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Relationship Between Postpartum Depression and Perinatal Cigarette Smoking: An Analysis of PRAMS Data[☆]

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Abstract

Introduction—This study examines the relationship between postpartum depression (PPD) and cigarette smoking from prior to pregnancy to postpartum.

Methods—The study sample consisted of 29,654 U.S. women who reported smoking in the 3 months prior to pregnancy and for whom data on PPD were available from the Pregnancy Risk Assessment Monitoring System (PRAMS). Two sets of analyses were conducted. The first compared smoking at 2 time points (prior to pregnancy and postpartum) and the second at 3 time points (prior to pregnancy, during pregnancy, and postpartum). PPD was defined as responses of “often” or “always” to 2 questions: “Since your baby was born, how often have you felt down, depressed, or sad?” and “Since your new baby was born, how often have you had little interest or little pleasure in doing things?”

Results—Overall, 22% of the sample endorsed PPD symptoms. In the 2 time-point analysis, controlling for known confounders, participants whose smoking was reduced or unchanged postpartum were about 30% more likely to have PPD compared to those who quit (OR: 1.34; 95% CI = 1.10–1.60, $p = 0.001$; OR: 1.32; 95% CI: 1.10–1.50, $p < 0.001$ respectively). Participants who increased smoking postpartum were 80% more likely to have PPD compared those who quit (OR: 1.80; 95% CI: 1.50–2.30, $p < 0.001$). In the 3 time-point analysis, participants who continued smoking at any level during pregnancy and postpartum had 1.48 times the odds of reporting PPD (95% CI: 1.26, 1.73) compared to those who quit during pregnancy and remained quit postpartum. Participants who quit during pregnancy but resumed postpartum had 1.28 times the odds of reporting PPD (95% CI: 1.06, 1.53) compared to those who quit during pregnancy and remained quit postpartum.

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Conclusion—Results suggest an association among women who smoke cigarettes prior to pregnancy between PPD and continued smoking during pregnancy and postpartum.

Keywords

Smoking; Pregnancy; Postpartum depression

1. Introduction

Postpartum depression (PPD) is a relatively common disorder with potentially devastating effects (Beck, 2002, 2006; Gress-Smith, Luecken, Lemery-Chalfant, & Howe, 2012; Roux, Anderson, & Roan, 2002). PPD has a lifetime prevalence of approximately 13% (Jewell, Dunn, Bondy, & Leiferman, 2010) and, similar to other episodes of major depressive disorder, can vary in severity. In its most severe form, PPD symptoms may include hallucinations, delusions, suicidal ideation, and/or homicidal ideation, which can lead to maternal and child death (Brockington, 2004; Zauderer, 2009). However milder forms of PPD can also have a significant impact on maternal and child well-being (Gress-Smith et al., 2012; Rhodes & Segre, 2013). Although the causes of PPD are unknown, it has been associated with the hormonal fluctuations of childbirth, stress, lack of social support, interpersonal violence, and substance abuse (Dennis & Vigod, 2013; Fernandez, Grizzell, & Wecker, 2013; Goyal, Gay, & Lee, 2010; Kahn, Certain, & Whitaker, 2002; Marcus, 2009).

About 22% of women of reproductive age in the United States smoke cigarettes (Centers for Disease Control and Prevention (CDC), 2008). Although approximately half of female smokers quit smoking during pregnancy (Colman & Joyce, 2003; Martin et al., 2007; Tong et al., 2009), the majority who quit relapse within 6 months after delivery (Allen, Prince, & Dietz, 2009; Correa-Fernández et al., 2012; Kahn et al., 2002; Park et al., 2009; Solomon et al., 2008). Previous studies have demonstrated a relationship between maternal mental health and postpartum resumption of cigarette smoking, with both worsening stress and depression during pregnancy and PPD associated with smoking relapse following delivery (Allen et al., 2009; Park et al., 2009). The main objective of this study was to examine the relationship between PPD and the change in cigarette smoking behavior across 2 (prior to pregnancy and postpartum) and 3 time points (prior to pregnancy, during pregnancy, and postpartum).

2. Materials and methods

2.1. Study population

The Pregnancy and Risk Assessment Monitoring System (PRAMS) is a population-based project of the CDC and state health departments which surveys postpartum women about factors before, during, and shortly after their most recent pregnancy. PRAMS data are collected from 23 states and New York City, each of which uses a stratified sample system to recruit 100–300 women per month who have delivered a live infant. Detailed information about the PRAMS methodology has been published elsewhere (Shulman, Gilbert, Msphbrenda, & Lansky, 2006). Data from 2004–2008 (Wave 5) were used for this analysis

and limited to women who reported “any cigarette smoking in the 3 months prior to pregnancy” and for whom data were available regarding PPD (N = 29, 654).

2.2. Measures

Smoking at 3 time points was assessed: 3 months prior to pregnancy, during the last 3 months of pregnancy, and postpartum. The postpartum period was defined as the time between delivery and survey completion, which ranged from 2 to 9 months after delivery. Cigarette smoking behavior was assessed by response to survey items which aggregated the number of cigarettes smoked into 7 categories: none, less than 1, 1–5, 6–10, 11–20, 21–40, and 41 or more. As noted previously, inclusion criteria dictated that all participants endorsed smoking in the 3 months prior to pregnancy. Two distinct analyses were conducted to capture the relationship between PPD and perinatal smoking behavior change. First, participants were compared at 2 time points (prior to pregnancy and postpartum) on 4 smoking status variables: quit, reduced, unchanged, and increased smoking. Second, participants were compared at 3 time points (prior to pregnancy during pregnancy, and postpartum) on 3 smoking status variables: 1) smoking prior to pregnancy, not smoking (quit) during last 3 months of pregnancy, and remained quit through the postpartum period, 2) smoking prior to pregnancy, not smoking (quit) during last 3 months of pregnancy, and resumed smoking post-partum, and 3) smoking prior to pregnancy, continued smoking during last 3 months of pregnancy, and continued smoking postpartum. For the purpose of this study, PPD was defined by endorsement of PPD symptoms, as indicated by a response of “often” or “always” to both of 2 PRAMS survey questions: “Since your baby was born, how often have you felt down, depressed or hopeless?” and “Since your new baby was born, how often have you had little interest or little pleasure in doing things?” These 2 questions, based on a validated screen for general depression (Whooley, Avins, Miranda, & Browner, 1997), were adapted by the CDC as a surveillance tool for self-reported PPD on PRAMS. No other questions about depressive symptoms were included on the survey in every state. Socio-demographic factors such as race, age, education, marital status, parity, and income one year before delivery were captured in PRAMS. The institutional review boards at the University of Maryland School of Medicine, Johns Hopkins University School of Medicine, and Maryland Department of Health and Mental Hygiene qualified this project as exempt research.

2.3. Statistical analyses

Weighted univariate and multivariate analysis were performed using STATA v 12.0 to account for PRAMS’ complex sampling design (Shulman et al., 2006) and reported as population proportions with 95% confidence intervals. The weighted univariate analysis applying Chi square testing was performed to evaluate the association of the individual independent variables or confounders with PPD using $p = 0.05$ as the level of significance. Weighted univariate and multivariate logistic analyses were performed reporting crude and adjusted odds ratio. Backwards logistic regression model analysis was performed manually adjusting for important potential confounders. Finally, effect sizes for the odds ratio of the association between PPD and perinatal smoking were calculated using the standard formula.

3. Results

The study sample consisted of 29,654 women who reported smoking cigarettes in the 3 months prior to pregnancy and for whom data on PPD were available. Table 1 depicts the participant characteristics, both overall and stratified by change in smoking status from prior to pregnancy to postpartum (2 time-point analysis) and postpartum depression (PPD). Seventy-five percent of participants – all of whom endorsed smoking prior to pregnancy – also reported smoking postpartum (at reduced, unchanged, or increased levels). Twenty-two percent of all participants endorsed PPD symptoms. Participants who reported reduced, unchanged, or increased smoking from prior to pregnancy to postpartum were significantly more likely to have PPD compared to those who quit smoking (23, 23, and 33% vs. 15%, $p < 0.001$, respectively). Overall, most participants were less than 30-years old, at least high school-educated, and with an annual income under \$50,000. Most participants were white, but 30% of Black/non-Hispanic and 26% of Other/non-Hispanic participants reported PPD, $p = 0.02$ and $p = 0.007$ respectively.

The association of PPD and smoking behavior change from prior to pregnancy to postpartum (2 time-point analysis) and other participant characteristics is illustrated in Table 2. Controlling for known confounders, participants who reported reduced or unchanged smoking from prior to pregnancy to postpartum were about 30% more likely to have PPD than those who quit (OR: 1.34; 95% CI = 1.10–1.60; OR:1.32; 95% CI: 1.10–1.50, respectively) and those who reported increased smoking were 80% more likely to have PPD compared to those who quit (OR: 1.80; 95% CI: 1.50–2.30, $p < 0.001$). As previously mentioned, overall Black/non-Hispanic and Other/non-Hispanic women were more likely to have PPD compared to whites. PPD was also more common as both age and income decreased.

Table 3 stratifies the results based on smoking behavior across 3 time points (prior to pregnancy, during pregnancy, and postpartum). Slightly over half of all study participants continued to smoke during the last 3 months of pregnancy and postpartum. Among the remaining half who were not smoking during the last 3 months of pregnancy, half remained quit postpartum and half resumed smoking postpartum. Therefore, only one quarter of all participants were not smoking post-partum. Participants who continued smoking during the last 3 months of pregnancy and postpartum had 1.48 times the odds of reporting PPD (95% CI: 1.26, 1.73) compared to those who were not smoking during the last 3 months of pregnancy and remained quit postpartum, with an odds ratio effect size of 0.4. Participants who were not smoking during the last 3 months of pregnancy but resumed postpartum had 1.28 times the odds of reporting PPD (95% CI: 1.06, 1.53) compared to those who were not smoking during the last 3 months of pregnancy and remained quit postpartum, with an odds ratio effect size of 0.25.

4. Discussion

This study of nationally representative data suggests a significant relationship between PPD and perinatal smoking behavior. By analyzing the association between PPD and cigarette smoking behavior change among participants at both 2 (prior to pregnancy and postpartum)

and 3 time points (prior to pregnancy, during pregnancy, and postpartum), a more complex understanding of the relationship between PPD and perinatal cigarette smoking, both separately and in concert, emerges. Specifically, these results suggest that women who smoke cigarettes prior to pregnancy and continue to smoke during the last 3 months of pregnancy and postpartum are more likely to have PPD compared to women who quit. In addition, women who are smoking postpartum (regardless of their smoking status during the last 3 months of pregnancy) are more likely to have PPD compared to women who are not smoking during pregnancy and remain quit postpartum. In addition, these results suggest that women who self-identify their race/ ethnicity as Black/non-Hispanic or Other/non-Hispanic are more likely to report PPD.

PPD is a relatively common major mental disorder that adversely affects both maternal and infant health as well as family life (Fang et al., 2004; Farr, Dietz, O'Hara, Burley, & Ko, 2014; Gress-Smith et al., 2012; Rhodes & Segre, 2013). Although many studies have considered the effect of depression on cigarette smoking relapse in pregnant and non-pregnant individuals, few have examined the relationship between PPD and perinatal smoking behavior (Cinciripini et al., 2010; McCoy et al., 2008; Munafò, Heron, & Araya, 2008). One study did report an association between PPD and continued smoking (Dagher & Shenassa, 2012), which was found to be greater among younger women (Allen et al., 2009). Consistent with other studies, results from the current study suggest that approximately one third of women who increase cigarette smoking during pregnancy are likely to have PPD and that this association is greater among younger women.

The majority of published studies have found low educational attainment to be a risk factor for both PPD and cigarette smoking (Boury, Larkin, & Krummel, 2004; Kahn et al., 2002; Miyake, Tanaka, Sasaki, & Hirota, 2011; Webb, Culhane, Mathew, Bloch, & Goldenberg, 2011). Results from the current study also support this association as those participants with less than a high school education had a higher likelihood of PPD. In addition, some studies have reported more depressive symptomatology among ethnic minority versus non-minority mothers while others have indicated no difference between these 2 groups (Huang, Wong, Ronzio, & Yu, 2007; Rich-Edwards et al., 2006). The current study's results show that women who identify their race/ethnicity as Black/non-Hispanic or Other/non-Hispanic have a higher probability of reporting PPD compared to women of other race/ethnicity backgrounds.

Pregnancy is considered a window of opportunity for behavior change, a time when up to 50% of women are motivated to quit smoking. Unfortunately, about 50%–80% of these women resume smoking within 6 months postpartum (Carmichael & Ahluwalia, 2000). The results from the current study support these findings. Although one quarter of the total sample of smokers quit smoking prior to pregnancy (Table 1), of those who did not quit prior to pregnancy but quit during pregnancy, only a quarter remained quit postpartum (Table 3). Those women who quit during pregnancy but resumed smoking postpartum were more likely to have PPD compared to those who quit and remained quit postpartum, a finding consistent with a prior study of a different PRAMS cohort that indicated women with PPD were more likely to resume smoking postpartum (Allen et al., 2009).

There are several limitations to this study. The PRAMS data set does not include adequate information about depression prior to and during pregnancy in order to examine associations between depression during these periods and PPD. Another limitation concerns the study's definition of PPD. Because the PRAMS core data set (items used by all states) included only 2 items to assess PPD status, the definition used in the current study is the one that has been used in previous papers reporting on PPD from the PRAMS data set and is considered standard for this data set. Although other tools, such as the Edinburgh Postnatal Depression Scale or the Beck Depression Inventory have been validated for use in the clinical setting and are the preferred methods to screen for PPD by health care providers, the PRAMS survey only asks about some of these depressive symptoms. Another limitation of this study is that the PRAMS surveys are completed between 2 and 9 months postpartum and thus may not capture those mothers who develop PPD and/or increase smoking after completing the survey. Women who completed the survey 9 months after delivery may have a longer time period, in which to develop PPD and/or resume or otherwise increase smoking. Unfortunately, the data set does not include an item to indicate when the survey was completed and/or temporal relationship to delivery, so no conclusions can be drawn to compare early and late responders to the PRAMS survey. In addition, changes in smoking behavior could only be broadly approximated because the smoking items did not allow for an exact response regarding the number of cigarettes smoked but only a range in the number of cigarettes smoked. Therefore someone who smoked 12 cigarettes per day during pregnancy and then smoked 20 cigarettes per day postpartum would be categorized as "no change" (and not an increase) because their smoking response category (11–20 cigarettes per day) was the same.

5. Conclusion

These findings suggest a link between PPD and perinatal cigarette smoking, as PPD was associated with continued smoking during pregnancy and postpartum. Not only may these results be of immediate assistance to clinicians in the screening of PPD, but the results may also serve to guide researchers in the design of future longitudinal studies including those aimed at developing interventions to prevent PPD among women who smoke prior to pregnancy. The study's use of prior to pregnancy, during pregnancy, and postpartum time points to capture perinatal smoking behavior may also inform perinatal cigarette smoking prevention and treatment strategies of both clinicians and researchers. In addition, future studies of a more longitudinal nature, including those that assess depressive symptoms prior to pregnancy and/or that are designed to assess the potential causal relationship between PPD and perinatal smoking behavior change, are needed.

References

- Allen AM, Prince CB, Dietz PM. Postpartum depressive symptoms and smoking relapse. *American Journal of Preventive Medicine*. 2009; 36:9–12. <http://dx.doi.org/10.1016/j.amepre.2008.09.020>. [PubMed: 19095161]
- Beck CT. Postpartum depression: A metasynthesis. *Qualitative Health Research*. 2002; 12:453–472. [PubMed: 11939248]
- Beck CT. Postpartum depression: It isn't just the blues. *American Journal Nursing*. 2006; 106:40–50.

- Boury JM, Larkin KT, Krummel DA. Factors related to postpartum depressive symptoms in low-income women. *Women and Health*. 2004; 39:19–34. [PubMed: 15256353]
- Brockington I. Postpartum psychiatric disorders. *Lancet*. 2004; 363:303–310. [PubMed: 14751705]
- Carmichael SL, Ahluwalia IB. Correlates of postpartum smoking relapse. Results from the Pregnancy Risk Assessment Monitoring System (PRAMS). *American Journal of Preventive Medicine*. 2000; 19:193–196. [PubMed: 11020597]
- Centers for Disease Control and Prevention (CDC). Smoking prevalence among women of reproductive age—United States, 2006. *MMWR Morbidity and Mortality Weekly Report*. 2008; 57:849–852. (<http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5731a2.htm>). [PubMed: 18685552]
- Cinciripini PM, Blalock JA, Minnix JA, Robinson JD, Brown VL, Lam C, et al. Effects of an intensive depression-focused intervention for smoking cessation in pregnancy. *Journal of Consulting and Clinical Psychology*. 2010; 78:44–54. <http://dx.doi.org/10.1037/a0018168>. [PubMed: 20099949]
- Colman JC, Joyce T. Trends in smoking before, during, and after pregnancy in ten states. *American Journal of Preventive Medicine*. 2003; 24:29–35. [PubMed: 12554021]
- Correa-Fernández V, Ji L, Castro Y, Heppner WL, Vidrine JI, Costello TJ, et al. Mediators of the association of major depressive syndrome and anxiety syndrome with postpartum smoking relapse. *Journal of Consulting and Clinical Psychology*. 2012; 80:636–648. <http://dx.doi.org/10.1037/a0027532>. [PubMed: 22390410]
- Dagher RK, Shenassa ED. Prenatal health behaviors and postpartum depression : Is there an association ? *Archives of Women's Mental Health*. 2012; 15:31–37. <http://dx.doi.org/10.1007/s00737-011-0252-0>.
- Dennis CL, Vigod S. The relationship between postpartum depression, domestic violence, childhood violence, and substance use: Epidemiologic study of a large community sample. *Violence Against Women*. 2013; 19:503–517. <http://dx.doi.org/10.1177/1077801213487057>. [PubMed: 23660619]
- Fang WL, Goldstein AO, Butzen AY, Hartsock SA, Hartmann KE, Helton M, et al. Smoking cessation in pregnancy: A review of postpartum relapse prevention strategies. *The Journal of the American Board of Family Practice*. 2004; 17:264–275. [PubMed: 15243014]
- Farr SL, Dietz PM, O'Hara MW, Burley K, Ko JY. Postpartum anxiety and comorbid depression in a population-based sample of women. *Journal of Women's Health*. 2014; 23:120–128. <http://dx.doi.org/10.1089/jwh.2013.4438>.
- Fernandez JW, Grizzell JA, Wecker L. The role of estrogen receptor β and nicotinic cholinergic receptors in postpartum depression. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*. 2013; 40:199–206. <http://dx.doi.org/10.1016/j.pnpbp.2012.10.002>. [PubMed: 23063492]
- Goyal D, Gay C, Lee KA. How much does low socioeconomic status increase the risk of prenatal and postpartum depressive symptoms in first-time mothers? *Women's Health Issues : Official Publication of the Jacobs Institute of Women's Health*. 2010; 20:96–104. <http://dx.doi.org/10.1016/j.whi.2009.11.003>.
- Gress-Smith JL, Luecken LJ, Lemery-Chalfant K, Howe R. Postpartum depression prevalence and impact on infant health, weight, and sleep in low-income and ethnic minority women and infants. *Maternal and Child Health Journal*. 2012; 16:887–893. <http://dx.doi.org/10.1007/s10995-011-0812-y>. [PubMed: 21559774]
- Huang ZJ, Wong FY, Ronzio CR, Yu SM. Depressive symptomatology and mental health help-seeking patterns of U.S.- and foreign-born mothers. *Maternal and Child Health Journal*. 2007; 11:257–267. <http://dx.doi.org/10.1007/s10995-006-0168-x>. [PubMed: 17171544]
- Jewell JS, Dunn AL, Bondy J, Leiferman J. Prevalence of self-reported post-partum depression specific to season and latitude of birth: Evaluating the PRAMS data. *Maternal and Child Health Journal*. 2010; 14:261–267. <http://dx.doi.org/10.1007/s10995-009-0498-6>. [PubMed: 19669394]
- Kahn RS, Certain L, Whitaker RC. A reexamination of smoking before, during, and after pregnancy. *American Journal Public Health*. 2002; 92:1801–1808.
- Marcus SM. Depression during pregnancy: Rates, risks and consequences. *The Canadian Journal of Pharmacology*. 2009; 16:15–22.

- Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, Kirmeyer S, et al. Births: Final data for 2005. National vital statistics reports: From the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System. 2007; 56:1–103. (http://www.cdc.gov/nchs/data/nvsr/nvsr56/nvsr56_06.pdf).
- McCoy SJ, Beal JM, Saunders B, Hill EN, Payton ME, Watson GH. Risk factors for postpartum depression: A retrospective investigation. *The Journal of Reproductive Medicine*. 2008; 53:166–170. [PubMed: 18441719]
- Miyake Y, Tanaka K, Sasaki S, Hirota Y. Employment, income, and education and risk of postpartum depression: The Osaka Maternal and Child Health Study. *Journal of Affective Disorders*. 2011; 130:133–137. <http://dx.doi.org/10.1016/j.jad.2010.10.024>. [PubMed: 21055825]
- Munafò MR, Heron J, Araya R. Smoking patterns during pregnancy and post-natal period and depressive symptoms. *Nicotine & tobacco research: Official Journal of the Society for Research on Nicotine and Tobacco*. 2008; 10:1609–1620. <http://dx.doi.org/10.1080/14622200802412895>. [PubMed: 18988073]
- Park ER, Chang Y, Quinn V, Regan S, Cohen L, Viguera A, et al. The association of depressive, anxiety, and stress symptoms and postpartum relapse to smoking: a longitudinal study. *Nicotine & tobacco research: Official Journal of the Society for Research on Nicotine and Tobacco*. 2009; 11:707–714. <http://dx.doi.org/10.1093/ntr/ntp053>. [PubMed: 19436040]
- Rhodes AM, Segre LS. Perinatal depression: A review of US legislation and law. *Archives of Women's Mental Health*. 2013; 16:259–270. <http://dx.doi.org/10.1007/s00737-013-0359-6>.
- Rich-Edwards JW, Kleinman K, Abrams A, Harlow BL, McLaughlin TJ, Joffe H, et al. Sociodemographic predictors of antenatal and postpartum depressive symptoms among women in a medical group practice. *Journal of Epidemiology and Community Health*. 2006; 60:221–227. <http://dx.doi.org/10.1136/jech.2005.039370>. [PubMed: 16476752]
- Roux G, Anderson C, Roan C. Postpartum depression, marital dysfunction, and infant outcome: A longitudinal study. *The Journal of Perinatal Education*. 2002; 11:25–36. <http://dx.doi.org/10.1624/105812402X88939>. [PubMed: 17273318]
- Shulman HB, Gilbert BC, Msphbrenda CG, Lansky A. The Pregnancy Risk Assessment Monitoring System (PRAMS): Current methods and evaluation of 2001 response rates. *Public Health Reports*. 2006; 121:74–83. [PubMed: 16416701]
- Solomon LJ, Higgins ST, Heil SH, Badger GJ, Thomas CS, Bernstein IM. Predictors of postpartum relapse to smoking. *Drug and Alcohol Dependence*. 2008; 90:224–227. <http://dx.doi.org/10.1016/j.drugalcdep.2007.03.012>. [PubMed: 17475418]
- Tong VT, Jones JR, Dietz PM, D'Angelo D, Bombard JM. Centers for control and prevention (CDC). Trends in smoking before, during, and after pregnancy —Pregnancy risk assessment monitoring system (PRAMS), United States, 31 sites, 2000–2005. *Morbidity Mortality Weekly Report Surveillance Summaries*. 2009; 58:1–29.
- Webb DA, Culhane JF, Mathew L, Bloch JR, Goldenberg RL. Incident smoking during pregnancy and the postpartum period in a low-income urban population. *Public Health Reports*. 2011; 126:50–59. [PubMed: 21337931]
- Whooley MA, Avins AL, Miranda J, Browner WS. Case-finding instruments for depression, 2 questions are as good as many. *The Journal of Internal Medicine*. 1997; 12:23–31.
- Zauderer C. Postpartum depression: How childbirth educators can help break the silence. *The Journal of Perinatal Education*. 2009; 18:23–31. <http://dx.doi.org/10.1624/105812409X426305>. [PubMed: 20190853]

Table 1

Participant characteristics, both overall and stratified by change in smoking status from prior to pregnancy to postpartum (2 time-point analysis) and postpartum depression (PPD) status (weighted percentages).

Participant Characteristics	All Participants		Quit [*]		Reduced [*]		Unchanged [*]		Increased [*]		With PPD ^{**}	
	N = 29,654	Row %	N = 7366	Row %	N = 7868	Row %	N = 12,317	Row %	N = 2103	Row %	N = 6684	Row %
Smoking Behavior Change												
Quit	25	-	-	-	-	-	-	-	-	-	15	23
Reduced	26										23	23
Unchanged	42										23	33
Increased	7										26	20
Race/Hispanic origin												
White/non-Hispanic	79	26			26		42		6		30	23
Black/non-Hispanic	10	15			24		50		11		24	20
Hispanic	5	33			26		34		7		26	18
Other/non-Hispanic	6	27			26		40		7		26	19
Age, years												
30+	23	31			22		41		6		18	19
25-29	29	29			25		41		5		24	28
20-24	35	20			29		43		8		28	30
<20	13	18			28		44		10		28	19
Education												
<12 years	23	13			27		48		12		30	25
12 years or greater	77	28			26		40		6		25	11
Marital status												
Married	43	33			22		40		5		18	20
Unmarried	57	19			29		44		8		20	11
Income year prior to delivery												
>\$50,000	20	43			19		35		3		18	20
\$25,000-50,000	21	29			23		42		6		18	20
\$15,000-24,999	17	21			28		45		6		20	11

Participant Characteristics	All Participants	Quit [*]		Reduced [*]		Unchanged [*]		Increased [*]		With PPD ^{**}	
		N = 29,654	N = 7366	N = 7868	N = 12,317	N = 2103	N = 6684	Row %	Row %	Row %	Row %
	Column %										
\$10,000–14,999	13	18		29	44	9	25				
<\$10,000	29	15		30	44	11	30				
Parity (Prior live birth)											
Yes	55	20		23	49	8	24				
No	45	31		29	35	5	19				

* P-value for row percentage <0.001.

** Number of participants without PPD = 22,970.

Table 2

Association of PPD and smoking behavior change from prior to pregnancy to postpartum (2 time-point analysis) and other participant characteristics (weighted logistic regression).

Participant Characteristics	Crude OR (95% CI)	P-value	Adjusted OR 95% CI	P-value
Smoking Behavior Change				
Quit (Reference)	1		1	
Reduced	1.70 (1.40–1.90)	<0.001	1.34 (1.10–1.60)	0.001
Unchanged	1.70 (1.50–1.90)		1.32 (1.10–1.50)	<0.001
Increased	2.80 (2.30–3.50)		1.80 (1.50–2.30)	<0.001
Race/Hispanic origin				
White, non-Hispanic (Reference)	1		1	
Black, non-Hispanic	1.74 (1.50–2.03)	<0.001	1.20 (1.03–1.40)	0.02
Hispanic	1.21 (0.99–1.50)	0.06	1.05 (0.82–1.30)	0.7
Other, non-Hispanic	1.43 (1.20–1.73)	<0.001	1.30 (1.10–1.60)	0.007
Age, years				
30+ (Reference)	1		1	
25–29	1.07 (0.92–1.24)	0.3	1.03 (0.87–1.21)	0.72
20–24	1.43 (1.24–1.65)	<0.001	1.16 (0.97–1.40)	0.09
<20	1.81 (1.51–2.17)	<0.001	1.50 (1.18–1.80)	0.001
Education				
12 years or greater (Reference)	1		1	
<12 years	1.80 (1.60–2.00)	<0.001	1.20 (1.03–1.40)	0.01
Marital status				
Married (Reference)	1		1	
Unmarried	1.63 (1.45–1.80)	<0.001	0.95 (0.83–1.10)	0.6
Income year prior to delivery				
>\$50,000 (Reference)	1		1	
\$25,000–50,000	1.91 (1.60–2.30)	<0.001	1.70 (1.34–2.0)	<0.001
\$15,000–24,999	2.14 (1.80–2.60)	<0.001	1.80 (1.40–2.20)	<0.001
\$10,000–14,999	2.90 (2.30–3.50)	<0.001	2.10 (1.70–2.70)	<0.001
<\$10,000	3.70 (3.10–4.40)	<0.001	2.50 (2.01–3.10)	<0.001
Parity (Prior live birth)				
Yes (Reference)	1		1	
No	0.73 (0.65–0.80)	<0.001	0.75 (0.65–0.85)	<0.001

Table 3

PPD and smoking behavior change trajectory during pregnancy and postpartum among women who smoked prior to pregnancy (weighted logistic regression of 3 time-point analysis adjusted for socio-demographic covariates).

	All Smokers %	No PPD %	PPD %	Adjusted OR (95 CI)
Quit during pregnancy and remained quit postpartum	23	86	14	1
Quit during pregnancy but resumed smoking postpartum	22	80	20	1.28 (1.06–1.53)
Continued smoking at any level during pregnancy and postpartum	55	75	25	1.48 (1.26–1.73)