Cigarette Smoking Status and Substance Use in Pregnancy

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Abstract

Objectives—Substance use during pregnancy is a significant public health issue. Prenatal substance use increased in the past decade while prenatal cigarette smoking has remained stable. Co-use of tobacco and other drugs is a concern because of potential additive risks. This study aims to describe the prevalence rates of substance use among pregnant women and examine the association between smoking status (nonsmoker, recent quitter and current smoker) and other drug use.

Methods—In this cross-sectional study, pregnant women (n = 500) were recruited from two obstetric practices to complete three substance use screeners and have their urine tested for 12 different drug classes, including cannabis, opioids and cocaine. Participants were divided into three groups based on survey responses: nonsmokers, recent quitters (smoked in the month prior to pregnancy but not past month) and current smokers (past-month).

Results—Approximately 29% of participants reported smoking in the month before pregnancy. During pregnancy, 17, 12 and 71% were current smokers, recent quitters and nonsmokers respectively. Overall prevalence of illicit or prescription drug use in pregnancy was 27%. Cannabis was the most common drug used in pregnancy with prevalence of 22%, followed by opioids (4%), cocaine (1%), tricyclic antidepressants (TCAs) (1%), amphetamines (1%), and benzodiazepines (1%). On multivariable logistic regression, smoking in pregnancy was associated with a positive urine drug screen; with adjusted odds ratio (aOR) 4.7 (95% CI 2.6–8.3) for current smokers and 1.6 (95% CI 0.8–3.3) for recent quitters. Factors negatively associated with positive drug screen were second and third trimester pregnancies, 0.5 (0.3–0.9) and 0.3 (0.2–0.6) respectively; and employment, 0.5 (0.3–0.8).

Conclusions for Practice—Co-use of tobacco and illicit drugs, particularly cannabis, is relatively high during pregnancy. Additional research is needed to understand the health implications of co-use versus use of tobacco only. Given the strong association between smoking and other drug use, clinicians should routinely assess for illicit drug use in women who smoke during pregnancy.

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Introduction

Smoking and illicit drug use during pregnancy are significant public health issues in the United States and have well-documented associated harms (Cnattingius 2004; DHHS 2001, 2014). National survey data from 2016 reveal that among pregnant women, about 8% used illicit drugs and 13% smoked cigarettes in the past month; possibly exposing about 320,000 unborn children to illicit drugs and up to 510,000 to tobacco, all in 2016 alone (DHHS 2013, 2017; Forray 2016). Substance use tends to decrease over the course of pregnancy, with relapse common within the first 6 months postpartum (Curtin and Matthews 2016; SAMHSA 2009).

While prenatal tobacco use has remained somewhat stable in the past decade, use of opioids in pregnancy has increased fivefold between 2000 and 2009 (Patrick et al. 2012). After nicotine and alcohol, cannabis, opioids and cocaine are the most often used drugs in the prenatal period (Ebrahim and Gfroerer 2003; Metz et al. 2018). Drug use in pregnancy in general is associated with adverse pregnancy outcomes such as placental abruption, prematurity, low birth weight, congenital anomalies, fetal death and neonatal deaths (Kennare et al. 2005). Cannabis, the most commonly used illicit drug in the prenatal period, has been associated with preterm labor, low birthweight, neurodevelopmental problems and neonatal intensive care unit (NICU) admissions (Hayatbakhsh et al. 2012; Jaques et al. 2014). The use of stimulants like cocaine and methamphetamine in pregnancy has been associated with premature labor, preterm birth, low birthweight and neurodevelopmental problems (Forray 2016). Opioid use in the prenatal period is linked with neonatal abstinence syndrome (NAS) and more specifically neonatal opioid withdrawal syndrome (NOWS), low birth weight, neurodevelopmental and respiratory problems; and stillbirth (Patrick et al. 2012). However, because polysubstance use is very common in pregnant women who use drugs, separating the effects of specific substances remains a challenge (Jarlenski et al. 2017).

Co-use of tobacco and other drugs in pregnancy is a concern because of potential additive risks of adverse fetal outcomes. Of the estimated 1 in 10 women who smoke in the months leading to pregnancy, 54% quit smoking during pregnancy (Tong et al. 2013). In comparison to pregnant women who are recent (pregnancy) quitters or nonsmokers, current smokers in pregnancy are likely to have worse birth outcomes as measured by birth weight, head circumference and Apgar scores (Kharkova et al. 2017). Given the changing landscape of drug use in the United States, specifically with the escalating opioid epidemic and the evolving regulatory landscape of cannabis across the country, a need exists to revisit the co-prevalence of tobacco smoking and the use of illicit drugs within the context of pregnancy and assess factors associated with drug use that may be targets for prevention to improve maternal and fetal outcomes.

Polysubstance use is common; thus, the possibility exists that smokers in pregnancy, when compared to recent quitters for example, are more likely to use illicit drugs and have an aggregation of risk factors that could adversely affect maternal and fetal outcomes. The objective of this study is to describe the prevalence rates of illicit drug use among pregnant women, and examine the association between smoking status (never, recent quitter, and current smoker) and illicit drug use in pregnancy.

Methods

This cross-sectional study recruited a convenience sample of 500 pregnant women from two obstetric practices in Baltimore, Maryland, from January 2017 to January 2018. The first obstetric practice has an estimated annual patient load of 950, with most patients being on public insurance, primarily African American, and having lower socioeconomic status and higher risk for drug use (Coleman-Cowger et al. 2018). The second clinic has an estimated annual patient load of 500, most of whom are privately insured and of higher socioeconomic status. Both clinics are located in urban settings, in close proximity and are affiliated with the same academic institution (Coleman-Cowger et al. 2018).

Participants were enrolled in the study if they were (a) Pregnant; (b) At least 18 years; and (c) Able to speak and understand English. Participants were approached during their regularly scheduled prenatal appointment and those who were eligible provided informed consent and were asked to complete three substance use screeners (4 P's Plus; SURP-P; NIDA ASSIST). A demographic questionnaire was administered to elicit demographic information such as age, employment, education, obstetric and gynecologic history and pregnancy intention (whether participant intended to be pregnant at the time of pregnancy, earlier, later or never). Participants also provided informed consent to have their urine samples tested for 12 different drugs (Cocaine, Cannabis, Opioids, Amphetamines/ Methamphetamines, Phencyclidine, Benzodiazepines, Barbiturates, Methadone, Tricyclic Antidepressants (TCAs), Oxycodone, Propoxyphene, and Buprenorphine).

Participants were divided into three groups (nonsmokers, recent quitters and current smokers) based on 4P's plus survey responses: (1) nonsmokers: not current smokers prior to pregnancy and not smokers during current pregnancy either; (2) recent quitters: current smokers in the month prior to pregnancy but not smoked in the past month while pregnant; and (3) current smokers: current smokers before and during current pregnancy. Note that "nonsmokers" in the context of this study could have been former smokers who had quit smoking in the past prior to the immediate pre-pregnancy period.

Drug-specific prevalence estimates were assessed by urine screen results. Urine drug screen was conducted using Alere iCup® Dx 14 Panel Drug Test for point of care testing, no confirmatory testing was done on urine samples. All other characteristics considered in our study, including demographic features and smoking status, were obtained from survey responses. The sample size for this study was based on power analyses for the main aims of the parent study (Coleman-Cowger et al. 2018). Methods for this study have been described in detail elsewhere (Coleman-Cowger et al. 2018).

Analysis

Survey responses from the 4P's Plus were used to classify participants by smoking status into current smoker, non-smoker and recent quitter categories. For 4 participants with missing enrolment data, we used other survey responses collected within a week of enrolment to categorize by smoking status. We approached 1170 pregnant women for this study in both sites, of these, 719 met eligibility criteria, and 500 were enrolled. A total of 494 participants were considered in the final analyses.

Firstly, we presented sociodemographic features and obstetric history for all smoking categories. For continuous variables, means were compared for the 3 smoking status categories using analysis of variance (ANOVA). For categorical variables, we compared proportions using Fisher's Exact and Chi-Square tests as appropriate. Any characteristic that differed significantly between smoking status categories (at $\alpha = 0.10$) meant that the characteristic was included as a covariate in subsequent multivariable analyses. Secondly, we presented prevalence of smoking in pregnancy, alongside prevalence of general and specific substance use by smoking status in the study sample. Thirdly, multivariable logistic regression was conducted to evaluate differences in drug use by smoking status categories. For further covariate selection, we conducted a stepwise process, including in the model all covariates that had a *p* value less than or equal to 0.10 on bivariable analyses with the outcome of interest—positive urine screen. Thus, the following variables were included in the multivariable model: age, race/ethnicity, trimester, education, marital status, employment status, pregnancy intention, gravidity and parity. For all analyses, *p* values of 0.05 or lower were considered statistically significant. All statistical analyses were conducted with STATA version 13.

Ethics and Dissemination

This study was approved by the Institutional Review Boards (IRB) of the University of Maryland, Baltimore (HP-00072042); and Battelle Memorial Institute (0619–100106433). All participants gave their informed consent prior to engagement in any study procedure. The study was conducted in accordance with the ethical standards stipulated by 1964 Helsinki Declaration and its subsequent amendments.

Results

Demographic Characteristics

Of the 500 women consented, 6 were excluded from analysis for incomplete study enrollment. A total of 494 participants are described in Table 1. The mean age of participants was 28.0 years (SD = 5.2), and most were African-American (71.2%), never married (65.2%), employed (66.1%) and having high school or some college education (62.3%). A meaningful proportion of participants (32.0%) had prior histories of miscarriages or stillbirths. When evaluated by smoking status—nonsmoker, recent quitter and current smoker—participants differed significantly by marital status, race, employment status, education, trimester of pregnancy, and number of prior pregnancies and deliveries. Current smokers were more likely to be never married, unemployed, African-American and have less than a high school education.

Prevalence of Drug Use in Pregnancy by Smoking Status

Twenty-nine percent (29%) of participants reported smoking in the month before pregnancy. During pregnancy, 17, 12 and 71% were current smokers, recent quitters, and nonsmokers respectively. Table 2 shows overall drug use prevalence, broken down by specific substances and by smoking status.

Overall, prevalence of all-drug use in pregnancy was 27.4%, with prevalence of cannabis use of 22.3%, opioids use – 4.0%, amphetamines—1.2%, cocaine use – 0.8%, benzodiazepines —1.0% and TCAs—1.0%. Current smokers had a higher prevalence of overall drug use (61.9%), cannabis use (50.0%) and opioid use (11.9%). Recent quitters had a higher prevalence of benzodiazepine use (5.2%).

Factors Associated with Drug Use in Pregnancy

On multivariable analysis, adjusting for age, ethnicity, trimester, education, marital status, employment, pregnancy intention, and number of prior pregnancies and deliveries, current smokers were more likely to use drugs in pregnancy compared to nonsmokers, aOR 4.7 (95% CI 2.6–8.3). For recent quitters, the association was not statistically significant, aOR 1.6 (0.8–3.3). Factors associated with drug use in pregnancy were trimester of pregnancy and employment status. For trimester, compared to first trimester pregnancies, 2nd trimester pregnancies were less likely to use drugs in pregnancy, aOR 0.5 (0.3–0.9), as were 3rd trimester pregnancies, aOR 0.3 (0.2–0.6). Employed women were less likely to use drugs in pregnancy, aOR 0.5 (0.3–0.8) (Table 3).

Discussion

Results indicate that women who smoke cigarettes are more than four times more likely to have a positive drug screen in pregnancy compared with nonsmokers. These findings are aligned with previous research conducted with cigarette smokers in the general population (Lai et al. 2000). Half of current smokers were concurrently using cannabis and almost twothirds were using some illicit drug. This is much higher than has been reported in previous studies (Coleman-Cowger et al. 2017; Mark et al. 2016), which may be due to the specific patient population studied or because of increased detection in our study due to biologic screening as opposed to self-report. Additionally, the high rates of cannabis use may be a result of emerging evidence that the spreading liberalization of cannabis policies across the US may result in increasing acceptance or tolerance of cannabis use more generally, and specifically in pregnancy (Crume et al. 2018; Keyes et al. 2016). The high rate of co-use identified likely has a multi-factorial explanation including the underlying environmental and psychological stressors that lead women to use any substances.

As has been shown previously, women were more likely to use tobacco and other drugs in the first trimester, whereas women in the second and third trimesters had lower prevalence of tobacco and other drug use. The fact that recent quitters were not significantly more likely to have a positive urine drug screen than nonsmokers is also notable. Several possible explanations for this finding exist. This likely indicates that women who are motivated to make positive changes in their pregnancies are more likely to stop intake of all harmful

substances; it may also speak to the ability of some women more easily than others to quit or cut back on addictive substances. Studies have shown that many providers avoid discussing cannabis use with pregnant women and just over half of providers report screening for tobacco (England et al. 2014; Holland et al. 2016a, b), as such, some uncertainty exists as to whether these changes in pregnancy are actually related to screening and counseling/treatment or are self-driven changes.

Although universal screening of pregnant women for substance use is recommended by the American College of Obstetricians and Gynecologists (ACOG 2015), the United States Preventive Services Task Force concluded that "current evidence is insufficient to assess the balance of benefits and harms of screening...pregnant women for illicit drug use (USPSTF 2015)." Even with a strong recommendation for prenatal alcohol and tobacco screening from the USPSTF, screening is not always done for many reasons including time, resources, and provider knowledge or comfort. As providers may be more comfortable screening for tobacco use, understanding that nearly two-thirds of women who smoke during pregnancy are also using some other drugs is important. This information should lead providers to provide screening and education to women using tobacco about other substance use in pregnancy as well.

Secondary findings of this study are also noteworthy. More than one in ten current smokers also concurrently used opioids in pregnancy, which may not be unusual in a treatment setting given the high prevalence rates of smoking that have been reported among treatment-seeking individuals with opioid use disorder (Chun et al. 2009; Ram et al. 2016), but was not anticipated in a prenatal care clinic setting. Additionally prevalence rates of cannabis and opioids use in our sample of pregnant women are higher when compared to recent studies on cannabis and opioid use in pregnancy for other populations (Brown et al. 2017; Osmundson et al. 2018). These higher use rates are likely a result of the characteristics of our sample i.e. predominantly low socioeconomic status, which is associated with higher risk of drug use in pregnancy (Havens et al. 2009). Also, of concern is the miscarriage/stillbirth rate among this population. Almost a third reported a previous miscarriage or stillbirth, which is significantly higher than rates that are typically reported and may tie in to previous findings that African-American women are at higher risk of miscarriage and stillbirths (Hogue et al. 2013; Hogue and Silver 2011; MacDorman et al. 2012; Michels and Tiu 2007; Mukherjee et al. 2013; Wilcox et al. 1988).

This study has some limitations. Given the specific patient population with a substance use rate higher than the national average, our findings may be difficult to apply to other, lower risk populations. However, studying the highest risk groups can help to identify areas for improvement with current practices for all populations. Our study utilizes urine drug screening (no confirmatory testing was done) which has been shown to have both false positives and false negatives and have variable timeframes for positivity for each substance (Saitman et al. 2014), so positive screens may over report cannabis and underreport other substances with shorter half-lives. Further limits to generalizability include the fact that our study is a convenience sample and is thus susceptible to selection bias; however, our study sample is representative of the clientele of the two diverse clinics from which they are sourced (Coleman-Cowger et al. 2018). In addition, tobacco use was self-reported and not

biologically confirmed, which may have underestimated the actual prevalence, and only cigarette smoking was assessed which did not allow for an examination of e-cigarette or cigar use. Finally, our study did not include information on mental health comorbidities, which could independently predict cigarette smoking and/or substance use.

Despite these limitations, this study elucidates the frequency of co-use of tobacco and other drugs in a convenience sample of pregnant women presenting to obstetric clinics. When discussing the topic of substance use screening in pregnancy, providers and patients both have legitimate concerns regarding repercussions for pregnant women. Reports of women being penalized rather than treated for use in pregnancy or having the custody of their children jeopardized provide significant barriers to screening and treatment (Terplan and Minkoff 2017). These issues that lead to resistance to universal screening are not addressed in this study but certainly deserve recognition. Advocating for adequate screening protocols is only reasonable if the purpose of screening is to increase access to care and to improve health outcomes for women and their babies. However, avoiding screening because of concerns for social and legal ramifications is missing an opportunity to provide comprehensive treatment for women in need. The harms of tobacco on a mother and developing fetus are well known. Whether or not co-use of substances increases risk greater than each individual substance is not well studied, but further research in this area is warranted. Additional research is also necessary to explore the clinical utility of validated screening tools and questionnaires designed to screen for illicit drug use in obstetric practice settings. Education and resources should be provided to all obstetric healthcare providers to ensure adequate screening and to assist women in cessation of all harmful substances during pregnancy.

Acknowledgements

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Significance

This study examines cigarette smoking and substance use in a high-risk population of pregnant women. Given the changing substance use landscape with increasing cannabis legalization and an unremitting opioid use epidemic, this study provides a current description of the association between tobacco smoking and substance use in pregnancy and speaks to the need to understand the potential implications for the unborn child. The study finds that smokers are more likely to use illicit substances in pregnancy when compared to recent quitters and nonsmokers. Recommendations are provided for engaging pregnant smokers, including incorporating substance use screening for pregnant women who smoke.

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Table 1

Sample characteristics by smoking status

	Nonsmoker (n = 352)	Current smoker (n = 84)	Recent quitter (n = 58)	Total (N = 494)	p value
Age, mean (SD)	28.2 (5.4)	27.2 (4.6)	27.7 (4.8)	28.0 (5.2)	0.31
Marital status					<0.001*
Never married	205 (58.6%)	72 (85.7%)	42 (76.4%)	319 (65.2%)	
Ever married	145 (41.4%)	12 (14.3%)	13 (23.6%)	170 (34.8%)	
Employment					<0.001*
Unemployed	96 (27.6%)	44 (53.7%)	24 (44.4%)	164 (33.9%)	
Employed	252 (72.4%)	38 (46.3%)	30 (55.6%)	320 (66.1%)	
Education					<0.001*
Less than high school	21 (6.0%)	14 (16.9%)	6 (10.7%)	41 (8.4%)	
High school/some college	199 (57.0%)	65 (78.3%)	40 (71.4%)	304 (62.3%)	
College graduate or more	129 (37.0%)	4 (4.8%)	10 (17.9%)	143 (29.3%)	
Race/ethnicity					0.01*
Non-Hispanic white	85 (24.3%)	12 (14.5%)	7 (12.3%)	104 (21.2%)	
Black/African American	233 (66.6%)	71 (85.5%)	45 (79.0%)	349 (71.2%)	
Hispanic	4 (1.1%)	0 (0.0%)	1 (1.8%)	5 (1.0%)	
Other	28 (8.0%)	0 (0.0%)	4 (7.0%)	32 (6.5%)	
Trimester					0.02*
1st trimester	108 (31.1%)	32 (38.1%)	8 (14.3%)	148 (30.4%)	
2nd trimester	113 (32.6%)	29 (34.5%)	27 (48.2%)	169 (34.7%)	
3rd trimester	126 (36.3%)	23 (27.4%)	21 (37.5%)	170 (34.9%)	
Pregnancy intention (wanted to be pregnant…)					0.09
Sooner	59 (16.9%)	12 (14.3%)	12 (21.4%)	83 (16.9%)	
Later	126 (36.0%)	39 (46.3%)	18 (32.1%)	183 (37.4%)	
Then	127 (36.3%)	18 (21.3%)	20 (35.7%)	165 (33.7%)	
Did not want to be pregnant	38 (10.9%)	15 (17.9%)	6 (10.7%)	59 (12.0%)	
Past miscarriages or stillbirths					0.36
Yes	106 (30.1%)	30 (35.7%)	22 (37.9%)	158 (32.0%)	
No	246 (69.9%)	54 (64.3%)	36 (62.1%)	336 (68.0%)	

	Nonsmoker (n = 352)	Current smoker (n = 84)	Recent quitter (n = 58)	Total (N = 494)	p value
Alcohol use in pregnancy					
Use	70 (19.9%)	18 (21.4%)	8 (13.8%)	96 (19.4%)	
No use	282 (80.1%)	66 (78.6%)	50 (86.2%)	398 (80.6%)	0.49
No of prior pregnancies, mean (SD)	3.1 (2.2)	4.1 (2.2)	4.3 (2.9)	3.4 (2.3)	< 0.001*
No of births, mean (SD)	1.9 (1.1)	2.6 (1.4)	2.4 (1.6)	2.1 (1.3)	< 0.001*

Table 2

Prevalence of drug use in pregnancy by smoking status

Smoking status	All drugs[*]	Marijuana[*]	Opioids[*]	Cocaine	Amphetamines	Benzodiazepines[*]	TCAs
All	27.4%	22.3%	4.0%	0.8%	1.2%	1.0%	1.01
Nonsmoker	19.1%	15.6%	2.0%	0.3%	0.6%	0.3%	0.9%
Current smoker	61.9%	50.0%	11.9%	2.4%	2.4%	1.2%	2.4%
Recent quitter	27.6%	22.4%	3.5%	1.7%	3.5%	5.2%	0.0%
P value	< 0.001	< 0.001	< 0.001	0.11	0.10	0.003	0.32

[*]
Statistically significant at α = 0.05

Table 3

Multivariable analysis of factors associated with drug use in pregnancy

	Adjusted odds ratio	95% Confidence interval	*p* value
Smoking status			
Nonsmoker (ref)	1	1	
Current smoker	4.7	2.6–8.3	< 0.001 [*]
Recent quitter	1.6	0.8–3.3	0.20
Trimester			
1st Trimester (ref)	1	1	
2nd trimester	0.5	0.3–0.9	0.01 [*]
3rd trimester	0.3	0.2–0.6	0.004 [*]
Employment			
Unemployed (ref)	1	1	
Employed	0.5	0.3–0.8	< 0.001 [*]

[*] Statistically significant at $\alpha = 0.05$