2017

Posttraumatic symptom reporting and reported cigarette smoking during pregnancy

Sara L. Kornfield
Washington University School of Medicine in St. Louis

Marian Moseley
University of Pennsylvania Perelman School of Medicine

Dina Appleby
Penn Center for Women's Behavioral Wellness

Courtney L. McMickens
Yale University School of Medicine

Mary D. Sammel
University of Pennsylvania Perelman School of Medicine

See next page for additional authors

JOURNAL OF WOMEN'S HEALTH
Volume 26, Number 6, 2017

DOI: 10.1089/jwh.2016.5928

Posttraumatic Symptom Reporting and Reported Cigarette Smoking During Pregnancy

Sara L. Kornfield, PhD,[1,3,4,*] Marian Moseley, MSW, MPH,[2,*] Dina Appleby, MS,[3,4] Courtney L. McMickens, MD, MPH,[5] Mary D. Sammel, ScD,[6] and C. Neill Epperson, MD[2–4]

Abstract

Introduction: Increased prevalence of nicotine dependence among individuals suffering from posttraumatic stress disorder (PTSD) is well established. However, there are limited studies on the prevalence of smoking during pregnancy in relation to prepregnancy history of trauma exposures and active PTSD symptoms during pregnancy. Prenatal smoking has been implicated in a host of negative outcomes for mother and baby. Given maternal and fetal risk, it is critical to define predictors of continued cigarette smoking during pregnancy.

Methods: Pregnant women from an urban perinatal clinic completed an anonymous survey of trauma history using a modified Traumatic Life Events Questionnaire (TLEQ), PTSD symptoms using the PTSD Symptom Checklist—Civilian Version (PCL-C) and current and past smoking behavior. Those who smoked any number of cigarettes per day after pregnancy confirmation were considered to be ''pregnant smokers.''

Results: Of 218 women who completed the survey, 34 (15.6%) reported smoking cigarettes after confirmation of pregnancy. In unadjusted models, trauma exposure that resulted in fear, helplessness, or horror (FHH), as well as current PTSD symptom severity and probable PTSD diagnosis showed statistical significance as predictors of smoking during pregnancy. After adjusting for age only, PTSD symptoms retained their significant association with smoking during pregnancy. When history of smoking at least five cigarettes per day was added to our models, none of the associations remained significant.

Conclusions: These findings emphasize the importance of the behavioral response to past traumatic exposures in influencing cigarette smoking behavior before pregnancy. Given such behaviors enhance risk for continued tobacco use during pregnancy, a trauma-informed approach to smoking cessation in preconception care may ultimately reduce the likelihood of smoking during pregnancy and requires further study.

Keywords: PTSD, smoking, pregnancy, obstetrics

Implications

This study found that among low-income pregnant women, severity of posttraumatic stress disorder symptoms during pregnancy influences cigarette smoking behavior during pregnancy after adjusting for age. However, this association was diminished after adjusting for a history of smoking at least five cigarettes per day. Traditional smoking cessation curricula may need to be modified to include a trauma-informed approach, especially in preconception care of low-income or chronically stressed women.

Introduction

As of 2014, 16.8% of adults in the United States reported smoking cigarettes, with somewhat higher rates reported among those who are younger (16%–20%), identify

[1]Department of Psychiatry, Washington University School of Medicine, St. Louis, Missouri.
[2]Department of Obstetrics and Gynecology, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, Pennsylvania.
[3]Penn Center for Women's Behavioral Wellness, Philadelphia, Pennsylvania.
[4]Department of Psychiatry, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, Pennsylvania.
[5]Robert Wood Johnson Foundation Clinical Scholars Program, Yale University School of Medicine, New Haven, Connecticut.
[6]Department of Biostatistics and Epidemiology, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, Pennsylvania.
*These authors contributed equally as first authors.

as non-Hispanic Black or African Americans (17.5%), and live in poverty (26.3%).[1] On average, 15% of pregnant women in the United States smoke cigarettes with some variation by race, ethnicity,[2] and location.[3] Smoking has been associated with numerous adverse pregnancy and birth outcomes, including placenta previa, placental abruption, intrauterine growth restriction, low birth weight, and perinatal mortality.[4,5] Women are more likely than men to smoke cigarettes to modulate stress and negative affect,[6,7] and women with posttraumatic stress disorder (PTSD) have been found to have higher rates of cigarette use than their nontraumatized peers.[8,9] PTSD occurs in roughly 10.4% to 13.8% of women of childbearing age.[10] Epidemiological studies suggest that more than half of women will be exposed to a traumatic event in their lifetime, with rates as high as 86% among African American, urban-dwelling women.[11] Active PTSD symptoms and diagnosis during pregnancy have been associated with increased risk of poor pregnancy outcomes such as preterm birth, particularly when comorbid with major depression.[12]

While the relationship between childhood trauma,[13] PTSD,[14] and smoking in nonpregnant women is well established, factors that contribute to continued nicotine use among pregnant women may differ given extensive education regarding the adverse effects of smoking on pregnancy and infant outcomes as well as societal condemnation of smoking during pregnancy. A large government-funded program, Pregnancy Risk Assessment Monitoring System (PRAMS) found that tobacco smoking during pregnancy is negatively associated with income and education[15,16] and prevalence varies widely from state to state (7% to 35%),[15] whereas a smaller study documented a relationship between early childhood trauma and nicotine use during pregnancy.[17] Considering the potential adverse pregnancy sequelae of antepartum nicotine use as well as active PTSD symptoms/diagnosis, we sought to determine the relationship between traumatic life events, PTSD symptoms, and provisional PTSD diagnosis on cigarette smoking during pregnancy in an urban obstetrics–gynecology clinic serving primarily low-income, minority women. We chose to focus on this pregnant population as exposure to trauma has been reported to be significantly higher in low-resourced communities, with rates as high as 88% in some studies.[18] Moreover, trauma exposures independent of PTSD and depression have been linked to substance abuse, including nicotine, among large cohorts of men and nonpregnant women.[19,20]

Specifically, we hypothesized that exposure to traumatic life events would be associated with greater rates of smoking during pregnancy, and those women who reported experiencing intense fear, helplessness, or horror (FHH, required for a diagnosis of PTSD) in response to traumatic life events would have higher rates of smoking during pregnancy than those who did not. Also, greater severity of PTSD symptoms would be associated with increased odds of smoking during pregnancy. Finally, among women who reported at least one lifetime trauma exposure resulting in FHH, those who met DSM-IV-TR[21] criteria for partial PTSD (pPTSD) or full PTSD (fPTSD) would be more likely to smoke during pregnancy than those who did not meet these criteria. While both tobacco smoking and PTSD are independently associated with poor pregnancy outcomes,[4,9,22] this project is the first to address the impact of trauma exposures themselves on risk for nicotine use during pregnancy. The significance of this study lies in the ease with which pregnant women could be identified as being at risk for continued nicotine use due to self-reported traumatic exposures.

Materials and Methods

Participants and recruitment

Anonymous survey packets were distributed to pregnant women attending one urban, university-based perinatal care clinic for low-income women over an 18-month period from June 2011 to January 2013. The packets included a face sheet describing the study, a two-item comprehension ''test,'' the Traumatic Life Events Questionnaire (TLEQ), the PTSD Checklist—Civilian version (PCL-C), and a survey assessing women's lifetime smoking behavior, current smoking behavior, attempts to quit smoking, legal and illegal substance use, and environmental exposure to tobacco smoke during the current pregnancy. Initially, the survey packets were distributed to all pregnant women at 30 weeks or greater gestation, and were later distributed to all pregnant women regardless of gestational age. Despite best efforts, survey packets were not distributed at all clinic sessions due to limitations in staff availability. However, there was no systematic bias in which particular clinic sessions were omitted and no women were systematically excluded based on any specific criteria at clinic sessions during which the packets were being distributed. Respondents placed completed survey packets in a secured box stationed close to the reception. This project was approved by the University of Pennsylvania Institutional Review Board and patients demonstrated informed consent by completing the survey.

Assessments

Tobacco and other drug use. To determine lifetime history of smoking, each participant was asked whether she had ever smoked at least five cigarettes a day. Smoking habits during pregnancy were assessed by asking each participant if she had smoked, how many cigarettes per day she smoked, when was the last time she smoked, and if she had tried to quit smoking during this pregnancy. In addition to smoking history, participants were asked if they had used other legal or illegal substances, specifically cocaine, heroin, ecstasy, oxycodone or oxycontin (not prescribed), marijuana, downer/sleeping pills, such as Xanax (not prescribed), and alcohol during their current pregnancy.

Traumatic life events questionnaire. The TLEQ[23] is a self-report measure addressing 22 different types of potentially traumatic events, including natural disasters, personal violence, and abuse. For this study, the TLEQ was modified slightly to include one additional type of event, house fire, as this has been a relatively common experience for women in this particular setting. Participants were asked to mark the check box next to each of the events they have experienced. The last check-box on the list allows the participant to identify ''None of these events happened to me.'' A follow-up question asks whether the participant experienced intense FHH in response to any of the reported events, and if so, participants are instructed to circle the life event or events that resulted in such feelings. The TLEQ was validated on abused women and Vietnam War veterans with documented

combat service. The measure showed good test–retest reliability with kappa coefficients showing 0.86 agreement over 2 weeks for the 22 items assessed, and 0.89 agreement for the presence of FHH. Convergent validity was assessed, and the mean percentage of agreement between the TLEQ and a modified interview version of the same checklist was 0.92. Although we added one item to this measure, we do not expect that this significantly changed the reliability and validity of the measure as a whole. Discriminative validity was good with women who met the cutoff for PTSD on a self-report measure reporting significantly more types of traumatic events, more total events, and more events that evoked FHH on the TLEQ than women who did not meet the PTSD cutoff.[23]

The PTSD checklist—civilian version. PCL-C is a 17-item questionnaire designed to assess the severity of PTSD symptoms. Respondents rate each item on a 5-point Likert scale from 1 (not at all) to 5 (extremely) to indicate how much they have been bothered by the particular symptom in the last month. The 17 items correspond to the 17 symptoms in DSM-IV.[21] Total possible scores range from 17 to 85 with a cut-off of 50 sometimes suggested as consistent with a diagnosis of fPTSD.[24] The PCL-C has demonstrated strong psychometric properties. Estimates of internal consistency (Cronbach's alpha) range between 0.94[25] and 0.97.[24] Test–retest reliability has been reported as 0.96 at 2–3 days and 0.88 at 1 week.[25,26] The PCL-C shows convergent validity of $r = 0.85$–0.95 with the Mississippi PTSD Scale,[24] and strong correlations with a diagnostic instrument, the Clinician-Administered PTSD Scale ($r = 0.92$).[25]

In this study, total PCL-C score was used as an indication of severity of PTSD symptoms among all women who answered at least 15 of the 17 questions. Among women who reported at least one traumatic life event resulting in intense FHH, a presumed diagnosis of PTSD was assigned based on the DSM-IV criteria, as follows: Women who rated a score of 3 (Moderately) or higher on at least one symptom from cluster B (re-experiencing), at least three from cluster C (avoidance), and at least two from cluster D (arousal) were categorized as having fPTSD. pPTSD was defined as a condition in which a respondent met criteria for cluster B and *either* cluster C *or* cluster D, but not both. Symptom clusters refer to specific types of symptoms outlined in the DSM-IV-TR diagnostic criteria. Symptom cluster B refers to re-experiencing symptoms, including frequent intrusive memories, dreams, or flashbacks of the traumatic event; symptom cluster C refers to avoidance symptoms, such as cognitive or behavioral avoidance or difficulty remembering the traumatic event, and feeling detached from others with a restricted affective range; symptoms cluster D refers to increased arousal as indicated by insomnia, anger, poor concentration, hypervigilance, and an exaggerated startle response.[21]

Data analysis

Inclusion/exclusion criteria. Data collected were coded and entered into a Microsoft Excel file. Surveys were examined for completeness and excluded from the sample if the participant was <18 years old; if the nicotine section was not completed; if there was inconsistency in reporting of one or more traumatic life events versus the ''None of these happened to me'' box; or if one or more traumatic life events were reported, but the question regarding intense FHH was not completed. Incorrect answers on the two-item comprehension test were also grounds for exclusion. Ten participants who answered fewer than 15 of the 17 PCL-C questions were excluded from the analyses on PTSD symptom severity and diagnosis.

Statistical analyses. Group differences in mean maternal age and mean gestational age were evaluated using *t*-tests, whereas Fisher's Exact test was used to compare the distribution of race/ethnicity between groups. Logistic regression models were used to evaluate the effect of exposure to traumatic events, PCL-C score, and presumed PTSD diagnosis on the odds of smoking during pregnancy. Results are presented as unadjusted, adjusted for age only, and adjusted for age and history of ever smoking five or more cigarettes per day.

All analyses were performed using SAS 9.4, Cary, NC.

Results

Demographics

Approximately 76.6% of women who were given a survey packet at their prenatal visit completed the survey. Of the 449 surveys distributed over 18 months, 344 were returned. Of these, 19 were excluded due to age <18, 80 were excluded for incorrect answers to the comprehension test questions, and 27 were excluded for inconsistent responses to questions regarding cigarette smoking; traumatic life events; fear, horror, and helplessness; and PTSD symptoms. A total of 218 participants' survey responses were included in the analysis.

Of these, 34 (15.6%) reported smoking during their current pregnancy. Participants' characteristics are depicted in Table 1 overall and by reported smoking status during pregnancy. Briefly, respondents were 18–42 years old, with a mean age of 24.9 years of age (SD = 5.2) and an average gestational age of 30.5 (8.9) weeks. Women who reported smoking during pregnancy (mean age 27.7; SD = 5.2) were significantly older than nonsmokers (24.4; SD = 4.8; $p = 0.0005$). More than 80% of the participants were African American, ~8% were White, and less than 2% were Hispanic, which is consistent with the general population of women who use this clinic for obstetrical and gynecological care.

Tobacco smoking and substance use reported

Of the total sample, 44 (20.2%) reported having smoked at least five cigarettes per day in their lifetime (Table 1). Of the 34 pregnant smokers in the sample, 26 (76.5%) reported having smoked at least five cigarettes/day at some point in their lives, compared with only 18 (9.5%) of those who denied smoking during pregnancy [OR 30.0 (11.8–75.9); $p < 0.0001$]. Seventy women reported living in a household with at least one other smoker; this was also significantly associated with smoking during pregnancy [4.1 (1.9–8.8); $p = 0.0003$], as was use of any drugs or alcohol during this pregnancy, a claim reported by 8 (23.5%) of the women who smoked during pregnancy versus 12 (6.5%) of the women who did not [4.4 (1.6–11.8); $p = 0.0032$].

Traumatic life events

One hundred forty-eight (67.9%) participants reported at least one event assessed by the TLEQ; of these, 36 (24.3%) reported having experienced 1 event, 33 (22.3%) reported 2

Table 1. Participant Characteristics

	Total participants (N = 218)	*Women reporting smoking during pregnancy (N = 34)*	*Women denying smoking during pregnancy (N = 184)*	*Statistical significance*
Mean age (SD), years	24.9 (5.2)	27.7 (6.1)	24.4 (4.8)	$t = 3.52$; $p = 0.0005$
Mean gestational age (SD), weeks	30.5 (8.9)	29.8 (9.3)	30.6 (8.8)	$t = -0.52$; $p = 0.6068$
Race/Ethnicity, *n* (%)				Fisher's *p*-value = 0.0721[a]
African American	177 (81.2)	23 (67.7)	154 (83.7)	
Asian	5 (2.3)	1 (2.9)	4 (2.2)	
White	18 (8.3)	5 (14.7)	13 (7.1)	
Hispanic/Latina	4 (1.8)	1 (2.9)	3 (1.6)	
Other	11 (5.1)	4 (11.8)	7 (3.8)	
No response	3 (1.4)	0	3 (1.6)	
Smoking/substance abuse, *n* (%)				OR (CI); *p*-value
Smoked at least five cigarettes per day	44 (20.2)	26 (76.5)	18 (9.8)	30.0 (11.8–75.9); <0.0001
Anyone living in household smokes cigarettes	70 (33.8)	21 (61.8)	49 (28.3)	4.1 (1.9–8.8); 0.0003
Any drugs or alcohol	20 (9.2)	8 (23.5)	12 (6.5)	4.4 (1.6–11.8); 0.0032

[a]This is excluding the three with no response. Fisher's exact test table probability = 0.0006.

events, 37 (25.0%) reported 3 or 4, and the remaining 42 (28.4%) reported 5 or more. Of the 148 women reporting at least one traumatic exposure, 70 (43.8%) reported FHH in response to at least one event. The most commonly reported traumatic life event was miscarriage, reported by 56 (25.7%) of respondents. The next most prevalent were motor vehicle accidents and witnessing family violence while growing up, each of which were reported by 43 women (19.7%).

Reporting at least one traumatic event was not significantly associated with smoking during pregnancy ($p = 0.123$ unadjusted or after adjusting for age only, $p = 0.236$, or when adjusted for maternal age and smoking history, $p = 0.449$) (Table 2) and neither did we find a significant dose/response relationship between number of traumatic events and odds of smoking during pregnancy (data not shown). However, exposure to at least one traumatic event that also resulted in FHH was significantly associated with smoking during pregnancy [unadjusted OR 2.14 (1.02–4.51); $p = 0.045$]. This association was attenuated after adjusting for age [OR 2.02 (0.94–4.36); $p = 0.072$] and age and history of smoking five or more cigarettes per day [OR = 1.29 (0.49–3.41); $p = 0.602$].

PTSD symptoms and diagnosis

PCL-C scores ranged from 17 to 76, with a median of 24 [Interquartile Range (IQR) = 18–34]. This distribution was highly skewed, with 48 (22.9%) of participants reporting the lowest possible score of 17. In unadjusted logistic regression models, each 1-point increase in PCL-C total was associated with a 4% increased odds of smoking during pregnancy [OR 1.04 (1.01–1.07); $p = 0.004$]. Results were similar when this model was adjusted for age only, however, this relationship fell below the level of significance once the model was adjusted for age and smoking history [OR 1.02 (0.99–1.06); $p = 0.204$].

Because there was such a large floor effect in the PCL-C scores, we tested a three-level categorical model comparing women who reported the minimal score of 17 (no symptoms) versus those who scored 18–49 (moderate symptoms) versus those who scored 50 or higher (severe symptoms). In this study, as expected, the unadjusted model was highly significant ($p = 0.004$ overall) with significant *post hoc* test results for both the moderate and severe scores as compared with those with no symptoms ([OR 9.32 (1.23–70.88); $p = 0.031$], and [OR 32.9 (3.63–298); $p = 0.002$], respectively.) (Table 3.) Associations were similar after adjusting for age only [OR 9.03 (1.18–69.41); $p = 0.034$] and [OR 42.45 (4.54–397.25); $p = 0.001$]. Even after adjusting for age and history of smoking five or more cigarettes per day, the overall effect of this three-level variable was still borderline significant ($p = 0.056$), with the comparison of those with severe symptoms still significantly associated with increased odds of smoking during pregnancy compared with those without any PTSD symptoms [OR 17.57 (1.59–194.6); $p = 0.020$].

Among the 70 women who completed the PCL-C and reported at least one traumatic life event resulting in FHH, 16 (23.2%) and 15 (21.7%) women met our diagnostic criteria for probable fPTSD and pPTSD, respectively. Note that this represents 7.6% and 7.1%, respectively, of the 210 women who completed the PCL-C. Using a three-level categorical variable to contrast no PTSD versus partial versus full, an unadjusted logistic regression model for smoking during pregnancy showed overall significance ($p = 0.040$), with a finding of significant association *post hoc* between those with fPTSD and those with none [OR 4.07 (1.35–12.26); $p = 0.013$]. The overall test of association was similar after adjustment for age, $p = 0.027$, however significance did not remain after controlling for age and smoking history (overall $p = 0.165$). Incidentally, higher PCL-C scores were associated with a history of heavy smoking ($\chi^2 = 11.91$, $p = 0.003$) and women with probable PTSD diagnosis, measured by the three-level variable were significantly more likely to have a history of smoking five or more cigarettes per day ($\chi^2 = 11.01$, $p = 0.004$).

Discussion

The relationship between PTSD symptoms and prenatal smoking behavior was evaluated in a sample of low-income, minority women residing in an urban setting. The prevalence of reported cigarette use during pregnancy in this sample (15.6%), was similar to that reported by the Center for

Table 2. Association of Traumatic Life Events and Smoking During Pregnancy

	Prevalence of smoking during pregnancy		OR (CI); p-value				
	Smoked (N = 34)	*Denied (N = 184)*	*Un-adjusted*	*Adjusted for age only*	*Adjusted for age and history of smoking 5+ cigarettes/day*	*Age*	*History of smoking 5+ cigarettes/day*
Exposure to at least 1 traumatic event	27 (79.4)	121 (65.8)	2.01 (0.83–4.9); 0.123	1.73 (0.70–4.28); 0.236	1.55 (0.50–4.77); 0.449	1.123 (1.03–1.23); <0.0001	29.78 (11.25–78.86); 0.010
At least 1 traumatic event that results in FHH	16 (47.1)	54 (29.4)	2.14 (1.02–4.51); 0.045	2.02 (0.94–4.36); 0.072	1.29 (0.49–3.41); 0.602	1.123 (1.03–1.23); <0.0001	29.11 (10.92–77.57); 0.010
Three-way trauma variable			Wald $\chi^2 = 4.43$; 0.109	Wald $\chi^2 = 3.39$; 0.184	Wald $\chi^2 = 0.608$; 0.738		
0 = no TLE	7 (20.6)	63 (34.2)	Reference	Reference	Reference		
1 = at least 1 TLE, but no FHH	11 (32.4)	67 (36.4)	1.48 (0.54–4.05); 0.448	1.26 (0.45–3.55); 0.657	1.46 (0.41–5.20); 0.556	1.12 (1.03–1.23); 0.010	29.37 (10.98–78.55); <0.0001
2 = at least 1 TLE and at least 1 FHH	16 (47.1)	54 (29.4)	2.67 (1.02–6.96); 0.045	2.31 (0.86–6.19); 0.184	1.62 (0.47–5.57); 0.444		

FHH, fear, helplessness, or horror; TLE, traumatic life event.

Disease Control for the State of Pennsylvania in 2010,[27] suggesting that the smoking rate in our sample is representative of that in the general population. As expected, respondents reported high levels of potentially traumatic life events with more than a third experiencing three or more events across their lifetimes. The proportion of women reporting at least one trauma exposure (67.9%) was somewhat higher than that reported in a similar, but larger cohort of pregnant women (54.5%) from whom trauma history was assessed face-to-face. Those reporting having experienced the requisite emotional response for the event to be characterized as a ''trauma,'' according to the DSM-IV (FHH), was 32.1% in the present study and 36.3% in the larger study.[28] With respect to our hypotheses, our principal finding is that greater PTSD symptom severity and possible diagnosis of fPTSD, but not exposure to traumatic life events, were associated with smoking during pregnancy after adjusting for age.

We also found that age and, not surprisingly, lifetime history of smoking five or more cigarettes per day were significantly associated with smoking during pregnancy. Given the powerful influence of previous smoking history on smoking behavior during pregnancy, we were able to observe an impact of trauma exposure, PTSD symptoms, and probable fPTSD diagnosis on smoking in pregnancy in age-adjusted models only. Including the effects of prepregnancy smoking behavior (smoking five or more cigarettes per day ever) in the statistical models understandably washed out the effects of trauma specifically on prenatal smoking. This supports the idea that lifetime history of heavy smoking is a mediator of the relationship between PCL-C or PTSD and smoking during pregnancy.

Given that prior research (e.g., Ref.[29]) has found that nonpregnant women who screen positive for PTSD are more likely to engage in negative health behaviors, such as alcohol and substance abuse, contact with multiple sexual partners, and smoking, this finding could be explained by the fact that PTSD symptoms may make cessation of these behaviors (at conception or otherwise) difficult without treatment.

Having exposure to a potentially traumatizing event was not sufficient to influence prenatal smoking. This was the case regardless of the number of traumatic events an individual reported. The subjective experience of FHH in response to at least one event was required to observe a relationship between events and smoking during pregnancy. This finding is consistent with our observation that women with the highest PCL-C scores or those meeting criteria for probable fPTSD were more likely to smoke during pregnancy. It is possible that those who have been exposed to a traumatic stressor and do not go onto meet criteria for PTSD (full or partial) may possess protective psychosocial factors, and are less likely to need affective modulation from nicotine. Alternatively, external supportive factors, such as social support, education, behavioral health, and community and spiritual resources, have been shown to increase the resilience in women who have been exposed to trauma.[30,31] These protective factors serve to modulate stress, contributing to decreased smoking or smoking cessation. Limited or no access to these protective factors and resources could compound stress, leading to continued tobacco smoking during pregnancy. These data suggest that simply screening women for history of traumatic exposures is not sufficient to determine increased risk for continued smoking during

Table 3. Association of Posttraumatic Stress Disorder Symptom Severity and Diagnosis with Smoking During Pregnancy

	Prevalence of smoking during pregnancy		*OR (CI);* p-*value*				
	Smoked (N = 32)	*Denied (N = 178)*	*Unadjusted*	*Adjusted for age only*	*Adjusted for age and Hx of smoking 5+ cigarettes/day*	*Age*	*History of smoking 5+ cigarettes/day*
PCL total score [continuous variable]	31 [22–46]	22 [17–32]	1.04 (1.01–1.07); 0.004	1.04 (1.01–1.07); 0.002	1.02 (0.99–1.06); 0.204	1.12 (1.02–1.23); 0.017	24.17 (8.99–65.06); <0.0001
PCL total score (three-way categorical variable)			Wald $\chi^2 = 11.07$; 0.004	Wald $\chi^2 = 12.95$; 0.002	Wald $\chi^2 = 5.76$; 0.056		
PCL-Tot = 17 (min possible score)	1 (3.1)	47 (26.4)	Reference	Reference	Reference		
PCL-Tot between 18 and 49	24 (75.0)	121 (68.0)	9.32 (1.23–70.88); 0.031	9.03 (1.18–69.41); 0.034	5.82 (0.68–49.53); 0.107	1.12 (1.02–1.23); 0.014	22.40 (8.24–60.93); <0.0001
PCL-Tot 50+	7 (21.9)	10 (5.6)	32.9 (3.63–298.0); 0.002	42.45 (4.54–397.26); 0.001	17.57 (1.59–194.6); 0.020		
PTSD diagnosis			Wald $\chi^2 = 6.43$; 0.040	Wald $\chi^2 = 7.23$; 0.027	Wald $\chi^2 = 3.60$; 0.165		
None	23 (71.9)	156 (87.6)	Reference	Reference	Reference		
Partial	3 (9.4)	12 (6.7)	1.70 (0.45–6.47); 0.440	1.22483 (0.30–5.00); 0.778	0.37 (0.06–2.22); 0.274	1.14 (1.04–1.25); 0.005	29.38 (10.48–82.38); <0.0001
Full	6 (18.8)	10 (5.6)	4.07 (1.35–12.26); 0.013	4.83 (1.53–15.24); 0.007	2.89 (0.68–12.19); 0.149		

PTSD, posttraumatic stress disorder.

pregnancy, rather pregnant women should be screened for trauma-related symptoms and resilience or external protective factors that may influence their smoking status.

Interestingly, 8 of the 34 women who reported smoking during pregnancy did not report a history of ever smoking five or more cigarettes per day, suggesting that any degree of smoking before pregnancy (not just heavier smoking) may place women at risk for continued cigarette use after conception. Alternatively, previous epidemiological research has shown that ~10% of women from low-income urban settings initiate cigarette smoking during pregnancy.[32] Risk factors for uptake of cigarette smoking during pregnancy included high levels of current stress and depression, additional risk factors for suboptimal pregnancy outcome, and potential targets for intervention.

The observation that in our sample, higher PCL-C scores and probable PTSD diagnosis were associated with history of smoking more than five cigarettes per day before pregnancy is not surprising given similar findings by Lopez et al.[16] The participants in that study who reported a history of heavy smoking were also more likely to smoke during their pregnancies if they regarded smoking as a coping mechanism for stress associated with PTSD.[16] Kim et al.[28] also found a significant association between tobacco smoking and subthreshold PTSD. The significance of these incidental findings is that women from lower socioeconomic backgrounds experiencing symptoms of PTSD are significantly more likely to be smokers preconception, leading to a higher likelihood of smoking during pregnancy.

Limitations

In addition to the small sample size, which may have underpowered our analyses, there are several study limitations to consider, the anonymous nature of the surveys may have contributed to greater self-disclosure of tobacco use during pregnancy, however, use could not be confirmed with standard cotinine assays or carbon monoxide testing and surveys could not be reviewed in real time to capture missing data and correct obvious mistakes in survey responses. Several,[33–35] but not all[36] studies suggest that the prevalence of smoking during pregnancy, confirmed by urine or serum cotinine levels, is significantly higher than what is self-disclosed. A previous study, using face-to-face interviews to obtain smoking history and blood cotinine levels as confirmation, found that pregnant women who smoked withheld their smoking status at a higher rate (22%) compared with nonpregnant smokers (9.2%),[37] perhaps due to the stigma of smoking while pregnant. Given that the prevalence of reported smoking during pregnancy in this sample is similar to that reported for the entire state of Pennsylvania and higher than the cotinine-confirmed smoking prevalence (13%) among pregnant women in the previously mentioned study, we feel assured that respondents to the survey answered truthfully.

Similarly, details regarding respondents' history of trauma exposure, emotional response to said traumas and diagnosis of PTSD could not be obtained given the anonymity of the surveys. We compensated somewhat for this limitation by using the TLEQ, which requires respondents to indicate whether the event in question evoked the requisite emotional response to consider the event as traumatic. However, only 38 of the 70 participants who indicated that they experienced FHH in response to at least one traumatic event followed the instructions to go back and circle the particular event(s) that caused those feelings. With this smaller sample size, analysis of a dose–response effect showed no significance in predicting smoking during pregnancy, even in unadjusted models. We cannot determine whether such an effect would have been detected had all of the respondents indicated which or how many events caused them distress.

Likewise, we examined both severity of posttraumatic symptoms using the PCL-C and then applied the DSM-IV criteria for PTSD to examine the various clusters of symptoms reported with sufficient severity on the PCL-C to determine probable diagnosis of pPTSD or fPTSD. Additionally, we limited the probable pPTSD and fPTSD distinctions to only those 70 women who reported experiencing the requisite emotional response to event exposures. In the present study, prevalence of probable pPTSD (7.1%) and fPTSD (7.6%) was somewhat higher than that reported when a structured clinical interview for DSM disorders (SCID) interview was administered in a study of 745 women receiving prenatal care through three different Healthy Start Programs (pPTSD = 4.2% and fPTSD = 6.6%).[28]

Conclusions

Previous exposure to stressful life events may not be sufficient to increase the risk of cigarette smoking during pregnancy, however, women who have elevated trauma-related symptoms or probable PTSD and smoke before conception may fail to quit after conception. Screening at-risk pregnant women should include assessment of the individual's emotional response to potentially traumatizing events as well as severity of posttraumatic symptoms. That smoking before pregnancy is such a strong predictor of smoking during pregnancy and exposure to traumatic life events was sufficient to increase prepregnancy smoking suggests that assessment of how smoking may be used to cope with the emotional sequelae of these events should occur in the primary or preconception care of women.

Acknowledgments

This article was supported, in part, by funding due to the following grants: Dr. Kornfield's 5K23MH102360 and Dr. Epperson's P50 MH099910; K24 DA030301; and R01 DA037289.

Author Disclosure Statement

No competing financial interests exist.

References

1. Centers for Disease Control and Prevention. Current cigarette smoking among adults—United States, 2005–2014. Morb Mortal Wkly Rep 2015;64:1233–1240.
2. SAMHSA. Substance use during pregnancy varies by race and ethnicity. Center for Behavioral Health Statistics and Quality Data Spotlight, 2012. Available at: www.samhsa.gov/data/sites/default/files/Spot062PregnantRaceEthnicity2012/Spot062PregnantRaceEthnicity2012.pdf. Accessed April 10, 2016.
3. CDC. Smoking prevalence among women of reproductive age—United States, 2006. Morb Mortal Wkly Rep 2008; 57:849–852.
4. Cnattingius S. The epidemiology of smoking during pregnancy: Smoking prevalence, maternal characteristics, and pregnancy outcomes. Nicotine Tob Res 2004;6:S125–S140.
5. Salihu HM, Wilson RE. Epidemiology of prenatal smoking and perinatal outcomes. Early Hum Dev 2007;83:713–720.

6. Xu J, Azizian A, Monterosso J. Gender effects on mood and cigarette craving during early abstinence and resumption of smoking. Nicotine Tob Res 2008;10:1653–1661.
7. Perkins KA, Karelitz JL, Giedgowd GE, Conklin CA. Negative mood effects on craving to smoke in women versus men. Addict Behav 2013;38:1527–1531.
8. Chung EK, Nurmohamed L, Mathew L, Elo IT, Coyne JC, Culhane JF. Risky health behaviors among mothers-to-be: The impact of adverse childhood experiences. Acad Pediatr 2010;10:245–251.
9. Seng JS, Low LK, Sperlich M, Ronis DL, Liberzon I. Prevalence, trauma history, and risk for posttraumatic stress disorder among nulliparous women in maternity care. Obstet Gynecol 2009;114:839–847.
10. Loveland Cook CA, Flick LH, Homan SM, Campbell C, McSweeney M, Gallagher ME. Posttraumatic stress disorder in pregnancy: Prevalence, risk factors and treatment. Obstet Gynecol 2004;103:710–717.
11. Gill JM, Page GG, Sharps P, Campbell JC. Experiences of traumatic events and associations with PTSD and depression development in urban healthcare-seeking women. J Urban Health 2008;85:693–706.
12. Yonkers KA, Smith MV, Forray A, et al. Pregnant women with posttraumatic stress disorder and risk of preterm birth. JAMA Psychiatry 2014;71:897–904.
13. Ganz ML. The relationship between external threats and smoking in central Harlem. Am J Public Health 2000;90: 367–371.
14. Acierno RA, Kilpatrick DG, Resnick HS, Saunders BE, Best CL. Violent assault, posttraumatic stress disorder, and depression: Risk factors for cigarette use among adult women. Behav Modif 1996;20:363–384.
15. Tong VT, Jones JR, Dietz PM, D'Angelo D, Bombard JM. Trends in smoking before, during and after pregnancy—Pregnancy Risk Assessment Monitoring System (PRAMS), United States, 31 sites, 2000–2005. Morb Mortal Wkly Rep 2009;58:1–29.
16. Lopez WD, Konrath SH, Seng JS. Abuse-related posttraumatic stress, coping, and tobacco use in pregnancy. J Obstet Gynecol Neonatal Nurs 2011;40:422–431.
17. Blalock JA, Nayak N, Wetter DW, et al. The relationship of childhood trauma to nicotine dependence in pregnant smokers. Psychol Addict Behav 2011;25:652–663.
18. Gillespie CF, Bradley B, Mercer K, et al. Trauma exposure and stress-related disorders in inner city primary care patients. Gen Hosp Psychiatry 2009;31:505–514.
19. Waldrop AE, Cohen BE. Trauma exposure predicts alcohol, nicotine, and drug problems beyond the contribution of PTSD and depression in patients with cardiovascular disease: Data from the Heart and Soul Study. Am J Addict 2014;23:53–61.
20. Walsh K, Elliott JC, Shmulewitz D, et al. Trauma exposure, posttraumatic stress disorder and risk for alcohol, nicotine, and marijuana dependence in Israel. Compr Psychiatry 2014; 55:621–630.
21. American Psychiatric Association. Diagnostic and statistical manual of mental disorders (4th ed., text rev.). Washington, DC: American Psychiatric Association; 2000.
22. Morland L, Goebert D, Onoye J, et al. Posttraumatic stress disorder and pregnancy health: Preliminary update and implications. Psychosomatics 2007;48:304–308.
23. Kubany E, Haynes S, Leisen M, et al. Development and preliminary validation of a brief broad-spectrum measure of trauma exposure: The Traumatic Life Events Questionnaire. Psychol Assess 2000;12:210–224.
24. Weathers F, Litz B, Herman D, Huska J, Keane T. The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility. Paper presented at the Annual Convention of the International Society for Traumatic Stress Studies, San Antonio, TX, 1993.
25. Blanchard EB, Jones-Alexander J, Buckley TC, Forneris CA. Psychometric properties of the PTSD checklist (PCL). Behav Res Ther 1996;34:669–673.
26. Ruggiero KJ, Del Ben K, Scotti JR, Rabalais AE. Psychometric properties of the PTSD checklist-civilian version. J Trauma Stress 2003;16:495–502.
27. Tong VT, Dietz PM, Morrow B, et al. Trends in smoking before, during and after pregnancy—Pregnancy risk assessment monitoring system, United States, 40 sites, 2000–2010. CDC Surveill Summ 2013;62:1–19.
28. Kim HG, Harrison PA, Godecker AL, Muzyka CN. Posttraumatic stress disorder among women receiving prenatal care at three federally qualified health centers. Matern Child Health J 2014;18:1056–1065.
29. Dobie DJ, Kivlahan DR, Maynard C, et al. Posttraumatic stress disorder in female veterans: Association with self-reported health problems and functional impairment. Arch Intern Med 2004;164:394–400.
30. Domhardt M, Münzer A, Fegert JM, Goldbeck L. Resilience in survivors of child sexual abuse. Trauma Violence Abuse 2015;16:476–493.
31. McAdoo HP. African-American families: Strengths and realities. In: McCubbin HI, Thompson EA, Thompson AI, Futrell JA, eds. Resiliency in African-American families. Thousand Oaks, CA: Sage Publications, 1998:17–30.
32. Webb DA, Culhane J, Mathew L, Bloch JR, Goldenberg RL. Incident smoking during pregnancy and the postpartum period in a low-income urban population. Public Health Rep 2011;126:50–59.
33. Britton GR, Brinthaupt J, Stehle JM, James GD. Comparison of self-reported smoking and urinary cotinine levels in a rural pregnant population. J Obstet Gynecol Neonatal Nurs 2004;33:306–311.
34. Russell T, Crawford M, Woodby L. Measurements for active cigarette smoke exposure in prevalence and cessation studies: Why simply asking pregnant women is not enough. Nicotine Tob Res 2004;6 Suppl 2:S141–S151.
35. Burstyn I, Kapur N, Shalapay C, et al. Evaluation of the accuracy of self-reported smoking when the biomarker level in an active smoker is uncertain. Nicotine Tob Res 2009;11:670–678.
36. Ross JA, Swensen AR, Murphy SE. Prevalence of cigarette smoking in pregnant women participating in the supplemental nutrition programme for women infants and children in Minneapolis and Saint Paul, Minnesota USA. Paediatr Perinat Epidemiol 2002;16:246–248.
37. Dietz PM, Homa D, England LJ, et al. Estimates of nondisclosure of cigarette smoking among pregnant and nonpregnant women of reproductive age in the United States. Am J Epidemiol 2001;173:355–359.

Address correspondence to:
Sara L. Kornfield, PhD
Department of Psychiatry
Washington University School of Medicine
600 S. Euclid Avenue
Campus Box 8134
St. Louis, MO 63110

E-mail: kornfields@psychiatry.wustl.edu