

Longer Previous Smoking Abstinence Relates to Successful Breastfeeding Initiation Among Underserved Smokers

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Abstract

Objectives: The purpose of this study was to examine sociodemographic and behavioral factors related to successful breastfeeding initiation among medically underserved maternal smokers—a population with persistently low rates of initiation.

Subjects and Methods: Pretreatment data from a larger randomized behavioral counseling, secondhand smoke reduction trial was examined for this study. Maternal smokers with babies younger than 4 years old reported breastfeeding behaviors. Mothers who breastfed for >4 weeks ($n = 50$) were matched with mothers who never initiated breastfeeding based on infant age, gender, and maternal race. Multinomial logistic regression analysis tested the hypothesis that a greater duration of mothers' longest previous smoking abstinence would predict successful breastfeeding initiation in the context of other sociodemographic and behavioral factors known to relate to breastfeeding (e.g., education level, income, and maternal age).

Results: The sample consisted of current maternal smokers with a mean age of 28.8 ± 7.1 years. Among participants, 94% were African American, 81% were single, 63% reported an annual family income less than \$15,000, and 76% had completed a high school education or less. Logistic regression demonstrated that a longer duration of previous smoking abstinence and education beyond high school predicted breastfeeding initiation.

Conclusions: Maternal smokers' previous success at smoking abstinence may increase the likelihood of successful breastfeeding initiation. To improve prenatal health education for maternal smokers with low education levels, researchers should explore the utility of merging smoking cessation and postpartum relapse prevention advice within the context of lactation counseling to maximize success of smokers' efforts to initiate breastfeeding.

Introduction

BREASTFEEDING IS RECOGNIZED internationally as the most complete and natural way to feed an infant, providing the ideal nutrients for infant growth and preventing infection and disease.¹ It could be a uniquely important practice for mothers with a history of smoking because many of the health consequences from which breastfeeding protects infants (e.g., ear infection, respiratory infection, sudden infant death syndrome)¹ are ones to which secondhand smoke-exposed babies have increased susceptibility.² Breastfeeding may also delay postpartum smoking relapse.^{3–6} However, rates of breastfeeding among maternal smokers are approximately 30% lower than nonsmokers and continue to lag behind rates in the general U.S. population.^{7–11} Understanding factors associated with breastfeeding initiation among smoking women is critical to efforts aimed at improving breastfeeding rates in this group of women.

Approximately 10–15% of pregnant women smoke tobacco,¹² and these rates are higher among minority and medically underserved women (i.e., disadvantaged, economically deprived individuals with socioeconomic barriers to healthcare information and access).^{13–15} For example, low income and education are consistently associated with smoking during pregnancy and postpartum. Almost 20% of African American women smoke tobacco during pregnancy, and even higher smoking rates are observed among women with less than 12 years of education and with lower incomes.¹⁶ Many women are unable to quit smoking during their pregnancy, and among those who do quit, most smokers relapse within 6 months postpartum.^{17,18} The American Academy of Pediatrics has stated that smoking is *not* a contraindication to breastfeeding¹⁹ and has recommended that maternal smokers attempt to initiate breastfeeding, asserting that the benefits of breastfeeding outweigh the risks of nicotine exposure through

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breastmilk. However, former and current smokers continue to express misperceptions about breastfeeding recommendations,^{3,20} and some pediatricians continue to resist implementing American Academy of Pediatrics breastfeeding counseling guidelines with smokers.²¹

Medically underserved and minority populations, as well as heavier smokers in general, demonstrate the lowest rates of breastfeeding initiation compared with the general population.^{22,23} These data concern public health officials because medically underserved populations, such as low-income African Americans, also have higher postpartum smoking rates and have children with greater secondhand smoke exposure (SHSe)-related morbidity and mortality susceptibility than other groups.²⁴⁻²⁶ In addition to race and ethnicity, other factors relate to decreased likelihood of breastfeeding initiation. For example, compared with mothers who successfully initiate breastfeeding, mothers who do not initiate breastfeeding have lower education and income and are younger—factors that are also associated with maternal smoking.²⁷

Researchers have begun to examine biochemical and physiological factors that may explain the differential rates of breastfeeding between smokers and nonsmokers. Studies suggest that nicotine may alter the prolactin level, attributing to observable and reported reduced milk production among smokers versus nonsmokers.²⁸⁻³¹ However, systematic reviews of human research have found no definitive biochemical or physiological explanation for the reduced rates and duration of breastfeeding among smokers compared with nonsmokers.^{27,32} Moreover, most studies have been limited to smoker-nonsmoker comparisons. Few studies have examined variability in breastfeeding behaviors within samples of smokers. Even fewer studies have examined breastfeeding *within* the most high-risk populations of smokers, typically because low breastfeeding initiation rates persist in these groups. Thus, examining factors that may influence successful breastfeeding initiation among medically underserved smokers is warranted. They could guide health education and lactation intervention strategies designed for populations of maternal smokers whose children would benefit the most from breastfeeding.

The purpose of this study was to examine factors within a sample of medically underserved maternal smokers that differentiated mothers who were successful at initiating breastfeeding versus mothers who never initiated breastfeeding. Previous research has shown that abstinence during pregnancy and postpartum relates to breastfeeding initiation among smokers and that longer periods of abstinence in the past relate to future quit success.³³⁻³⁵ Testing whether previous length of abstinence relates to breastfeeding initiation could provide additional information that would have implications for future lactation education and smoking cessation counseling. Thus, we focused on the duration of previous smoking abstinence as a proxy of abstinence during postpartum, hypothesizing that a longer duration of previous smoking abstinence would relate to successful breastfeeding initiation when controlling for other factors known to associate with breastfeeding (e.g., education, parity, etc.).

Subjects and Methods

Study overview

This study examined maternal-reported breastfeeding behaviors in a pretreatment sample of maternal smokers. Data

for this study were obtained prior to participants' enrollment in a fully randomized behavioral counseling, SHSe reduction trial: Philadelphia FRESH (Family Rules for Establishing Smoke-free Homes). This trial was designed to assist maternal smokers in reducing their children's SHSe, although mothers were explicitly instructed at enrollment that they would not be required to quit smoking or reduce their daily cigarette consumption in order to participate in the trial. Following the aims of the FRESH trial, investigators used a purposive sampling strategy to access low-income maternal smokers living in medically underserved urban neighborhoods. Participating mothers had to be over 18 years old, smoke at least five cigarettes per day, expose their child to at least two maternal cigarettes per day, and be free of severe psychopathology (e.g., psychotic disorder.) All participants who enrolled were English speaking and were not pregnant. FRESH staff recruited participants from pediatric primary care clinics and Women, Infants, and Children (WIC) clinics and through targeted advertising in local newspapers and on public transit lines in low-income neighborhoods. Following Institutional Review Board-approved human subjects protocols, participants voluntarily enrolled in the trial following a 10-minute eligibility screening interview, informed consent procedures, and completion of an in-home baseline interview approximately 1 hour in length.

Classification of cases and controls

For the current study, we selected only biological mothers from the larger clinical trial sample. Among the remaining participants, women who breastfed for more than 4 weeks were classified as successfully initiating breastfeeding. This classification was determined via retrospective self-reported responses to two questions: "Did you ever nurse [Target Child Name]?" and, if yes, "For how many weeks did you nurse [Child]?" This method of classification was more conservative than those determined by the national surveillance methods assessment question, "Has your child ever been breast fed? (Yes/No)."²³ Our decision to use this more conservative criterion was based on two sets of evidence. First, a large proportion of low-income, African American mothers with low education (characteristics that greatly overlap our sample characteristics) are unable to achieve breastfeeding for a duration of more than 4 weeks.²³ Second, previous research has found that short-term breastfeeders tend to overestimate their breastfeeding duration when behavior is assessed retrospectively.³³ Therefore, by using this more stringent criterion, we were able to classify mothers into the "successful breastfeeding initiation group," accounting for overestimation of breastfeeding duration and reducing the likelihood of the inclusion of token breastfeeders.

For the purpose of testing our hypothesis, cases who were defined as having successfully initiated breastfeeding (breastfeeding group) were randomly matched to a comparison group of control mothers in the sample who never breastfed and initiated only formula feeding from birth onward (formula-only group). The resulting case-control matching rate of 1:1 was achieved by matching breastfeeding group to formula-only group mothers on three factors: infant gender, infant age, and maternal race. Infant age was categorized for matching based on developmental similarity within categories using the following ranges: 0-3 months, 4-6

months, 5–9 months, 10–12 months, 13–18 months, 19–24 months, 25–36 months, and >36 months.

Measures

Measures were obtained via interviewer administration of the FRESH trial's screening and baseline assessments. Screening interviews, performed mainly by phone, collected inclusion, exclusion, sociodemographic, recruitment site, and participant contact data. Baseline interviews were conducted in-person and included questions relevant to trial aims such as a detailed smoking and SHSe history, child health, and factors hypothesized to influence smoking and SHSe outcomes. Interview questions were constructed by a panel of smoking intervention and public health experts and included a combination of standardized scales and content valid items that were below the 7th grade Flesch-Kinkaid reading level. They then were tested for content validity via interview to a pilot sample of postpartum smokers. Interviewers read items with common smoking assessment terms (e.g., "relapse") that included oral operational definitions with opportunity for interviewer clarification to a participant if queried or if the interviewer determined item misinterpretation.

Hypothesized predictor. Reported duration of the longest previous smoking abstinence was hypothesized as the primary predictor. Duration of longest previous abstinence was obtained by responses to the item, "What was the longest time period you have gone without smoking a single cigarette, even a puff?" Responses for duration of previous abstinence were coded on a 6-point scale where 1 = less than 1 day and 6 = more than 1 year. To maximize ease of interpretation in the multivariate logistic regression analysis, duration of abstinence was dichotomized at the median such that 1 = more than 1 month of abstinence and 0 = 1 month or less of abstinence.

Controlling covariates. Factors known to associate with breastfeeding initiation in the general population were examined as potential controlling variables for the multivariate analysis. These variables were maternal education, maternal age, parity, hospitalizations for premature birth, current or previous substance abuse diagnosis, alcohol use, and marital status. Maternal education was obtained by response to categorical educational milestones that ranged from "no education" through "completion of graduate degree." For analyses, education was converted into a dummy variable and dichotomized into 1 = training beyond high school versus 0 = high school education or less. Maternal age at enrollment was obtained as a continuous variable by maternal report. Hospitalization due to premature birth was obtained by maternal report and recorded as a dichotomous response (yes = 1, no = 0). Self-reported marital status was dummy-coded as 1 = married or living with a partner and 0 = being single, widowed, divorced, or separated. Age of smoking initiation was obtained by responses to the item, "How old were you when you started smoking at least one cigarette per day," and then was dichotomized at the median such that 0 = started smoking prior to 17 years of age and 1 = started smoking at 17 years old or later. This last controlling variable was included as a proxy for nicotine dependence.

We also explored the need to include additional factors in multivariate analyses outlined below. These factors included income, recruitment site, depressive symptoms (Center for Epidemiologic Studies Depression Scale [CES-D]), and number of times participants moved in the last year. Income was dummy-coded as 1 = above \$15,000 versus 2 = at or below \$15,000. Recruitment sites included pediatric or maternal primary care, WIC clinics, word of mouth referral, and response to media advertising. The number of times mothers reported moving residences in the last year was chosen as a potential factor as an index of residential instability.

Statistical analysis

First we assessed bivariate associations between breastfeeding initiation and income, recruitment site, CES-D, and number of times moved. If a correlation between a factor and breastfeeding initiation suggested a relational trend ($p < 0.20$), that factor would be included in the subsequent multivariate analysis as an additional controlling covariate. From this final set of a priori and explored covariates, we tested for interrelations prior to multivariate analyses. Because the criterion variable was dichotomous (breastfeeding vs. formula-only), we analyzed the multivariate dataset using multinomial logistic regression. The direct-entry (simultaneous) method was used to test our hypothesis. Analyses were performed using SPSS version 17 (SPSS, Inc., Chicago, IL).

Results

Sample characteristics

Participant characteristics in this study reflect a matched sample of 100 medically underserved maternal smokers. Table 1 displays the sample's demographic, smoking history, and birth history descriptive variables. There were no differences in demographic characteristics between the breastfeeding and formula-only groups, except for education. Most participants were African Americans who were approximately 30 years old and had an infant or toddler exposed to her secondhand smoke. The sample of mothers was primarily single, unemployed, and low income, with most of the participants recruited from Philadelphia WIC clinics. Three-fourths of the sample reported achieving a high school degree or less education. Most of the mothers started smoking daily between 16 and 17 years old, but few reported a history of substance abuse. Approximately half of the mothers reported living with another smoker.

Bivariate and logistic regression analyses

One variable in preliminary analysis, income, demonstrated a potential association with breastfeeding ($r = -0.15$, $p = 0.15$). Thus, among the additional variables explored for potential inclusion in the logistic regression analysis, only income was added to the list of a priori controlling covariates. Maternal age was not included as a covariate in multivariate analyses to reduce the risk of multicollinearity, because of its correlation to both parity ($r = -0.32$, $p = 0.001$) and substance abuse ($r = 0.28$, $p = 0.004$). Likewise, marital status was not included as a covariate because of its association with income ($r = 0.37$, $p < 0.001$), education ($r = 0.20$, $p = 0.04$), and abstinence duration ($r = 0.23$, $p = 0.03$).

TABLE 1. PARTICIPANT CHARACTERISTICS

Variable	Mean (SD)			p value
	All participants	Breastfeeding group	Formula-only group	
Mother's age (years)	28.83 (7.13)	28.24 (6.77)	29.42 (7.49)	0.41
Baby's age (months)	16.08 (12.73)	16.34 (12.93)	15.82 (12.65)	0.84
Total time smoked (months)	133.88 (86.71)	123.36 (78.56)	144.40 (93.78)	0.23
Age (years) started smoking daily	16.37 (3.34)	16.94 (3.46)	15.80 (3.11)	0.09
Number of cigarettes smoked daily	11.33 (6.50)	10.40 (4.15)	12.25 (8.15)	0.15
Number of previous quit attempts	2.19 (2.69)	2.36 (3.02)	2.02 (2.35)	0.53
	%	n (%)	n (%)	p value
Duration of previous smoking abstinence				
Less than 1 month	42%	17 (34%)	25 (50%)	0.11
More than 1 month	58%	33 (66%)	25 (50%)	
Marital status (single)	81%	40 (80%)	42 (81.0%)	0.80
Education (high school degree or less)	76%	33 (66%)	42 (85.7%)	0.02
Income < \$15,000	63%	35 (70%)	28 (59.6%)	0.28
Unemployed	64%	31 (62%)	33 (66%)	0.68
African American ethnicity	94%	49 (98%)	45 (90%)	0.05
Drink alcohol (>0 beverages per week)	48%	22 (44%)	26 (52%)	0.42
History of substance abuse	8%	4 (8%)	4 (8%)	1.00
Other smokers in home (besides mom)	52%	29 (58%)	23 (46%)	0.23
Recruited from WIC clinic	61%	30 (60%)	31 (62%)	0.84
More than one child	20%	12 (24%)	8 (16%)	0.32
Baby born prematurely	22%	11 (22%)	11 (22%)	1.00

WIC, Women, Infants, and Children.

Logistic regression analysis resulted in a statistically significant model (Nagelkerke $R^2 = 0.21$, $p = 0.03$) that accounts for an estimated 26% of the total variance predicting breastfeeding initiation (Table 2). Results supported the hypothesis that longer duration of prior smoking abstinence was associated with breastfeeding initiation in a sample of medically underserved smokers when controlling for other factors known to relate to breastfeeding in general. Our analysis shows that maternal smokers with more than 1 month of abstinence during their longest previous quit attempt have nearly three times the odds of successful breastfeeding for at least 4 weeks compared with maternal smokers with 1 month or less abstinence during their longest previous quit attempt. Consistent with previous research on breastfeeding initiation, our results also demonstrated that mothers with post-high school education had more than a fourfold increase in the probability of successful breastfeeding initiation compared with mothers with a high school education or lower. No other smoking, demographic, or child health factor was significant covariates in the model, although lower income may be an important contributing factor that reduces the likelihood of breastfeeding initiation in this sample.

Discussion

This study offers an initial test of potential factors influencing the initiation of breastfeeding in an medically underserved sample of mothers (and infants) that represent a population known to have increased risk of general health problems as well as tobacco-related morbidity and mortality. The results add to the breastfeeding literature, suggesting that maternal smokers with more than 1 month's duration of

previous smoking abstinence are much more likely to initiate breastfeeding than maternal smokers with less than 1 month's duration of previous smoking abstinence. In previous research, the duration of previous quit attempts has been associated with increased likelihood of future smoking cessation success³⁴⁻³⁶ either by increasing confidence in future cessation attempts or because of prior acquisition of skills to manage nicotine withdrawal and urges to smoke. Thus, maternal smokers with greater success, or longer periods of abstinence, during previous smoking cessation attempts may be more likely to initiate breastfeeding because of their increased ability to maintain smoking abstinence after delivery compared with maternal smokers with less or no success with previous smoking cessation attempts.

In addition, our results are consistent with previous research showing a breastfeeding-education level association across populations. Education level had the strongest influence on breastfeeding initiation in our sample, holding greater importance than smoking-specific factors. Maternal smokers with education beyond high school graduation had more than a fourfold increase in the likelihood of breastfeeding initiation compared with mothers with only a high school education or less. Low education is also a factor in postpartum smoking relapse.^{23,37,38} The influence of education on breastfeeding initiation among smokers may reflect lack of clarity among less educated women about recommendations to breastfeed regardless of smoking status, perhaps reducing one's consideration of breastfeeding if the individual relapses to smoking.^{39,40} Thus, undereducated pregnant smokers might benefit from prenatal health education about the synergistic maternal and child health benefits of quitting smoking and breastfeeding. Future research could examine this hypothesis

TABLE 2. LOGISTIC REGRESSION: FACTORS PREDICTING BREASTFEEDING INITIATION (N = 100)

Predictor	Odds ratio	95% CI		p value
		Lower	Upper	
Longest previous period of smoking abstinence (>1 month)	2.89	1.12	7.47	0.03
Education > high school graduate	4.43	1.45	13.52	0.01
Income > \$15,000	0.37	0.14	0.98	0.05
Parity	2.37	0.74	7.56	0.15
Baby born prematurely	0.76	0.27	2.16	0.61
Started smoking prior to age 17 years	0.64	0.26	1.57	0.20
History of current substance abuse	1.35	0.27	6.72	0.60
Drink alcohol	0.80	0.31	2.02	0.63

For breastfeeding initiation, 1 = breastfeeding for more than 4 weeks, 0 = formula only.
CI, confidence interval.

to guide improved prenatal education for smokers with literacy challenges or otherwise known to have a low level of educational achievement.

Because variables in this study were obtained from a larger SHSe reduction trial with aims that focused on factors relevant to child SHSe and not breastfeeding, the dataset for the present study had limitations necessary to consider when interpreting the results and considering future directions. For example, the dataset did not contain information about mothers' physical health, psychosocial well-being, and smoking behavior during pregnancy and neonatal periods that may have influenced feeding choices and behavior. Future studies should assess those factors and include measures of concurrent psychosocial context (mood and anxiety presentation, social support, etc.) in a prospective manner. Even though current CES-D scores were not associated with reported previous breastfeeding in our sample, studies have shown that depressive symptoms relate with smoking, influence infant care in general,⁴¹⁻⁴⁴ and may be an important factor in breastfeeding.⁴⁵

The association between previous smoking abstinence and success with breastfeeding in our study is a novel finding that points to the need to replicate and clarify this association. Future research could prospectively examine a more detailed set of smoking history variables during pregnancy and postpartum that could relate to breastfeeding initiation. Pregnancy is a critical period for promoting breastfeeding intentions⁴⁶ as well as smoking cessation.^{12,47} Thus, in designing future studies, researchers should be aware that, like all preliminary correlational studies, this study cannot ascertain causality: Whether longer smoking abstinence periods prior to pregnancies predict success with breastfeeding initiation, or whether breastfeeding initiation predicts longer periods of smoking abstinence. Either outcome would be informative to public health and both smoking and breastfeeding intervention and education. For example, if future research finds that longer prior smoking abstinence predicts breastfeeding success, implications point to improved assessment of pregnant mothers' smoking history as a strategy to help determine which maternal smokers may benefit most from more-intensive breastfeeding education and advice. Alternatively, if breastfeeding success is found to predict subsequent successful smoking cessation, maternal health practitioners and public health professionals may consider the utility of promoting breastfeeding as a component of smoking

cessation counseling for maternal smokers that would prevent maternal and child health consequences of tobacco use and exposure.

When considering the generalizability of the results, readers should understand that the resulting sample in this study reflected purposive sampling strategies used to target the minority, medically underserved population in accordance with the aims of the larger SHSe reduction trial. Nonetheless, the psychosocial and interpersonal characteristics of our sample represent the broader population of maternal smokers, and the sample represents a group of medically underserved mothers exposed to increased socioeconomic deprivation and stress, which are risk factors for maternal smoking in general.^{48,49} Also, even though intention to quit was not a requirement for enrollment in the SHSe reduction trial, there could be concern that the sample included smokers more interested in modifying their smoking behavior than the general population. However, it is well known that the majority of smokers in the general population report wanting to modify or quit smoking.⁵⁰

Additional research is necessary to replicate findings in this study and expand our understanding of a more complete range of factors affecting breastfeeding initiation among medically underserved maternal smokers. Nonetheless, the results in this study are likely to generalize to other populations of smoking mothers experiencing socioeconomic hardship. The current study is also important in laying the groundwork to understanding some fundamental factors that may influence breastfeeding initiation among medically underserved smoking mothers, a population where little is known about breastfeeding because of the low initiation rates.

Implications and Conclusions

Results from this study suggest that among medically underserved maternal smokers, longer previous smoking abstinence duration and higher education level relate to breastfeeding initiation when controlling for other breastfeeding-related factors. Additional research is necessary to replicate these findings. However, results suggest that these two factors may be important for practitioners to consider when identifying maternal smokers that could benefit from more intensive prenatal breastfeeding advice. For example, practitioners could inform undereducated maternal smokers with a history of difficulty in quitting smoking about the

protective effects of breastfeeding on postpartum smoking relapse along with the broader benefits of breastfeeding.

Advancing our understanding of factors related to successful breastfeeding initiation among maternal smokers can only improve public health and health education programs targeting these women. Such efforts are necessary to promote the health benefits of breastfeeding among smokers, particularly maternal smokers in medically underserved and high-risk populations. Without additional studies exploring the variability in breastfeeding initiation among medically underserved smokers, efforts to expand breastfeeding rates in medically underserved populations will likely remain short of U.S. public health goals.

Disclosure Statement

No competing financial interests exist.

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