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Association of Maternal Smoking Status With Breastfeeding Practices: Missouri, 2005

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KEY WORDS

breastfeeding, maternal smoking

ABBREVIATIONS

aPR—adjusted prevalence ratio

CI—confidence interval

aPAF—adjusted population attributable fraction

aHR—adjusted hazard ratio

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WHAT'S KNOWN ON THIS SUBJECT: In populations with high rates of breastfeeding and low rates of smoking in pregnancy, smoking has been associated with decreased likelihood of initiating breastfeeding. Smokers who do breastfeed wean earlier than women who do not smoke.



WHAT THIS STUDY ADDS: Using 2 multivariable models, we describe the association between smoking and breastfeeding initiation (binomial regression) and duration (Cox proportional hazards) in a population with a low rate of breastfeeding initiation and a high rate of smoking in pregnancy.

abstract

OBJECTIVE: We sought to determine the association of smoking status as a risk factor for reduced initiation and duration of breastfeeding.

METHODS: The Missouri Pregnancy Related Assessment and Monitoring System collected a stratified sample of new mothers in 2005. Surveys were mailed, with telephone follow-up, and completed within 2 to 12 months after delivery. Respondents were classified as nonsmokers, smokers who quit during pregnancy, light smokers (≤ 10 cigarettes per day), or moderate/heavy smokers (> 10 cigarettes per day). Multivariable binomial regression and Cox proportional hazards models were used to assess breastfeeding initiation and duration according to smoking status.

RESULTS: Overall, 1789 women participated (weighted response rate: 61%). Approximately 74% of the women ever breastfed; 31% of the women ever smoked while pregnant. Compared with nonsmokers, the moderate/heavy smokers and light smokers were less likely to initiate breastfeeding, after controlling for sociodemographic characteristics, the presence of other smokers in the household, alcohol use, mode of delivery, and infant hospitalization. Compared with nonsmokers, the moderate/heavy smokers, light smokers, and smokers who quit during pregnancy were more likely to wean over time, controlling for the same covariates. There were no significant differences between nonsmokers and smokers regarding reasons for not initiating or ceasing breastfeeding.

CONCLUSIONS: Mothers who smoked initiated breastfeeding less often and weaned earlier than nonsmoking mothers. Incorporating knowledge of the association between smoking and breastfeeding into existing smoking-cessation and breastfeeding programs could provide opportunities to reduce perinatal exposure to tobacco smoke, improve interest in breastfeeding, and address other barriers to breastfeeding that smoking mothers may face. *Pediatrics* 2009;124:1603–1610

Breastfeeding improves infant survival through the passage of maternal antibodies and superior nutritional composition compared with formula.^{1,2} Smoking during pregnancy is associated with multiple adverse fetal outcomes, including low birth weight, preterm delivery, and increased risk for neonatal respiratory distress. Second-hand smoke exposure during infancy has been implicated in higher rates of respiratory infections, early-onset wheezing and asthma, and sudden infant death syndrome.^{3–6} Breastfeeding modifies the effects of smoking during pregnancy and protects infants from conditions whose incidence is known to be associated with exposure to tobacco smoke during the postpartum period.^{1,2} Consequently, smoking assessment and cessation counseling are important components of prenatal care. The decisions to continue smoking during and after pregnancy and the extent to which those decisions affect breastfeeding can further increase the risk for development of adverse outcomes during the first year of life.

Women who smoke are less likely to breastfeed than those who do not smoke. Many hypotheses have explored the association between smoking and breastfeeding, including biological mechanisms (eg, nicotine effects on dopamine and prolactin^{7,8}) and sociobehavioral factors (eg, education, marital status, employment), and intention to breastfeed.^{9–11} Many studies of the association between smoking and breastfeeding have been conducted among populations with high breastfeeding rates and low prevalence of smoking during pregnancy or after delivery.^{12–16}

Our study used a population-based survey to describe the association between smoking status and breastfeeding in a setting where breastfeeding initiation is comparatively low (67.3%

in Missouri vs 73.8% in the United States),¹⁷ and smoking during pregnancy is high (18.1% in Missouri vs 10.2% in the United States).^{18,19} We also described other factors that are associated with breastfeeding initiation and duration.

METHODS

The Missouri Pregnancy Related Assessment and Monitoring System, a population-based survey that was conducted statewide during 2005, collected detailed prenatal, intrapartum, and postpartum information from women who recently gave birth to a live infant in Missouri. The survey was modeled after the Pregnancy Risk Assessment and Monitoring System sponsored by the Centers for Disease Control and Prevention^{20–22} and was approved by the institutional review board at the Missouri Department of Health and Senior Services.

Each month, a systematic, stratified, random sample of 250 mothers was drawn from births that had occurred during the previous 2 to 6 months, as recorded in the Missouri Live Birth Registry. Infants with low birth weight (<2500 g) and infants whose mother lived in a rural area were oversampled to ensure that these populations were adequately represented, because low birth weight and access to care associated with rural residence have been found to be associated with a number of other exposure and outcome measures.^{3,5,20} Survey questionnaires were mailed to the sampled mothers. For nonresponders, up to 2 additional questionnaires were sent approximately every 2 weeks. At least 15 attempts were made to contact by telephone those who did not respond to any of the mailed questionnaires. The completed surveys were then linked to birth certificate data.

Responses were weighted for nonresponse, stratifying variables that were

used for oversampling and noncoverage (ie, live births that had not been captured by the birth registry at the time of sampling).²² All analyses were conducted by using the survey analysis procedures in SAS (SAS Institute, Inc, Cary, NC) and SUDAAN (Research Triangle Institute, Research Triangle Park, NC) to account for the complex sampling design.

Women were asked whether they had smoked ≥ 100 cigarettes during the 2 years before their most recent pregnancy. Nonsmokers were women who had not smoked ≥ 100 cigarettes during the previous 2 years or who reported that they had not smoked during the 3 months before pregnancy, the last 3 months of pregnancy, and at the time of the survey (after delivery). Smoking status was categorized as quit during pregnancy, light smoker (smoked ≤ 10 cigarettes per day during or after pregnancy), and moderate/heavy smoker (smoked > 10 cigarettes per day during or after pregnancy). Of those who were classified as light or heavy/moderate smokers, 114 (20%) were women who reported that they had quit smoking during pregnancy (third trimester) but relapsed in the postpartum period; they were classified as either moderate/heavy or light smokers on the basis of their smoking behavior at the time of the survey.

Breastfeeding initiation was determined by a positive response to the question, "Did you ever breastfeed your infant?" Among those who had ever breastfed, breastfeeding duration was determined by subtracting the date of birth from the date of the survey for those who indicated that they were still breastfeeding at the time of the survey. When the mother reported she was no longer breastfeeding, the duration reported by the mother was used. Breastfeeding initiation and duration were not restricted

to exclusive breastfeeding. Other questions included attitude toward breastfeeding and reasons for not breastfeeding or stopping breastfeeding.

Multivariable binomial regression was used to calculate the adjusted prevalence ratio (aPR) and 95% confidence interval (CI) for failure to initiate breastfeeding in relation to smoking status and to assess potential confounding and effect modification according to sociodemographic variables (race, education, maternal age, and Medicaid) and other variables (presence of another smoker in the household, alcohol use, first trimester prenatal care, prepregnancy BMI, mode of delivery, prolonged infant hospitalization, or ICU). Kaplan-Meier plots and Cox proportional hazards modeling were used to evaluate the association between smoking status and duration of breastfeeding among mothers who initiated breastfeeding. We used the proportional hazards model to evaluate the association between breastfeeding duration and smoking, rather than using binomial regression to model early weaning, so that all available information could be used.^{14,16,23} The assumption of proportional hazards was evaluated by including interaction terms between covariates and the logarithm of time in the Cox model.

Mothers who reported still breastfeeding at the time of the survey and those with breastfeeding duration >32 weeks were censored in the survival analysis because few observations remained in each of the categories beyond that time. Only mothers whose infants were alive at the time of the survey were included in the analysis. Observations with missing values for the dependent variable were excluded; observations with missing values in any of the independent variables were retained by specifying an unknown category for each variable and including

these in the final model as separate dummy variables.

The AFLOGIT command in Stata (Stata Corp LP, College Station, TX) was used to calculate the adjusted population attributable fraction (aPAF) and 95% CI of not initiating breastfeeding from smoking. An approximate weight was used in AFLOGIT to incorporate population weight and design effect. Smoking at any level before, during, or after pregnancy was used as the definition for smoking.²⁴

RESULTS

Of 3000 women sampled, 1488 responded to the mailed surveys and 301 responded to the telephone follow-up, for a total of 1789 respondents (weighted response rate: 61%). Surveys with certain missing data and those that were completed by mothers whose infant had died were excluded, leaving 1748 respondents. Survey respondents were significantly more likely to have a normal birth weight infant; to be white, married, and older; and to have a higher attained education level compared with nonrespondents ($P < .01$; data not shown). The median time to complete the survey was 21.6 weeks (range: 7.9–55.4 weeks). Noninitiation of breastfeeding was more common for women who smoked or who lived with someone who smoked, women aged <20, those who had <12 years of formal education, those who had Medicaid at delivery, and those who were not married (Table 1).

Multivariable binomial regression analysis of the association between breastfeeding initiation and smoking status (Table 2) revealed that, compared with nonsmokers, heavy smokers (aPR: 1.4 [95% CI: 1.0–1.9]), light smokers (aPR: 1.4 [95% CI: 1.0–1.8]), and smokers who quit during pregnancy (aPR: 1.4 [95% CI: 0.9–2.3]) were more likely never to initiate breast-

feeding. Other covariates that were associated with not initiating breastfeeding included the presence of another smoker in the home (aPR: 1.4 [95% CI: 1.0–1.8]) and having received Medicaid payment at the time of delivery (aPR: 1.4 [95% CI: 1.0–1.8]). Maternal education <12 years (aPR: 1.3 [95% CI: 1.0–1.7]) and being unmarried (aPR: 1.3 [95% CI: 1.0–1.7]) were also associated with not initiating breastfeeding. Interactions were assessed by using 2-way product terms in the binomial regression model; none of the terms was statistically significant ($P > .05$).

The Kaplan-Meier survival curve (Fig 1) demonstrated that, compared with nonsmokers, moderate/heavy smokers had the steepest decline in breastfeeding after delivery, such that by 6 weeks after delivery, only 44% of the women in this group who initiated breastfeeding continued to breastfeed their infants. Light smokers and smokers who quit during pregnancy also weaned their infants sooner than nonsmokers.

When the data were analyzed by using Cox proportional hazards modeling, controlling for the same covariates as in the binomial regression model, moderate/heavy smokers, light smokers, and smokers who quit during pregnancy were significantly more likely than nonsmokers to wean their infants at any given time during the follow-up period, with adjusted hazards ratios (aHRs) of 1.9 (95% CI: 1.4–2.7), 1.7 (95% CI: 1.3–2.4), and 1.6 (95% CI: 1.1–2.6), respectively (Table 2). Being unmarried (aHR: 1.4 [95% CI: 1.1–1.9]), having a prepregnancy BMI ≥ 30 (aHR: 1.4 [95% CI: 1.1–1.9]), and being a young mother (<20 years of age at delivery; aHR: 1.4 [95% CI: 0.9–2.0]) were also associated with quicker weaning. Interaction terms between covariates and the logarithm of time in the Cox model did not reach the recommended level of statistical significance for in-

TABLE 1 Weighted Percentage of Never Initiating Breastfeeding According to Selected Characteristics: MOPRA, 2005

Characteristic	<i>n</i>	%	95% CI	<i>P</i> (χ^2)
Smoking status				<.001
Nonsmoker	1124	20.9	17.5–24.3	
Quit during pregnancy	92	33.1	18.3–47.9	
Light smoker	244	37.5	28.5–46.6	
Moderate/heavy smoker	245	42.8	33.6–52.0	
Unknown or unclassified	43	—		
Smoker in the home				<.001
Yes	262	42.6	33.4–51.8	
No	1486	23.4	20.3–26.5	
Alcohol use				.790
Yes	546	25.7	20.5–30.9	
No	1202	26.6	22.9–30.2	
Maternal age, y				<.001
<20	186	38.3	28.2–48.4	
20–29	980	29.0	24.9–33.2	
≥30	582	17.7	13.3–22.1	
Maternal race				.400
White, other	1587	25.7	22.6–28.8	
Black	161	30.1	19.9–40.3	
Maternal education, y				<.001
<12	265	42.5	33.7–51.4	
≥12	1470	22.9	19.9–26.0	
Unknown	13	—		
Medicaid at delivery				<.001
Yes	812	36.0	31.1–41.0	
No	936	17.8	14.5–21.1	
Married				<.001
Yes	1195	19.5	16.5–22.5	
No	553	36.9	31.0–42.8	
First trimester prenatal care				.500
Yes	1577	25.9	22.8–29.1	
No	171	29.3	19.1–39.6	
Cesarean section				.750
Yes	635	25.5	20.3–30.8	
No	1113	26.6	23.0–30.2	
Prolonged infant hospitalization or ICU				.210
Yes	552	30.8	22.9–38.6	
No	1196	25.6	22.3–28.8	
Prepregnancy BMI				.660
<18.5	109	30.8	17.1–44.4	
18.5–24.9	879	25.3	21.2–29.4	
25.0–29.9	371	27.6	21.1–34.0	
≥30.0	312	28.5	21.1–36.0	
Unknown	77	—		

MOPRA indicates Missouri Pregnancy Related Assessment and Monitoring System.

teraction ($P > .01$)²⁵; therefore, we considered that the proportional hazards assumption was satisfied.

When we analyzed the data regarding the self-reported intention to breastfeed and reasons for not initiating breastfeeding and for stopping breastfeeding, the proportion of nonsmokers who reported that they knew that they would breastfeed (65.4%) was significantly greater than that reported by

smokers who quit during pregnancy (48.40%), light smokers (48.6%), and moderate/heavy smokers (43.9%; Table 3). Breastfeeding intention before the birth of an infant was significantly correlated with actual breastfeeding ($\kappa = 0.8$; $P < .0001$). No statistically significant differences existed between the smoking categories in the proportions of women who indicated reasons for not initiating breastfeed-

ing or reasons for ceasing breastfeeding. For nonsmokers, light smokers, and moderate/heavy smokers, the most common reason for not breastfeeding was “not liking breastfeeding.” After “other,” the next most common reason for not breastfeeding was “having to return to school or work” (nonsmokers and light smokers) or “having another child to care for” (moderate/heavy smokers). The 2 most common reasons for stopping breastfeeding for all groups were either believing that they “did not produce enough breast milk” or “breast milk alone did not satisfy infant.” “Difficulty nursing” was the third most common reason to wean for nonsmokers, whereas having to return to school or work was the third most common reason given by both light and moderate/heavy smokers (Table 3).

The aPAF was calculated for each of the study variables in the models. The aPAF for smoking (11.9% [95% CI: 0.3%–22.1%]) was the only factor that was statistically significant.

DISCUSSION

Our study provides evidence that moderate/heavy and light smoking during the postpartum period were associated with failure to initiate breastfeeding. For mothers who initiated breastfeeding, postpartum smoking was also associated with weaning sooner, compared with women who did not smoke. These findings are consistent with other, recently published studies.^{12,14,15} The magnitudes of association in our study were similar to those observed in a study that used the same methods (Oregon Pregnancy Risk Assessment and Monitoring System), despite Missouri’s having a substantially lower breastfeeding prevalence and higher prevalence of maternal smoking than Oregon.^{15,18} The presence of another person in the

TABLE 2 Analysis of Risk Factors for Failure to Initiate Breastfeeding and for Earlier Weaning: Missouri, 2005

Variable	Failure to Initiate, aPR (95% CI)	Earlier Weaning, aHR (95% CI) ^a
Smoking status		
Moderate/heavy smoker	1.4 (1.0–1.9)	1.9 (1.4–2.7)
Light smoker	1.4 (1.0–1.8)	1.7 (1.3–2.4)
Quit smoking during pregnancy	1.4 (0.9–2.3)	1.6 (1.1–2.6)
Nonsmoker	1.0	1.0
Smoker in the home		
Yes	1.4 (1.0–1.8)	1.0 (0.7–1.4)
No	1.0	1.0
Alcohol use		
Yes	0.9 (0.7–1.1)	1.1 (0.9–1.4)
No	1.0	1.0
Maternal age, y		
<20	1.0 (0.7–1.3)	1.4 (0.9–2.0)
20–29	1.0	1.0
≥30	0.8 (0.6–1.1)	0.9 (0.7–1.1)
Maternal race		
White, other	1.0	1.0
Black	1.0 (0.7–1.4)	1.0 (0.6–1.5)
Maternal education, y		
<12	1.3 (1.0–1.7)	1.2 (0.8–1.7)
≥12	1.0	1.0
Medicaid at delivery		
Yes	1.4 (1.0–1.8)	1.3 (1.0–1.6)
No	1.0	1.0
Married		
Yes	1.0	1.0
No	1.3 (1.0–1.7)	1.4 (1.1–1.9)
Prenatal care in first trimester		
Yes	1.0	1.0
No	1.2 (0.8–1.7)	1.3 (0.9–1.9)
Cesarean section		
Yes	1.0 (0.8–1.3)	1.1 (0.9–1.4)
No	1.0	1.0
Prolonged infant hospitalization or ICU		
Yes	1.2 (0.9–1.6)	1.1 (0.9–1.5)
No	1.0	1.0
BMI		
<18.5	1.0 (0.6–1.5)	1.3 (0.8–2.0)
18.5–24.9	1.0	1.0
25.0–29.9	1.1 (0.8–1.5)	1.0 (0.7–1.3)
≥30.0	1.1 (0.8–1.5)	1.4 (1.1–1.9)

^a Measured by aHR of breastfeeding termination from proportional hazard model.

home who smoked was also strongly associated with failure to breastfeed, a finding that is consistent with previous studies in which the presence of a partner or other person in the household who smoked was demonstrated to be associated with both the higher likelihood that women will continue to smoke during pregnancy and the lower likelihood that women will initiate breastfeeding.^{15,26,27} Receiving Medicaid at delivery was also significantly associated with not

breastfeeding, perhaps serving as a proxy for lower socioeconomic status. Other factors, such as having <12 years of education and being unmarried, might indicate a lack of social support mechanisms and greater risks for adverse birth outcomes, although they were not statistically significant.^{10,27,28} These socioeconomic factors help to identify other women in Missouri who are at greater risk for choosing not to breastfeed.

Breastfeeding requires a high level of commitment to be successful.⁹ Women who smoke might be less willing or less able to make that commitment²¹; however, we identified no statistically significant difference between women of different smoking categories with regard to the reasons for not initiating breastfeeding or the reasons for ceasing to breastfeed. As with other health behaviors, the complex interplay among sociodemographic, economic, and behavioral factors with regard to breastfeeding has been extensively studied; however, variation exists in the results of these studies.^{10,29–31} The finding that the most common reason not to breastfeed was that women did not like breastfeeding might indicate a lack of commitment to initiate breastfeeding; however, there was no difference between women who smoked and women who did not with regard to not liking breastfeeding. If intention to breastfeed could be considered an indicator of commitment to breastfeed, then the high concordance between intention to breastfeed and initiation of breastfeeding provides additional evidence of the importance of planning and committing to breastfeed. Additional qualitative study to identify motivational factors and ways to overcome barriers to breastfeeding that stem from personal preferences may be helpful in supporting women to choose to breastfeed.

Previous studies suggested a biological mechanism whereby smoking could affect breastfeeding duration by demonstrating decreased prolactin production in women who smoke compared with nonsmokers.^{9,32} Smoking mothers of preterm infants also expressed less milk volume and had lower fat content in their milk than nonsmoking mothers.⁷ The differences in milk production between the 2 groups were significant at 4 and 6 weeks after delivery but not at 2 weeks after delivery, which supports the obser-

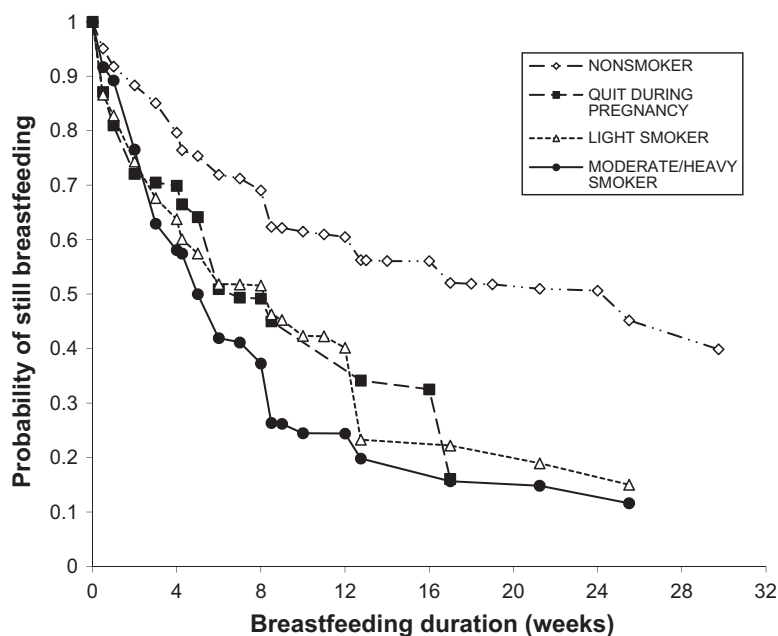


FIGURE 1 Kaplan-Meier survival curve of breastfeeding according to smoking status: Missouri, 2005.

vation of earlier weaning among mothers who smoke but does not explain differences in breastfeeding initiation.

Societal barriers may also inhibit women who smoke from breastfeeding. One qualitative study described how women who smoked during pregnancy felt criticized by health care providers for continuing to smoke while pregnant or breastfeeding and were less likely to admit tobacco use or to access smoking-cessation programs. When persistent or relapsed smokers considered breastfeeding, they reported feeling guilty about giving their infant breast milk that contained nicotine and the negative impact of criticism by health care providers, friends, or family. Thus, although some women who smoke during pregnancy may desire to quit or may still desire to

TABLE 3 Intention to Breastfeed and Reasons for Noninitiation or Termination of Breastfeeding, Missouri, 2005

Question/Response	Nonsmokers			Quit Smoking During Pregnancy			Light Smokers			Moderate/Heavy Smokers		
	n	%	95% CI	n	%	95% CI	n	%	95% CI	n	%	95% CI
Intention to breastfeed	1124			92			244			245		
Knew would breastfeed		65.4	61.5–69.4		48.4	33.48–63.4		48.6	39.5–57.8		43.9	34.8–53.3
Thought would breastfeed		17.3	14.1–20.4		28.8	14.2–43.4		20.5	13.1–27.8		21.5	13.4–29.6
Knew would not breastfeed		16.7	13.6–19.8		22.8	11.3–34.3		30.2	21.7–38.6		34.3	23.0–40.9
Undecided		10.6	0.0–1.2		—	—		0.7	0.0–2.0		0.3	0.0–0.6
Reasons for not initiating breastfeeding	215			25			83			107		
Infant sick		5.1	1.5–8.8		3.1	0.0–8.0		3.3	0.0–6.7		1.7	0.3–3.1
Mother sick/medication		16.3	9.2–23.4		8.1	0.0–19.9		16.0	3.9–28.1		12.8	2.7–22.8
Caring for other children		25.9	17.8–34.1		41.5	11.7–71.2		16.7	5.5–28.0		35.4	21.2–49.5
Too many household duties		16.3	9.2–23.3		0.7	0.0–1.7		12.2	1.4–23.1		24.9	11.5–38.2
Did not like breastfeeding		39.6	30.5–48.8		36.3	11.0–61.6		46.4	30.7–62.1		39.3	25.3–53.3
Did not want to be tied down		11.1	5.5–16.6		17.3	0.0–38.9		18.3	5.9–30.7		9.5	0.3–18.8
Embarrassed to breastfeed		10.2	5.4–15.1		31.3	5.7–56.9		12.7	2.9–22.5		12.9	4.1–21.8
Returned to school or work		28.7	20.6–36.8		24.2	4.1–44.2		24.1	11.0–37.2		25.1	12.9–37.3
Wanted body back to herself		13.2	7.0–19.4		1.2	0.0–3.1		22.0	9.0–35.0		18.0	6.6–29.5
Other		35.8	26.7–44.8		36.2	11.7–60.8		28.9	14.7–43.1		36.9	22.8–50.9
Reasons for ceasing breastfeeding	473			51			133			112		
Infant had difficulty nursing		26.3	20.6–32.0		21.6	5.8–37.4		25.2	15.0–35.4		19.1	9.9–28.3
Breast milk alone did not satisfy		36.1	29.9–42.3		40.8	20.6–61.1		34.0	22.7–45.3		32.7	20.5–44.8
Thought infant not gaining weight		5.6	3.1–8.1		15.0	1.1–28.8		3.4	0.5–6.3		9.3	1.9–16.8
Infant sick		2.6	0.6–4.5		0.1	0.0–0.4		2.3	0.0–5.4		2.2	0.0–5.3
Nipples sore, cracked, or bleeding		17.4	12.4–22.3		16.6	1.6–31.6		22.0	12.5–31.5		15.3	6.5–24.1
Thought not enough milk		39.9	33.5–46.3		38.0	19.1–56.9		38.6	26.9–50.3		41.3	27.9–54.6
Too many household duties		12.4	8.0–16.7		2.4	0.0–6.0		12.4	3.1–21.8		15.9	6.1–25.8
Believed was the right time to stop		17.9	13.1–22.8		5.2	0.0–11.5		9.2	2.3–16.0		9.3	2.0–16.6
Mother sick		6.7	3.4–9.9		7.9	0.0–17.5		15.5	4.6–26.4		5.3	0.0–12.8
Returned to school or work		24.3	18.8–29.9		15.2	3.5–26.8		31.2	20.0–42.5		22.9	11.6–34.3
Wanted/needed another to feed		12.3	8.1–16.6		2.1	0.0–6.1		17.2	7.2–27.2		9.6	2.6–16.6
Infant became jaundiced		7.9	4.2–11.7		1.2	0.0–2.5		1.9	0.0–4.6		8.7	1.8–15.5
Other		23.7	18.5–29.0		27.6	11.4–43.8		19.4	10.3–28.6		12.1	5.6–18.6

breastfeed, not all are able to achieve success.³⁵

This study had several limitations. First, there were significant differences with regard to low birth weight, race, marital status, age, and years of formal education between survey respondents and nonrespondents. Despite our effort to weight the data, bias likely still existed, which might have led to an underestimation of the effect of these variables in our models. Second, selected variables that are known to be associated with the likelihood of breastfeeding (eg, mother's return to work, previous employment status)³⁴ could not be assessed with the available data. In future surveys, such questions should be asked of all respondents, not just of those who initiated breastfeeding. Postpartum depression is another factor that has been associated with both breastfeeding and smoking,^{3,35} but this was not available in this study. Another limitation is that some of the women (20%) who were classified as light or moderate/heavy smokers had quit for some period of time during pregnancy but relapsed after delivery. The timing of their relapse was not assessed by the survey; therefore, we cannot know for certain whether it was smoking re-

lapse or other factors that interfered with breastfeeding initiation and duration. In a separate analysis (data not shown), we considered alternative smoking categorizations, separating relapsed smokers (women who quit smoking during pregnancy but resumed smoking after delivery) from persistent smokers (women who smoked throughout pregnancy and after delivery). In that analysis, relapsed smokers seemed very similar to persistent smokers in terms of the proportion who initiated breastfeeding and the duration of breastfeeding and the distribution of other characteristics. Finally, our study lacked the ability to verify biologically self-reported smoking status. Although this may have caused an underestimation of the association of smoking and breastfeeding, the use of self-administered questionnaires or telephone-administered surveys has been shown to provide valid information for certain exposures (eg, use of tobacco, alcohol, and drugs).³⁶

CONCLUSIONS

The findings from this study add to the growing evidence that postpartum smoking status is an important factor

associated with the initiation of breastfeeding and the length of time that women continue to breastfeed. These results can assist maternal and child health programs to focus on the importance of assessing women's smoking status and making appropriate referrals for smoking cessation. Strengthening smoking-cessation services that target pregnant women and women of childbearing age before they become pregnant will be important to reduce the harmful effects of tobacco smoke in utero. These results can also help plan breastfeeding promotion activities by identifying women who are less likely to initiate or maintain breastfeeding as recommended. Reducing smoking during the perinatal period to remove 1 additional barrier to successful breastfeeding has been suggested by other studies^{33,37}; we estimate that such reduction in smoking could address 11.9% of the prevalence of not initiating breastfeeding in this population. Studies such as ours are useful in monitoring population-based smoking and breastfeeding trends over time to demonstrate the gains in breastfeeding that may be attributable to successful smoking-cessation efforts.

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