likely to have more inpatient days (β , 0.059; $P=.0158$) (Figure 2) and ≥ 3 inpatient days compared with < 3 (AOR, 1.69 [95% CI, 1.07–2.67]; $P=.0256$). Opioid-, stimulant-, and nicotine-related diagnoses were independently associated with ≥ 3 inpatient days (AOR, 3.52 [95% CI, 1.42–8.75]; $P=.0067$; AOR, 3.51 [95% CI, 1.31–9.34]; $P=.0123$; AOR, 2.74 [95% CI, 1.11–6.73]; $P=.0285$, respectively) (Table 3).

Discussion

Principal findings

Within a large matched pregnancy cohort in a healthcare system that provides tertiary care and is a referral system for other providers in the community, women with an SRD during the antepartum period were more likely to have fewer outpatient clinical visits, more ED visits, and more inpatient days in the hospital than women without an SRD.

Some of the findings from this study were consistent with a 2003 to 2007 study, which found that women with an SUD (a type of SRD) accounted for 5.5% ($n=20,707$) of the sample (total $n=375,851$) and used the ED and were

TABLE 2

Matched adjusted analysis of healthcare utilization and substance-related diagnosis among women with a documented delivery from a large healthcare system's electronic health record from April 1, 2012, to September 30, 2019

Parameter	Total	SRD	No SRD	Adjusted odds ratio (95% CI) or β	χ^2 or SE	P value
All	1986 (100.0)	993 (50.0)	993 (50.0)			
All outpatient visits (range, 0–87)	15.40±11.30	14.00±11.60	16.80±11.60	−0.131	0.540	<.0001 ^a
All outpatient visits						
≤10 visit	722 (36.4)	430 (43.3)	292 (29.4)	1.81 (1.44–2.28)	26.22	<.0001 ^a
>10 visit	1264 (63.7)	563 (56.7)	701 (70.6)	—		
All emergency visits (range, 0–31)	0.48±1.60	0.63±2.00	0.33±1.18	0.049	0.076	.0373 ^a
All emergency visits						
≥1 visit	264 (13.3)	162 (16.3)	102 (10.3)	1.36 (1.00–1.85)	3.76	<.0001 ^a
0 visit	1722 (86.7)	831 (83.7)	891 (89.7)	—		
All inpatient days (range, 0–10)	0.45±1.04	0.56±1.17	0.34±0.87	0.059	0.051	.0158 ^a
All inpatient days						
≥3 d	100.0 (5.0)	69 (7.0)	31 (3.1)	1.69 (1.07–2.67)	4.98	.0256 ^a
<3 d	1886 (95.0)	924 (93.0)	962 (96.9)	—		

Data are presented as number (percentage) or mean±standard deviation, unless otherwise indicated. Of note, 4 deliveries did not have predelivery inpatient days in the hospital listed in the EMR. Adjusted means controlling for all sociodemographic and health variables that were significantly associated with the healthcare service utilization outcomes in the bivariate analysis.

CI, confidence interval; β , beta coefficient; EMR, electronic medical record; SE, standard error; SRD, substance-related diagnosis.

^a P value ≤.05 represent statistical significance.

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hospitalized more often than women who did not have an SUD.⁶ However, the women in the previously mentioned study represented higher rates of ED visits (38.3% vs 16.0%) and hospitalizations (24% vs 11.2%) than the women in this study. This may be because of the differences in the samples (ages of 15–49 in Massachusetts with a clinically diagnosed SUD vs ages of 18–44 in Southern California with any SRD). Despite these differences, the results from both studies represented disproportionate ED visits and inpatient days in the hospital among women with an SRD. Furthermore, research has suggested that pregnant women using the ED are less likely to access and receive sufficient prenatal care. In 1 study, ED visits during pregnancy were a marker for late entry for prenatal care and were also strongly associated with substance use.³³ In another study, women with mental health disorders (eg, depression or SUD) used the ED during the postnatal period for psychiatric and obstetrical reasons more often than women

without mental health disorders.³⁴ A 2021 study found that pregnant women with an SRD were nearly 2 times more likely to have SMM.³ SMM refers to 21 life-threatening labor and delivery outcomes that result in adverse consequences to a women's health (eg, blood transfusion or hemorrhage, hysterectomy, or eclampsia), which lead to higher rates of ED visits and hospitalizations.

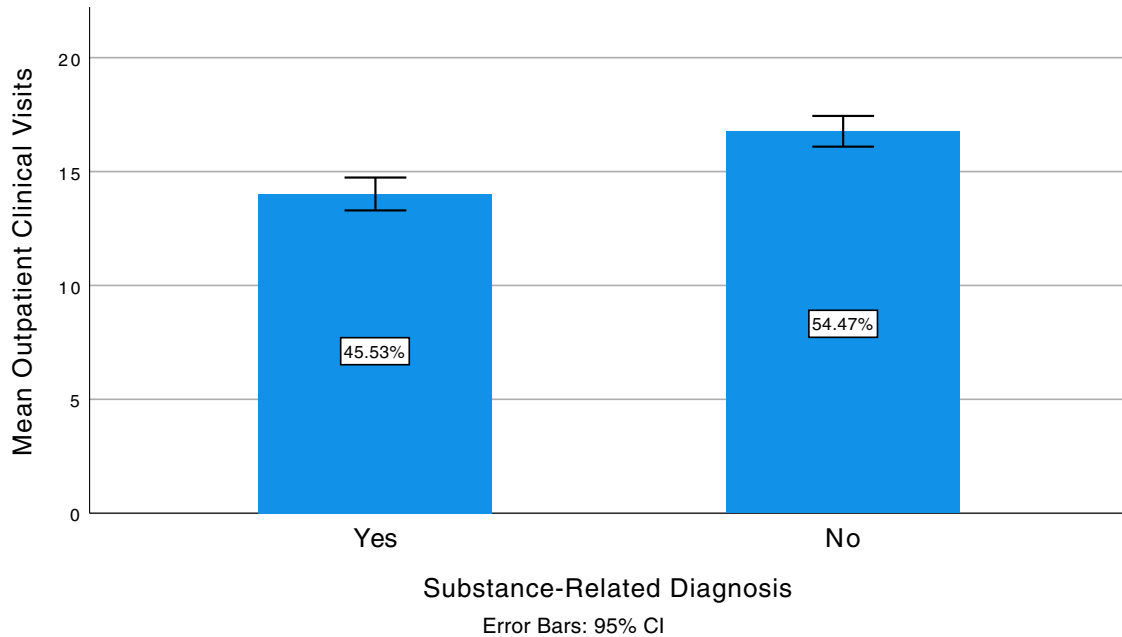
Research on healthcare use among pregnant women with specific SRDs (eg, alcohol, opioids, stimulants, nicotine, and cannabis) in the United States is limited. In the current study, women with an alcohol-related diagnosis during the antepartum period had significantly fewer outpatient visits than those without an alcohol-related diagnosis. There was no significant difference between ED visits and hospitalizations. To our knowledge, no study has investigated the direct relationship between an alcohol-related diagnosis and HSU among pregnant women. A study investigating singleton live births in California from

2007 to 2012 found that smoking, alcohol or other drug dependence, and residing in a rural county were significantly associated with an increased risk of late prenatal care.³⁵ Unfortunately, the individual difference between alcohol and other substances was not reviewed. Unlike the previous study, there was no significant association between a nicotine-related diagnosis and outpatient visits. The difference observed in our study may be related to how smoking was measured. The ICD-10 codes that were used to identify a nicotine-related diagnosis represented use, misuse, and dependence of nicotine use, which went beyond the “smoking” (yes or no) category. In addition, our study measured any outpatient visit, which include prenatal visits. A 2012 study demonstrated that pregnant women who smoke and also use substances are at increased risk of serious complications during pregnancy, which is consistent with results from our study demonstrating that nicotine is associated with greater number of inpatient days.³⁶

FIGURE 1

Outpatient clinical visits in women with and without a substance-related diagnosis who delivered a single live birth or stillbirth at 20 weeks of gestation from April 1, 2012, to September 30, 2019

Outpatient clinical visits in women ages 18-44 years with and without a substance-related diagnosis who delivered a single live or stillbirth at 20 weeks of gestation from April 1st, 2012-September 30th, 2019



CI, confidence interval.

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Women with an opioid-related diagnosis during the antepartum period had fewer outpatient visits and more ED visits and hospitalizations than women without an opioid-related diagnosis. Pregnancy is a unique opportunity to identify opioid problems and facilitate treatment using medications for opioid use disorder (MOUD; eg, methadone or buprenorphine) and harm reduction services (eg, syringe services) and to coordinate care among specialists, behavioral health, and social services.³⁷ After delivery, women with an opioid-related diagnosis may benefit from postpartum support services, including SUD treatment, and neonates may benefit from treatment of neonatal opioid withdrawal syndrome if necessary.³⁷ As discussed in the limitations, the data used in this study did not identify pregnant women in treatment using MOUD. It is possible that patients in this study may be receiving care outside of the healthcare system. Additional research on

how to reduce ED visits and hospitalizations among pregnant women with an opioid-related diagnosis is needed to improve maternal and neonatal outcomes.^{38–40}

Women with a stimulant-related diagnosis during the antepartum period had fewer outpatient visits and more ED visits and hospitalizations than women without a stimulant-related diagnosis. Among pregnant women who use substances, stimulant use (eg, cocaine or methamphetamine) has been shown to be a leading cause of antepartum hospitalizations⁴¹ and is associated with increased risk of hemorrhage and preeclampsia.⁴² Moreover, 1 study investigating trends in hospitalizations among pregnant women who use stimulants from 1998 to 2004 found that medical complications were more common in women with an amphetamine-related diagnosis than in women in the non-SRD group.³⁴ In addition, vasoconstrictive

effects, such as cardiovascular disorders and hypertension complicating pregnancy, were more common in pregnant women with an amphetamine-related diagnosis than in those with a cocaine-related diagnosis.

Clinical and research implications

The results of this study have reinforced a need to increase the engagement of pregnant women with SRDs in outpatient visits and reduce the number of ED and inpatient days. Excess use of ED visits and hospitalizations may result in unnecessary services that cause an increase in hospital costs.¹⁶ Early screening and treatment can decrease the risk of serious maternal and neonatal complications. However, factors, such as stigma, fear, and underreporting of substance use during pregnancy, serve as barriers to ideal treatment.⁴³ Fewer than half of the states in the United States have funded drug treatment programs for pregnant women.⁴⁴

TABLE 3

Demographic and health-related characteristics in a matched sample of women who delivered their first single live birth or stillbirth at ≥ 20 weeks of gestation with and without a substance-related diagnosis by substance type from a large healthcare system's electronic health record from April 1, 2012, to September 30, 2019

Parameter	Adjusted odds ratio (95% CI)	X^2	<i>P</i> value
≤ 10 outpatient visits			
Alcohol-related diagnosis	3.16 (1.67–6.04)	12.17	.0005 ^a
Opioid-related diagnosis	3.02 (1.79–5.09)	17.20	<.0001 ^a
Stimulant-related diagnosis	2.18 (1.39–3.41)	11.43	.0007 ^a
Cannabis-related diagnosis	1.32 (0.90–1.94)	2.05	.1520
Nicotine-related diagnosis	1.24 (0.85–1.82)	1.21	.2698
≥ 1 emergency visits			
Alcohol-related diagnosis	0.75 (0.22–2.53)	0.22	.6369
Opioid-related diagnosis	2.28 (1.09–4.77)	4.78	.0287 ^a
Stimulant-related diagnosis	2.01 (1.07–3.78)	4.71	.0301 ^a
Cannabis-related diagnosis	0.76 (0.43–1.35)	0.93	.3341
Nicotine-related diagnosis	3.38 (1.90–6.02)	17.07	<.0001 ^a
≥ 3 inpatient days ^b			
Alcohol-related diagnosis	1.03 (0.27–4.02)	0.00	.9619
Opioid-related diagnosis	3.52 (1.42–8.75)	7.35	.0067 ^a
Stimulant-related diagnosis	3.51 (1.31–9.34)	6.27	.0123 ^a
Cannabis-related diagnosis	1.29 (0.52–3.23)	0.31	.5802
Nicotine-related diagnosis	2.74 (1.11–6.73)	4.80	.0285 ^a

Data include a sample of 1986 women.

CI, confidence interval.

^a *P* value $\leq .05$ represent statistical significance; ^b Of note, 4 deliveries did not have predelivery inpatient days in the hospital listed in the electronic medical record. Each variable was assessed individually in matched 1:1 groups by substance type (ie, alcohol, opioids, stimulants, cannabis, or nicotine). Adjusted means controlling for all of the sociodemographic and health variables that were significantly associated with the healthcare service utilization outcomes in the bivariate analysis.

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pregnant women in need of intervention and treatment.

Strengths and limitations

This study was strengthened by a large sample size of >7.5 years, and the use of a robust methodology. This study was limited by using ICD-10 codes for health-related diagnoses, which could have involved misclassification bias, unmeasured confounding (eg, current treatment for SRD, MOUD, or pregnancy intention), eligibility changes over time (eg, discontinued substance use after an SRD), and missing data (eg, polysubstance substance use that is not accounted for).^{46,47} To mitigate these concerns, we used robust matching techniques, only selected women with an SRD from conception to ≥ 42 weeks of gestation, and removed anyone with an SRD after delivery. Without a universal screening for substance use in our health system, SRDs were likely underreported. However, those who are identified with ICD-10 diagnostic codes for SRDs were likely identified because they exhibited acute problematic symptoms. As such, these diagnostic codes were likely a marker that the patient's presentation is significant enough to warrant designation by providers. The generalizability between SRD and HSU in this study was limited by the restriction to 1 large health system in Southern California and the low proportion of non-White (eg, Black) subjects in this region. However, this study included a relatively large proportion of Black women (10%) for the region because of matching. It was not possible to differentiate between prenatal visits and general outpatient visits because prenatal visits were not clearly labeled in the EHR. However, it was clear that women with an SRD had fewer outpatient visits and more ED visits and inpatient days in the hospital than women without an SRD, indicating that these women were likely not accessing essential prenatal healthcare services in the same capacity.

Conclusion

Women with an SRD during the antepartum period had fewer outpatient clinical visits, more ED visits, and more inpatient

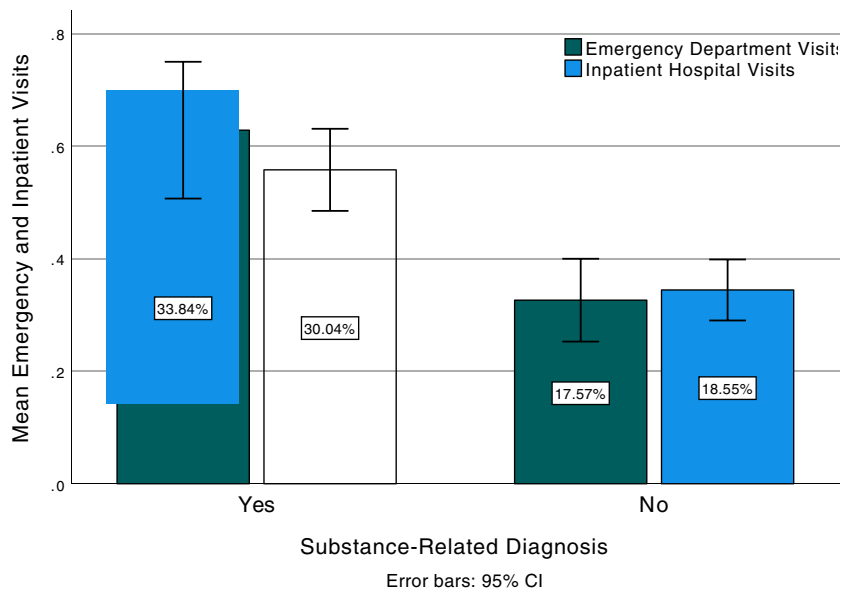
Creating safe and destigmatizing clinical environments for pregnant women with SRDs, mental illness, and preexisting health conditions will aid in addressing the potential risks that were identified in this study. Because women with an SRD during the antepartum period may be engaging with the health system in different capacities, nonjudgmental questions regarding substance use should be posed during outpatient, ED, and hospitalizations often and be specifically related to substances, such as alcohol, opioids, stimulants, and nicotine.

Future studies should investigate the psychosocial barriers (eg, domestic

abuse and transportation) that may inhibit access to prenatal care.⁴⁵ Moreover, it would be helpful to qualitatively capture the experiences and perspectives of pregnant women with an SRD who are engaging in the health system in different capacities. In addition, research on the HSU of women who choose to terminate their pregnancies and multiparous women would be useful. Future research should investigate differences in HSU by substance type (eg, alcohol, opioids, or stimulants) in different populations of pregnant women, and a focus on polysubstance use should be included to better identify

FIGURE 2

Emergency department and inpatient hospital visits in women with and without a substance-related diagnosis who delivered a single live birth or stillbirth at 20 weeks of gestation from April 1, 2012, to September 30, 2019



CI, confidence interval.

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days in the hospital than women without an SRD. Alcohol-, opioid-, and stimulant-related diagnoses were independently associated with ≤ 10 outpatient clinical visits. Opioid-, stimulant-, and nicotine-related diagnoses were independently associated with ≥ 1 ED visit and ≥ 3 inpatient days. These results indicated a need to identify women with SRDs early in their pregnancy to minimize disproportionate healthcare use through intervention and treatment. Future studies should focus on identifying modifiable barriers to treatment for pregnant women with SRDs, such as stigma and logistical barriers.

Highlights

- Pregnant women with a substance-related diagnosis were more likely to have fewer outpatient visits, more emergency visits, and more inpatient days in the hospital than pregnant women without a substance-related diagnosis.

- Alcohol-, opioid-, and stimulant-related diagnoses were associated with ≤ 10 outpatient visits.
- Opioid-, stimulant-, and nicotine-related diagnoses were associated with ≥ 1 emergency visit and ≥ 3 inpatient days.
- A cannabis-related diagnosis was not associated with any change in outpatient, emergency, or inpatient use.

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Supplementary materials

Supplementary material associated with this article can be found in the

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