Original Investigation

Breast feeding is associated with postpartum smoking abstinence among women who quit smoking due to pregnancy

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Abstract

Introduction: The purpose of this study was to characterize the relationship between breast feeding and postpartum smoking abstinence among women who quit smoking due to pregnancy and who were participating in a randomized clinical trial of an intervention designed to prevent postpartum relapse.

Methods: A total of 251 women were enrolled in the intervention between 30 and 33 weeks postpartum and were followed through 26 weeks postpartum. Participant characteristics were assessed at the prepartum baseline visit, any breast feeding was assessed at 8 weeks postpartum, and smoking abstinence was assessed at 8 and 26 weeks postpartum.

Results: Although 79.1% of participants intended to breast feed, only 40.2% reported breast feeding at 8 weeks postpartum. Characteristics associated with breast feeding at 8 weeks postpartum included Caucasian race/ethnicity, greater education, higher household income, and being married/living with a significant other. Logistic regression analysis indicated that breast feeding at 8 weeks postpartum was significantly associated with smoking abstinence at 8 weeks postpartum, odds ratio (OR) = 7.27 (95% CI = 3.27, 16.13), $p < .001$. Breast feeding at 8 weeks postpartum was also associated with abstinence at 26 weeks postpartum after controlling for smoking status at 8 weeks postpartum, OR = 2.64 (95% CI = 1.14, 6.10), $p = .02$.

Discussion: Encouraging breast feeding among women who quit smoking due to pregnancy may facilitate postpartum smoking abstinence while increasing adherence to current infant feeding guidelines.

Introduction

The current recommendation for infant feeding is exclusive breast feeding during the first 6 months of life and breast feeding in combination with complementary foods for the remainder of the first 1 to 2 years (Gartner et al., 2005; World Health Organization [WHO], 2003). However, despite the efforts of the Supplemental Nutrition Program for Women, Infants, and Children (see Carr, 2009) and others (U.S. Department of Agriculture [USDA], 1996; U.S. Department of Health and Human Services [USDHHS], 2000), in the United States, only 22.4% of mothers breast feed at all during the first 6 months postpartum and only 9.5% breast feed exclusively (Li, Ogden, Ballew, Gillespie, & Grummer-Strawn, 2002). Rates of breast feeding for this time period are even lower among women who smoke during pregnancy, with only 9.4% breast feeding at all and 3.3% breast feeding exclusively (Li et al.). Maternal smoking is associated with lower rates of breast-feeding initiation and reduced breast-feeding duration (Donath, Amir, & the ALSPAC Study Team, 2004; Horta, Victora, Menezes, & Barros, 1997; Sayers, Corcoran, & Burke, 1995; Weiser et al., 2009). There is evidence that the negative influence of smoking on breast feeding may be due primarily to motivational (e.g., women who smoke are less likely to report breast-feeding intentions and are also less likely to initiate breast feeding) rather than physiological factors (Amir & Donath, 2002; Donath et al.).

Although tobacco use is not currently considered to be a contraindication to breast feeding (Gartner et al., 2005), the effects of nicotine on nursing infants remain largely unknown (American Academy of Pediatrics Committee on Drugs, 2001). Thus, the American Academy of Pediatrics has recommended

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that health care professionals encourage breast-feeding mothers to quit smoking (American Academy of Pediatrics Committee on Drugs; Gartner et al.). Although nearly 50% of women quit smoking during pregnancy, approximately half will relapse within 6 months of delivery (Colman & Joyce, 2003). Thus, postpartum smoking cessation interventions may help to reduce relapse rates among women who quit smoking due to pregnancy, reduce nicotine exposure among breast-feeding infants, and increase the rates and duration of breast feeding among women who smoked prior to or during pregnancy.

The findings of several studies suggest that breast feeding may protect against postpartum smoking relapse (Kaneko et al., 2008; Letourneau et al., 2007; Martin et al., 2008; O'Campo, Faden, Brown, & Gielen, 1992; Ratner, Johnson, & Bottorff, 1999; Ratner, Johnson, Bottorff, Dahinten, & Hall, 2000). However, the methodologies predominant in this literature often do not permit a clear inference because smoking and breast feeding are measured during either the same or the overlapping periods of time without identifying the timing of the status change (Kaneko et al.; Martin et al.; O'Campo et al.; Ratner et al., 1999, 2000). In addition, descriptions of the items used to measure breast-feeding status and/or the timing of the breast-feeding assessment are frequently omitted (Letourneau et al.; Martin et al.; O'Campo et al.). A single prospective study showed a relationship between breast feeding during the postpartum hospital stay and continued smoking abstinence at 2 weeks postpartum (Letourneau et al.). However, studies are needed to determine if continued breast feeding beyond the first few days postpartum reduces the likelihood of smoking relapse later into the postpartum period.

Thus, studies that use clearly defined measures of breast feeding and smoking status, measured at specific points in time, are needed to determine the prospective influence of breast feeding on later smoking cessation. Given the possible treatment utility of breast-feeding promotion for facilitating smoking cessation and relapse prevention during the postpartum period, studies of the influence of breast feeding on postpartum smoking cessation are also needed. As such, it will be important to identify the characteristics associated with breast feeding, in order to specifically target women who are more likely to prematurely discontinue breast feeding for breast-feeding promotion efforts.

The purpose of this analysis was to (a) characterize the prospective relationship between early breast feeding and postpartum smoking abstinence during a specific quit attempt among women participating in a postpartum relapse prevention study intervention and (b) identify demographic and socioeconomic characteristics associated with breast feeding in a group of women who may be less likely to follow current infant feeding guidelines (i.e., smokers). It was hypothesized that continued breast feeding during the first 8 weeks postpartum would be associated with smoking abstinence at 26 weeks postpartum. Demographic and socioeconomic characteristics associated with breast feeding were expected to reflect the characteristics of breast-feeding women in the general population. Findings may be used to improve smoking cessation interventions for postpartum women and to increase breast-feeding rates among individuals who possess socioeconomic and demographic characteristics associated with a reduced likelihood of breast feeding.

Methods

Data used in the current study were collected as part of a randomized clinical trial to evaluate the efficacy of two versions of a motivation and problem-solving (MAPS) treatment designed to reduce postpartum relapse among women who quit smoking during pregnancy. The MAPS treatments were compared with usual care in a racially/ethnically diverse sample of women of predominantly low socioeconomic status. Participants were followed from 34 weeks prepartum through 26 weeks postpartum. The findings of the parent study are reported elsewhere (Reitzel et al., 2010).

Participants

Pregnant women were eligible to participate if they (a) were ≥ 18 years of age, (b) were in their 30th–33rd week of pregnancy, (c) were able to speak English, (d) smoked an average of ≥ 1 cigarette/day during the year prior to their pregnancy, and (e) stopped smoking either during their pregnancy or within 1 month prior to becoming pregnant. Participants were excluded from the study if they reported a high-risk pregnancy. Smoking abstinence was verified at enrollment with an expired carbon monoxide level of < 10 ppm.

Measures

The *Demographic Information Questionnaire* is a self-report measure of demographic (i.e., age, race/ethnicity, gender, partner status) and socioeconomic characteristics (i.e., annual household income, education). The *Tobacco History Questionnaire* is a self-report measure of tobacco use characteristics including years of smoking, daily smoking rate, and time to first cigarette. *Breast feeding* was assessed with two questions: (a) "Do you intend to breastfeed?" that was measured at the prepartum visit and (b) "Are you currently breastfeeding?" that was measured at 8 weeks postpartum. Participants responded with either a "yes" or a "no" answer to each item. It is important to note that breast feeding reflects "any" breast feeding (rather than "exclusive" or "ever" breast feeding). *Abstinence* was defined as a self-report of abstinence from smoking without any lapses during the previous 7 days accompanied by either an expired carbon monoxide level of < 10 ppm or a salivary cotinine level of < 20 ng/ml. Participants who self-reported a lapse and/or produced carbon monoxide or cotinine levels inconsistent with abstinence were considered relapsed.

Procedure

The present study was approved by the Institutional Review Board of the University of Texas M.D. Anderson Cancer Center. Informed consent was obtained from all participants. Questionnaire measures were completed at the prepartum baseline visit. Breast feeding was assessed at 8 weeks postpartum and smoking abstinence was assessed at 8 and 26 weeks postpartum.

Data analyses

Chi-square analyses and *t* tests were conducted to test for differences in demographic and socioeconomic characteristics by breast-feeding status at 8 weeks postpartum. Separate logistic

regression analyses were conducted to evaluate the associations between self-reported breast feeding at 8 weeks postpartum and smoking abstinence at 8 and 26 weeks postpartum. Intervention group, age, race/ethnicity, education, annual household income, partner status, cigarettes per day (prior to quitting), and time to first cigarette (prior to quitting) were included as covariates in the regression analyses. In addition, smoking status at 8 weeks postpartum was included in the analyses of smoking status at 26 weeks postpartum. Participants with missing covariates (from baseline) or missing breast-feeding status (at 8 weeks postpartum) were excluded from the analyses. Participants who did not provide information about smoking status at 8 or 26 weeks postpartum were considered relapsed (consistent with an intent-to-treat approach).

Results

Participant characteristics

A total of 251 women participated in the parent study. After excluding women with missing data, the sample was reduced to 182–249 participants depending on the variables of interest. Although 79.1% (of 249 participants) reported at the baseline (prepartum) visit that they intended to breast feed, only 40.2% (of 199 participants) reported any breast feeding at 8 weeks postpartum. Chi-square analyses indicated that intervention group was not significantly associated with breast-feeding status at 8 weeks postpartum. Notably, 20.0% (of 199 participants; nearly half of breast-feeding women) reported that they had relapsed to smoking and were still breast feeding at 8 weeks postpartum. Participants who were not breast feeding at 8 weeks postpartum reported that they had discontinued breast feeding after an average of 3.94 ($SD = 2.87$) weeks. Characteristics associated with any breast feeding at 8 weeks postpartum included Caucasian race/ethnicity, greater education, higher annual household income, and being married or living with a significant other. See Table 1 for participant characteristics overall and by breast-feeding status at 8 weeks postpartum.

Breast feeding and postpartum smoking abstinence

The analyses included 182 participants who provided complete data. Missing data occurred primarily because of failure to report income at the baseline visit ($n = 29$) and failure to report breast-feeding status at 8 weeks postpartum ($n = 52$). In all cases, missing data on breast-feeding status at the 8-week postpartum assessment were due to women failing to attend that session. Participants who provided breast-feeding status did not differ from participants who were missing breast-feeding status on age, race/ethnicity, partner status, education, income, or intervention group. Notably, participants with missing breast-feeding status smoked more cigarettes per day prior to quitting ($p < .001$) but were less likely to smoke within 5 min of waking ($p = .009$).

After controlling for intervention group, age, race/ethnicity, education, annual household income, partner status, cigarettes per day, and time to first cigarette, logistic regression analysis indicated that self-reported breast feeding at 8 weeks postpartum was significantly associated with higher rates of smoking abstinence at 8 weeks postpartum, odds ratio (OR) = 7.27 (95% $CI = 3.27, 16.13$), $p < .001$, $N = 182$. Similarly, after controlling

Table 1. Participant characteristics by 8 weeks postpartum breast-feeding status

	Any breast feeding	Not breast feeding	<i>p</i>
Age (mean, <i>SD</i>)	25.5 (5.6)	24.3 (5.0)	.120
Cigarettes per day (prior to quitting; mean, <i>SD</i>)	10.0 (6.8)	9.4 (6.8)	.576
Years of smoking (prior to quitting; mean, <i>SD</i>)	7.6 (4.6)	6.5 (4.0)	.073
Race/ethnicity (%)	–	–	.041
Caucasian ($n = 67$)	52.2	47.8	–
Black ($n = 65$)	27.7	72.3	–
Latina ($n = 62$)	40.3	59.7	–
Other ($n = 5$)	40.0	60.0	–
Education (%)	–	–	<.001
<High school ($n = 32$)	12.5	87.5	–
High school/some college ($n = 136$)	41.9	58.1	–
≥Bachelor's degree ($n = 31$)	61.3	38.7	–
Annual household income (%)	–	–	.046
≤\$19,999 ($n = 59$)	33.9	66.1	–
\$20,000–\$39,999 ($n = 58$)	36.2	63.8	–
≥\$40,000 ($n = 65$)	53.8	46.2	–
Partner status (%)	–	–	.012
Single/divorced/separated/widowed ($n = 73$)	28.8	71.2	–
Married/living with significant other ($n = 126$)	46.8	53.2	–
Time to first cigarette (%)	–	–	.202
≤5 min of waking ($n = 49$)	32.7	67.3	–
>5 min of waking ($n = 149$)	43.0	57.0	–

Note. Group differences were evaluated with *t* tests for continuous variables and chi-square analyses for categorical variables.

for the covariates listed above as well as smoking status at 8 weeks postpartum, logistic regression analysis indicated that self-reported breast feeding at 8 weeks postpartum was significantly associated with higher rates of smoking abstinence at 26 weeks postpartum, $OR = 2.64$ (95% $CI = 1.14, 6.10$), $p = .02$, $N = 182$. The relationships between any breast feeding at 8 weeks postpartum and abstinence at 8 and 26 weeks postpartum are depicted in Figure 1.

Discussion

The current study generated several key findings. Perhaps of greatest importance was the finding that breast feeding at 8 weeks postpartum was prospectively associated with smoking abstinence at 26 weeks postpartum even after controlling for smoking status at 8 weeks. Although most participants (79.1%) reported at the initial prepartum visit that they intended to breast feed, the prevalence of actual breast feeding was substantially lower, with less than half (40.2%) of the women reporting any breast feeding at 8 weeks postpartum. Characteristics associated with breast feeding at 8 weeks postpartum included Caucasian race/ethnicity (and Latina race/ethnicity to a lesser extent), greater education, higher annual household income, and being married or living with a significant other. Overall,

Relationship between breast feeding and postpartum smoking abstinence

Figure 1. Association between any breast feeding at 8 weeks postpartum and abstinence at 8 and 26 weeks postpartum.

findings suggest that breast feeding is associated with smoking abstinence among women enrolled in a smoking cessation treatment trial. Additionally, many of the methodological weaknesses common in previous research were addressed in the current prospective study.

Findings suggest that the prevalence of breast feeding and the characteristics associated with breast feeding among women who quit smoking due to pregnancy (i.e., Caucasian race/ethnicity, greater education and income, and married/living with a partner) were comparable to the general population. In nationally representative samples, the prevalence rate of any breast feeding at 8 weeks postpartum is approximately 40% (Li et al.), and breast-feeding prevalence rates are generally higher among Caucasians and Mexican Americans than Blacks (Li et al.; McDowell, Wang, & Kennedy-Stephenson, 2008). Studies have also indicated that women who are married, have greater education, and higher income are also more likely to breast feed (Hendricks, Briefel, Novak, & Ziegler, 2006; Li et al.; McDowell et al.). In contrast with other research (Hendricks et al.; Li et al.), greater age was not significantly associated with breast feeding in the current sample. Perhaps this is because participants in the current study were somewhat younger ($M = 24.8$ years) than the women in other nationally representative samples (Hendricks et al.; Li et al.).

Several limitations of the current study should be noted. It is possible that the generalizability of the findings may be limited to treatment-seeking women who quit smoking early in pregnancy, and may not generalize to other groups of women, such as those who quit smoking later in pregnancy or those who do not choose to participate in smoking cessation treatment. Furthermore, the failure of many participants to attend the 8 weeks postpartum visit resulted in some missing breast-feeding status data. Although no demographic or socioeconomic differences were found between those who provided information on breast-feeding status and those with missing breast-feeding status, participants were found to differ in the number of cigarettes smoked per day and the time until first cigarette smoked in the morning (i.e., measures of nicotine dependence). As such, these variables were included as covariates in all models to adjust for differences. However, it is possible that missing data occurred as a result of other unobserved variables for which we were not

able to adjust. The current study also did not evaluate the influence of breast-feeding duration or exclusivity on postpartum smoking abstinence. Some research suggests that breast feeding for ≥ 6 months may have a greater impact on smoking cessation than breast feeding for shorter durations (Kaneko et al., 2008). It is also possible that exclusive breast feeding may be a more effective deterrent of tobacco use than mixed breast/formula feeding because exclusively breast-feeding women who use tobacco would have greater difficulty avoiding or minimizing infant exposure to nicotine.

Another limitation is that the current study does not illuminate the mechanisms that may link breast feeding with the prevention of smoking relapse. One possible explanation is that women may avoid smoking due to concerns about the effects of nicotine on their nursing infants (Edwards & Sims-Jones, 1998). Other research has indicated that breast feeding is associated with reduced negative affect, perhaps due to the release of oxytocin (Mezzacappa & Katkin, 2002). Given that negative affect is commonly found to be associated with smoking relapse in general (e.g., Shiffman et al., 2007) and also during the postpartum period (e.g., Park et al., 2009), it is possible that breast feeding may protect against relapse through the attenuation of postpartum negative affect. A variety of other factors may impact the initiation and duration of breast feeding, including infant temperament, breast-feeding difficulties, social/partner support for breast feeding, and breast-feeding self-efficacy.

Interestingly, one recent study showed that smoking cessation mediated the relationship between smoking cessation treatment and duration of breast feeding (Higgins et al., 2010). Thus, breast feeding and smoking cessation may have a reciprocal influence, such that breast feeding promotes smoking cessation and smoking cessation prolongs breast feeding. Alternatively, a third unidentified variable such as partner or family support may influence both smoking cessation and breast feeding. It is possible that women who maintain breast feeding for 8 weeks are more likely to possess other characteristics that facilitate postpartum smoking cessation. Future studies are needed to discriminate between possible confounding variables that are predictive of both breast feeding and smoking cessation (e.g., concerns about health of the infant) and variables that are hypothesized to occur as a result of breast feeding and have a positive influence on smoking cessation (e.g., positive influence of oxytocin on affect, desire to avoid exposing nursing infant to nicotine). Mediation analyses may be conducted to identify potential mechanisms of the relationship between breast feeding and smoking cessation, and more complex conceptual models may be evaluated using a structural equation modeling approach.

It is important to emphasize that the risks of smoking while breast feeding to the infant (e.g., infant exposure to nicotine and tobacco smoke) may not outweigh the risks associated with formula feeding and smoking (e.g., Sudden Infant Death Syndrome, respiratory and ear infections; for a discussion see American Academy of Pediatrics Committee on Drugs, 2001). Thus, breast feeding may remain beneficial and appropriate for many women who relapse to smoking, and strategies may be employed to minimize infant nicotine exposure among women having difficulty with smoking cessation. For example, smoking immediately after breast feeding allows more time for the nicotine and other chemicals to leave the breast milk before the next feeding. Women may also reduce their overall level of smoking to minimize

infant nicotine exposure. The transdermal nicotine patch may be another option for breast-feeding women attempting to quit smoking, as research has indicated that breast-feeding infants are exposed to less nicotine when the low-dose transdermal nicotine patch (7 mg) is used, compared with continued smoking or the use of a higher dose nicotine patch (21 mg; Ilett et al., 2003).

Smoking cessation and postpartum relapse prevention interventions may provide a unique opportunity to increase breast-feeding prevalence rates by educating women about the benefits of breast feeding and by facilitating and encouraging continued breast feeding throughout the first postpartum year. In turn, breast feeding may protect against smoking relapse while providing numerous health benefits to both mother and child. Particular attention must be paid to Blacks, individuals of lower socioeconomic status, and unmarried/single women enrolled in smoking cessation treatment, as women in each of these groups may be less likely to breast feed their infants. Encouraging breast feeding among women who quit smoking due to pregnancy may facilitate continued smoking postpartum abstinence while concurrently increasing knowledge of and adherence to currently accepted infant feeding recommendations.

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Declaration of Interests

None declared.

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