Original investigation

Pediatric Office Delivery of Smoking Cessation Assistance for Breast-Feeding Mothers

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Abstract

Introduction: National and international organizations have done an excellent job of advocating and promoting breast feeding for all mothers. This study assessed to what extent an intervention increased delivery of cessation assistance to breast-feeding mothers who smoke.

Methods: Data were collected between April and October 2015 in five US states as part of a cluster randomized controlled trial in 10 pediatric practices. Practices were randomized to the Clinical Effort Against Secondhand Smoke Exposure (CEASE) intervention or usual care control arms. Mothers were asked about their smoking status and breast-feeding history during a screening interview upon exiting the practice and eligible mothers who agreed to participate in an enrollment interview were asked if they received smoking cessation assistance during their child's visit. Mothers with a child 1 year old and younger were included in the analyses.

Results: Current breast feeding was associated with a reduced likelihood of current smoking (adjusted odds ratio [aOR] = 0.38, 95% confidence interval [95% CI] = 0.25 to 0.57) and a greater likelihood of quitting smoking (aOR = 2.33, 95% CI = 1.29 to 4.21) after controlling for known confounders. Mothers who concurrently smoked and breast-fed were more likely to be asked about smoking (66.7% vs. 28.6%, $p = .01$), advised to quit (61.1% vs. 21.4%, $p < .01$), prescribed nicotine replacement therapy (50.0% vs. 0%, $p < .001$), and enrolled into the quitline (27.8% vs. 0%, $p < .01$) at CEASE practices compared to control practices.

Conclusion: Breast-feeding mothers were less likely to be current smokers and more likely to have recently quit smoking. Among mothers who continue to smoke and breast feed, the CEASE intervention enhances delivery of smoking cessation assistance.

Implications: Breast feeding and eliminating infants' exposure to tobacco smoke are important protective factors for serious pediatric health risks including sudden infant death. This study shows that breast feeding was positively associated with desirable tobacco control outcomes, specifically that breast feeding was associated with a lower likelihood of smoking among ever smokers and a greater likelihood of recently quitting smoking. This is also the first study to look specifically at delivery of smoking cessation assistance to breast-feeding mothers seen at pediatric offices and demonstrates the effectiveness of delivering evidence-based smoking cessation assistance to them in this context.

Trial Registration: www.ClinicalTrials.gov (identifier NCT01882348).

Introduction

The 2012 American Academy of Pediatrics (AAP) Policy Statement on breast feeding does not classify maternal smoking an absolute contraindication to breast feeding, but it strongly discourages smoking while breast feeding, citing an increased risk of sudden infant death syndrome, infant respiratory allergy, low milk supply, and poor weight gain.¹ Although there are many well-established benefits to breast feeding,¹ there are also detrimental health effects to mothers and infants from smoking and exposure to tobacco smoke.² Mothers who smoke expose infants to environmental tobacco smoke^{3,4} and transmit toxic chemicals to infants through their breast milk.⁵ To comply with current AAP policy when seeing a mother who smokes with an infant, pediatricians have a critical role in advocating for breast feeding^{6,7} while also providing meaningful smoking cessation assistance.⁸ The 2015 AAP Policy Statement on clinical practice policy to protect children from tobacco, nicotine, and tobacco smoke states that pediatricians should counsel and refer parents who smoke to resources to help them quit smoking and consider prescribing medication such as nicotine replacement therapy (NRT).⁹

Studies have suggested that breast feeding is associated with a greater likelihood of smoking abstinence among mothers who had smoked,¹⁰⁻¹⁴ and that early weaning is associated with postpartum smoking relapse.^{10,15,16} A recent US study examining maternal attitudes of smoking and breast feeding showed smoking was not typically an influential factor in mothers' decisions to breast feed, but the majority of breast-feeding mothers who did consider the issue of smoking smoked less frequently or remained quit.¹⁷ This important finding suggests that smoking abstinence among breast-feeding mothers might be increased using interventions addressing mothers' smoking when they are preparing or beginning to breast feed. Despite AAP policy statements^{1,9} and studies suggesting the time of breast feeding as a critical opportunity to help mothers quit smoking,^{10,18} we are not aware of any studies that have determined if evidence-based cessation assistance is being delivered to breast-feeding mothers in pediatric practices. Furthermore, a need for studies that address the relationship between smoking and breast feeding in the context of an intervention has been noted in a recent systematic review.¹¹ The Clinical Effort Against Secondhand Smoke Exposure (CEASE) intervention,^{19,20} designed to deliver evidence-based assistance to parental smokers in the pediatric setting,²¹ was well-positioned to explore the relationship between smoking and breast feeding within pediatric practices.

We first aimed to investigate whether breast-feeding status was associated with smoking behaviors and quitting smoking prior to receiving the CEASE smoking cessation intervention among mothers assessed at baseline enrollment. A second aim was to evaluate to what extent the CEASE intervention might increase the delivery of evidence-based smoking cessation assistance to mothers who were breast feeding. This study is the first to look specifically at delivery of smoking cessation assistance in the form of NRT or enrollment in the tobacco quitline to breast-feeding mothers seen at pediatric offices.

Methods

Study Design

Data were collected between April and October 2015 in five US states (Ohio, Virginia, Tennessee, North Carolina, and Indiana) as part of a cluster randomized controlled trial testing the effectiveness of the CEASE intervention in 10 pediatric practices. The practices (two per state) were randomized to either receive training in the

CEASE intervention or to usual care control. Clinicians and office staff at intervention practices were trained using a telephone-based training protocol²⁰ that taught practices how to systematically screen all families for household tobacco use²² by using a brief screener on an iPad,¹⁹ to advise parents to keep homes²³ and cars²⁴ smoke free, and to provide evidence-based assistance by prescribing NRT and enrolling parents in their state's quitline.²⁵ Clinicians did not receive training from the research team that focused on how to intervene with breast-feeding mothers specifically; rather, trainings focused on addressing smoking with each household smoker. Methods of the intervention training are described in detail elsewhere.²⁰

Data Collection and Measures

Intervention practices were trained and the CEASE program was implemented in those practices. Research assistants then conducted exit interviews with parents after their child's visit in the intervention and control practices. During the screening interview, mothers were asked: Did you breast feed any of your children? Mothers who answered affirmatively were then asked: Did you breast feed the youngest child seen at the office today? Mothers who answered affirmatively were then asked: Are you still breast feeding? Mothers who reported they had smoked at least 100 cigarettes in their lifetime and had smoked a cigarette, even a puff, in the past 7 days were offered an opportunity to participate in an enrollment interview. Mothers who had quit smoking within the past 2 years by indicating that they had not smoked a cigarette, even a puff, in the past 7 days but have smoked a cigarette in the past 2 years and had smoked at least 100 cigarettes in their lifetime were also asked to participate in the enrollment interview. Participants signed a consent form and received \$5 upon completing the enrollment interview. Parents who were under 18 years or non-English-speaking were not eligible.

To assess if smoking cessation assistance was provided during the visit, enrolled mothers were asked: During your visit today, did a doctor, nurse, or other health care provider (1) ask if you smoke cigarettes? (2) advise you to quit smoking? (3) give you a prescription for medicine to help you quit smoking? and (4) enroll you in a telephone quitline? Institutional review board approval was obtained from Massachusetts General Hospital, the AAP, and local practices, when required.

Data Analyses

Secondary analyses of the post-implementation exit interview data are cross-sectional in nature.^{19,20} A categorical variable was created to classify mothers as (1) having *never breast-fed*, (2) having *ever breast-fed but not currently breast feeding*, or (3) *currently breast feeding*. The smoking status of mothers was similarly classified into a categorical variable as (1) having *never smoked* (at least 100 cigarettes in her lifetime), (2) *ever smoked* (at least 100 cigarettes in her lifetime) *but not currently* smoking, or (3) *currently smoking* (past 7 days). Analyses used data from mothers whose youngest child was less than or equal to 1 year old.

Breast-Feeding Status and Current Smoking

The purpose of this analysis was to examine how breast feeding was associated with the likelihood of being a current smoker among mothers who have ever smoked. The exposure variable was the mother's breast-feeding status (current, ever (not current), and never) and the outcome was defined as current smoking (past 7 days) compared to ever (but not currently) smoking. Bivariate analyses using Pearson chi-square tests were used to calculate the associations

between mother's breast-feeding status and current smoking status, and the Mantel-Haenszel test was used to evaluate if the associations differed for each age category of the mother's youngest child (≤ 6 months or > 6 months and ≤ 1 year). Pearson chi-square analyses between mother's breast-feeding status and current smoking status were then performed on stratified data based on the age of the mother's youngest child (≤ 6 months, > 6 months and ≤ 1 year).

Multivariable logistic regression was used to predict the adjusted odds of current smoking versus ever smoking (not currently) by breast-feeding status. Other independent variables included were mother's age, ethnicity and race, education level, and age of the youngest child. Subgroup sensitivity analyses were performed by including an interaction term between the breast-feeding status and age of the youngest child (≤ 6 months, > 6 months and ≤ 1 year) variables and breast-feeding status and mother's age (≤ 24 , 25–29, 30–34, and 35 and older) variables in the multivariable model separately to evaluate the robustness of the results across youngest child age and maternal age groups.

Frequency and Amount of Smoking by Breast-Feeding Status

Analyses were conducted among currently smoking mothers with the purpose of evaluating if smoking frequency and the number of cigarettes smoked per day were associated with current breast feeding or previous breast feeding. The exposure variable in these analyses was the mother's breast-feeding status (current, ever (not current), and never). Outcome variables included a dichotomous measure to assess frequency of cigarette smoking (every day or some days) and the self-reported number of cigarettes smoked per day (mean). A Pearson chi-square test was used to test associations between breast-feeding status and whether or not mothers reported smoking cigarettes every day or on some days. A one-way analysis of variance was conducted to compare the means of the number of cigarettes smoked per day for currently smoking mothers by breast-feeding status. The Tukey honestly significant difference post hoc test was used to determine significant differences in mean number of cigarettes smoked per day between breast-feeding groups. To examine the effect of the age of the youngest child and mother's age on the association between the mean number of cigarettes smoked per day and breast-feeding status, factorial analyses of variance were conducted.

Breast-Feeding Status and Quitting Smoking

The purpose of this analysis was to determine if the breast-feeding status of mothers was associated with an increased likelihood of quitting smoking within the past year and remaining quit at the time of the exit interview. Mother's breast-feeding status (current, ever (not current), and never) was the exposure variable; the outcome was self-reported quitting smoking within the past year and remaining quit at the time of the exit interview. A mother who reported quitting at some point within the past year was classified as quit smoking if she also reported not smoking a cigarette, even a puff, during the past 7 days. Bivariate analyses using Pearson chi-square tests across age groups of the mother's youngest child (≤ 6 months, > 6 months and ≤ 1 year) were conducted.

Multivariable logistic regression was used to calculate the adjusted odds for quitting smoking in the past year and remaining quit at the time of the exit interview by breast-feeding status. Other independent variables included in the model were mother's age, ethnicity and race, education level, and age of the youngest child. Subgroup sensitivity analyses were performed by including an interaction term between the mother's breast-feeding status and age of

the youngest child (≤ 6 months, > 6 months and ≤ 1 year) variables and the mother's breast-feeding status and mother's age (≤ 24 , 25–29, 30–34, and 35 and older) variables on quitting smoking within the past year and remaining quit at the time of the exit interview. Each interaction term was evaluated separately in the model. The prevalence of currently breast feeding mothers who made at least one quit attempt in the previous 3 months because they were trying to quit smoking but were still smoking (past 7 days) at the time of the exit interview was also calculated.

Effectiveness of CEASE Intervention in Delivering Evidence-Based Assistance to Mothers Who Smoke and Breast Feed

Pearson chi-square tests were used to determine if mothers who were currently smoking and breast feeding were more likely to receive assistance for their smoking at CEASE intervention practices versus control practices. Specifically, the proportions of breast-feeding mothers who were currently smoking were compared on the likelihood of being asked if they smoke cigarettes, advised to quit smoking, given a prescription for NRT, and enrolled in the quitline during their office visit. A Pearson chi-square test determined if enrolled mothers who were concurrently smoking and breast feeding were more likely than non-breast-feeding mothers (ever (not currently) and never) to receive assistance for their smoking at intervention practices through quitline enrollment or an NRT prescription.

Results

A total of 2139 mothers whose youngest child was less than or equal to 1 year old participated in a screening interview (924 intervention, 1215 control) and of these, 511 had smoked a cigarette in the past 7 days or had quit smoking within the past 2 years and consented to complete an enrollment interview (245 intervention, 266 control) and 176 refused (42 intervention, 134 control). Among screened mothers, 2109 were classified into one of the breast-feeding categories; 30 had missing data or provided responses that could not be classified into a breast-feeding category. Among enrolled mothers, 506 were classified into a breast-feeding category. Demographics are presented in [Table 1](#).

Breast-Feeding Status and Current Smoking

Among mothers with a child less than or equal to 1 year old who had ever smoked, currently breast-feeding mothers ($n = 208$) had a lower prevalence of current smoking than mothers who ever breast-fed but were not currently breast feeding ($n = 363$) (34.1% vs. 60.3%, $p < .001$). The Mantel-Haenszel test of conditional independence showed evidence ($p < .001$) that the association differs depending on the age category of the mother's youngest child (≤ 6 months or > 6 months and ≤ 1 year) (common odds ratio estimate = 0.35, 95% confidence interval [95% CI] = 0.24 to 0.52). Similarly, among mothers with a child less than or equal to 1 year old who had ever smoked, currently breast-feeding mothers ($n = 208$) had a lower prevalence of current smoking than mothers who never breast-fed ($n = 286$) (34.1% vs. 65.7%, $p < .001$). This association also showed evidence of conditional independence ($p < .001$) with the age group of the mother's youngest child (common odds ratio estimate = 0.29, 95% CI = 0.20 to 0.42). Prevalence of current smoking across breast-feeding strata differed significantly, and in the same direction, within both categories of the youngest child's age (see [Figure 1](#)). Stratified analyses based on the youngest child's age show that among mothers with a child younger than or equal to 6 months, currently breast-feeding mothers

Table 1. Characteristics of Mothers With a Child 1 Year Old or Younger Who Participated in the Screening Exit Interview and the Enrollment Exit Interview by Breast-Feeding Category

Characteristic	Mothers screened			Mothers enrolled		
	Never breast-fed (N = 638)	Ever breast-fed (not currently) (N = 829)	Currently breast feeding (N = 642)	Never breast-fed (N = 177)	Ever breast-fed (not currently) (N = 230)	Currently breast feeding (N = 99)
Smoking status						
Never smoked cigarettes	352 (55.2%)	466 (56.2%)	434 (67.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Ever smoked (not currently)	98 (15.4%)	144 (17.4%)	137 (21.3%)	35 (19.8%)	64 (27.8%)	53 (53.5%)
Currently smokes cigarettes	188 (29.5%)	219 (26.4%)	71 (11.1%)	142 (80.2%)	166 (72.2%)	46 (46.5%)
Age of mother (y)						
≤ 24	293 (46.0%)	341 (41.2%)	173 (27.0%)	88 (49.7%)	103 (44.8%)	35 (35.4%)
25–29	204 (32.0%)	231 (27.9%)	238 (37.1%)	62 (35.0%)	67 (29.1%)	39 (39.4%)
30–34	89 (14.0%)	177 (21.4%)	156 (24.3%)	20 (11.3%)	42 (18.3%)	17 (17.2%)
≥ 35	51 (8.0%)	79 (9.5%)	74 (11.5%)	7 (4.0%)	18 (7.8%)	8 (8.1%)
Age of youngest child						
6 months or younger	382 (59.9%)	389 (46.9%)	502 (78.2%)	109 (61.6%)	104 (45.2%)	81 (81.8%)
>6 mo and ≤1 y	256 (40.1%)	440 (53.1%)	140 (21.8%)	68 (38.4%)	126 (54.8%)	18 (18.2%)
Parent education						
Less than high school	91 (14.3%)	67 (8.1%)	35 (5.5%)	31 (17.5%)	31 (13.5%)	9 (9.1%)
High school or equivalent	304 (47.6%)	309 (37.3%)	136 (21.2%)	101 (57.1%)	110 (47.8%)	34 (34.3%)
College 1–3 y; trade school	154 (24.1%)	260 (31.4%)	214 (33.4%)	37 (20.9%)	70 (30.4%)	41 (41.4%)
College 4 y or more	89 (13.9%)	193 (23.3%)	256 (39.9%)	8 (4.5%)	19 (8.3%)	15 (15.2%)
Ethnicity/race						
Hispanic or Latino	25 (3.9%)	47 (5.7%)	43 (6.7%)	4 (2.3%)	10 (4.3%)	4 (4.0%)
Non-Hispanic Asian	7 (1.1%)	7 (0.8%)	13 (2.0%)	1 (0.6%)	1 (0.4%)	1 (1.0%)
Non-Hispanic black or African American	59 (9.3%)	74 (8.9%)	37 (5.8%)	11 (6.2%)	13 (5.7%)	0 (0.0%)
Non-Hispanic Native American or other	6 (0.9%)	9 (1.1%)	4 (0.6%)	3 (1.7%)	3 (1.3%)	0 (0.0%)
Non-Hispanic more than 1 race	12 (1.9%)	15 (1.8%)	11 (1.7%)	3 (1.7%)	4 (1.7%)	3 (3.0%)
Non-Hispanic, white	528 (82.9%)	677 (81.7%)	530 (83.1%)	155 (87.6%)	199 (86.5%)	91 (91.9%)
Arm						
Control	365 (57.2%)	474 (57.2%)	358 (55.8%)	83 (46.9%)	119 (51.7%)	62 (62.6%)
Intervention	273 (42.8%)	355 (42.8%)	284 (44.2%)	94 (53.1%)	111 (48.3%)	37 (37.4%)

Missing data not included.

($n = 168$) had a lower prevalence of current smoking than mothers who ever breast-fed but were not currently breast feeding ($n = 174$) (35.1% vs. 57.5%, $p < .001$) and than mothers who never breast-fed ($n = 174$) (35.1% vs. 61.5%, $p < .001$). Similarly, among mothers with a child older than 6 months and younger than or equal to 1 year old, currently breast-feeding mothers ($n = 40$) had a lower prevalence of current smoking than mothers who ever breast-fed but were not currently breast feeding ($n = 189$) (30.0% vs. 63.0%, $p < .001$) and than mothers who never breast-fed ($n = 112$) (30.0% vs. 72.3%, $p < .001$).

The multivariable logistic regression analysis (Table 2) shows that among ever smokers, currently breast-feeding mothers with a child younger than or equal to 1 year old were less likely to be current smokers (adjusted odds ratio [aOR] = 0.38, 95% CI = 0.25 to 0.57) after controlling for mother's age, ethnicity and race, education level, and age of the youngest child. Interactions (breast-feeding status $\times$ youngest child age and breast-feeding status $\times$ mother's age) were tested in the model separately using an alpha level of .05. The interactions were not significant and therefore were not included in the final model.

Frequency and Amount of Smoking by Breast-Feeding Status

Among current smokers with a child younger than or equal to 1 year old, mothers who were currently breast feeding were less likely to be everyday smokers ($n = 33$, 71.7%) compared to mothers who ever breast-fed but were not currently breast feeding ($n = 147$, 88.6%) and mothers who never breast-fed ($n = 125$, 88.0%), $\chi^2(2, N = 354) = 9.24, p = .01$. A significant difference was detected in the mean number of cigarettes smoked per day between breast-feeding status categories [$F(2, 351) = 3.62, p = .03$] of currently smoking mothers with a child younger than or equal to 1 year old. Post hoc comparisons revealed that currently breast-feeding mothers ($M = 7.63, SD = 5.94$) smoked, on average, fewer cigarettes per day than mothers who ever breast-fed but were not currently breast feeding ($M = 10.95, SD = 7.60$) and mothers who never breast-fed ($M = 10.64, SD = 7.91$). An analysis of variance with breast-feeding status and youngest child age (≤ 6 months, > 6 months and ≤ 1 year) as between-subjects factors showed a significant main effect of youngest child age [$F(1, 348) = 5.80, p = .02, \eta^2 = .016$] but not

Figure 1. Mothers who ever smoked at least 100 cigarettes in their lifetime and are currently smoking by breast-feeding history (percent and 95% CI). Matching symbols #, †, ‡, and ¥ signify significant difference in current smoking prevalence between corresponding categories ($p < .001$, $\alpha = .05$). CI = confidence interval.

of breast-feeding status [$F(2, 348) = 0.79$, $p = .46$, $\eta^2 = .005$] in the mean number of cigarettes smoked per day. An interaction between breast-feeding status and youngest child age was not detected [$F(2, 348) = 1.24$, $p = .29$, $\eta^2 = .007$]. An analysis of variance with breast-feeding status and mother's age (≤ 24 , 25–29, 30–34, and 35 and older) as between-subjects factors showed a significant main effect of breast-feeding status [$F(2, 342) = 7.28$, $p = .001$, $\eta^2 = .041$] but not of mother's age [$F(3, 342) = 1.81$, $p = .15$, $\eta^2 = .016$]. An interaction between breast-feeding status and mother's age was not found [$F(6, 342) = 2.02$, $p = .06$, $\eta^2 = .034$].

Breast-Feeding Status and Quitting Smoking

Among mothers with a child younger than or equal to 1 year old who reported concurrently breast feeding and smoking during the enrollment interview, 56.5% ($n = 26$) of respondents had made a quit attempt by stopping smoking for more than 1 day during the past 3 months because they were trying to quit. Among mothers with a child younger than or equal to 1 year old who had smoked in the past year, currently breast-feeding mothers ($n = 106$) were more likely to quit smoking at sometime within the past year and remain quit at the time of the exit interview than mothers who ever breast-fed but were not currently breast feeding ($n = 257$) (33.0% vs. 14.8%, $p < .001$) and than mothers who never breast-fed ($n = 220$) (33.0% vs. 14.5%, $p < .001$). Figure 2 displays the proportion of mothers with a child younger than or equal to 6 months and mothers with a child older than 6 months and less than or equal to 1 year who reported quitting smoking within the past year by their breast-feeding history. Stratified analyses based on the youngest child's age show that among mothers with a child less than or equal to 6 months, currently breast-feeding mothers ($n = 91$) were more likely

Figure 2. Mothers who quit smoking within the past year and remained quit at the time of the exit interview by breast-feeding history (percent and 95% CI). Matching symbols † and # signify significant difference in prevalence who quit smoking within the past year between corresponding categories ($p < .01$, $\alpha = 0.05$). *Insufficient sample size ($n = 15$) to calculate 95% CI.

to quit smoking at sometime within the past year and remain quit at the time of the exit interview than mothers who ever breast-fed but were not currently breast feeding ($n = 117$) (35.2% vs. 14.5%, $p = .001$) and than mothers who never breast-fed ($n = 133$) (35.2% vs. 19.5%, $p < .01$). A total of 15 mothers were currently breast feeding and had a youngest child older than 6 months and less than or equal to 1 year old. Of these, three (20.0%) mothers quit smoking within the past year and remained quit at the time of the exit interview, compared to 21 of 140 (15.0%, $p = .61$) who ever breast-fed but were not currently breast feeding and six of 87 who never breast-fed (6.9%, $p = .10$).

The multivariable logistic regression analysis (Table 2) shows that currently breast-feeding mothers with a child younger than or equal to 1 year old were more likely to have reported quitting smoking within the past year and remained quit at the time of the exit interview (aOR = 2.33, 95% CI = 1.29 to 4.21) after controlling for the independent variables. Interactions (breast-feeding status $\times$ youngest child age and breast-feeding status $\times$ mother's age) on quitting smoking within the past year were tested in the model separately using an alpha level of .05. The interactions were not significant and therefore were not included in the final model.

Effectiveness of CEASE Intervention in Delivering Evidence-Based Assistance to Mothers Who Smoke and Breast Feed

Compared to mothers with a child younger than or equal to 1 year old who are concurrently smoking and breast feeding seen in

Table 2. Multivariable Logistic Regression Analyses for Current Smoking vs. Ever Smoking and for Having Quit Smoking Within the Past Year and Remaining Quit Among Mothers With a Child 1 Year Old or Younger

Variable	Adjusted OR (95% CI) for current smoking vs. ever smoking (not currently) (N = 857)	Adjusted OR (95% CI) for quitting smoking within the past year and remaining quit vs. currently smoking (N = 583)
Breast-feeding status		
Currently breast feeding	0.38 (0.25 to 0.57)	2.33 (1.29 to 4.21)
Ever breast-fed, not currently	0.89 (0.63 to 1.26)	1.01 (0.59 to 1.72)
Never breast-fed	(Ref)	(Ref)
Age of youngest child		
≤6 mo	0.73 (0.54 to 1.00)	1.70 (1.03 to 2.79)
>6 mo and ≤1 y	(Ref)	(Ref)
Mother's age (y)		
≤24	1.82 (1.03 to 3.21)	2.64 (0.72 to 9.71)
25–29	1.73 (0.98 to 3.05)	3.25 (0.89 to 11.87)
30–34	1.05 (0.57 to 1.92)	3.70 (0.95 to 14.49)
≥35	(Ref)	(Ref)
Mother's ethnicity/race		
Hispanic/Latino	0.38 (0.17 to 0.87)	3.59 (1.23 to 10.51)
Non-Hispanic Asian	1.83 (0.22 to 14.96)	0.00 (0.00, 0.00)
Non-Hispanic black or African American	0.57 (0.28 to 1.16)	1.91 (0.66 to 5.54)
Non-Hispanic Native American or other	0.90 (0.20 to 4.00)	2.19 (0.38 to 12.66)
Non-Hispanic more than 1 race	1.76 (0.48 to 6.39)	1.11 (0.23 to 5.43)
Non-Hispanic, white	(Ref)	(Ref)
Education level		
Less than high school	7.89 (4.07 to 15.30)	0.29 (0.10 to 0.82)
High school graduate or equivalent	3.66 (2.22 to 6.05)	0.60 (0.27 to 1.35)
Some college or trade school	2.34 (1.40 to 3.92)	0.85 (0.37 to 1.93)
College graduate	(Ref)	(Ref)

CI = confidence interval.

control practices ($n = 28$), mothers with a child younger than or equal to 1 year old seen at CEASE intervention practices who were concurrently smoking and breast feeding ($n = 18$) were more likely to be asked if they smoke cigarettes (66.7% vs. 28.6%, $p = .01$), advised to quit (61.1% vs. 21.4%, $p < .01$), given a prescription for NRT (50.0% vs. 0%, $p < .001$), and enrolled into the state quitline (27.8% vs. 0%, $p < .01$). Among currently smoking mothers who had a child younger than or equal to 1 year old and were seen at intervention practices, mothers who were breast feeding ($n = 18$) received any assistance (prescription for NRT or quitline enrollment) at a higher percentage compared to non-breast-feeding mothers (ever (not currently) and never) ($n = 158$; 55.6% vs. 39.9%), though the difference was not statistically significant ($p = .20$).

Discussion

The results of this study show that current breast feeding was associated with a lower smoking prevalence among ever smokers and was associated with a greater likelihood of smoking abstinence among mothers who had previously smoked within the past year. Although the majority of enrolled mothers who were smoking while breast feeding indicated they had recently attempted to quit smoking, data collected at the usual care control practices demonstrate that breast-feeding mothers who smoke were not being referred to cessation resources such as the state quitline or being prescribed NRT. Use of the quitline and/or NRT significantly increases a mother's chance of successfully quitting smoking.²⁶ Taken together, this evidence strengthens the rationale for ensuring all mothers who are breast feeding or who plan to breast feed are referred to cessation services

to help them maximize the likelihood they will use this opportunity to become and remain tobacco free.

Mothers with a child younger than or equal to 1 year old who smoked while breast feeding smoked less frequently and consumed an average of approximately three fewer cigarettes per day compared to mothers who were no longer breast feeding or who had never breast-fed. Similarly, a German study found that breast-feeding mothers smoked an average of three cigarettes less per day than non-breast-feeding mothers.¹⁰ Another recent US study also found that mothers who breast-fed for 90 days at 9 months smoked roughly three fewer cigarettes per day compared to mothers who were not breast feeding.¹⁸ It is difficult to assess what magnitude of reduction in smoking is clinically meaningful for any particular mother who breast feeds, but the observed average reduction in smoking among breast-feeding mothers in this study and others is likely associated with a corresponding average reduction in nicotine dependence,²⁷ and further strengthens the case that pairing meaningful tobacco cessation assistance with breast-feeding initiation is a strategic opportunity to help this group of mothers quit smoking compared to other times when heavier smoking is the norm. Our analysis found that a greater percent of the variance in the number of cigarettes smoked per day is attributable to the age of the youngest child when compared to breast-feeding status. Therefore, providing tobacco cessation assistance to all mothers who smoke at the time they have a young child, regardless of breast-feeding status, would further maximize the likelihood of reaching mothers when they tend to be smoking fewer cigarettes per day.

At usual care control practices, only about one in four mothers who were smoking and breast feeding were asked if they smoked and about one in five were advised to quit smoking. However, the

majority of mothers seen at CEASE-trained practices who smoked while they were breast feeding were asked by a child health care provider if they smoked and were provided advice about quitting smoking at the pediatric practice. Further, only CEASE-trained practices provided mothers who were concurrently smoking while breast feeding a prescription for NRT or enrolled the mothers in the quitline. This analysis demonstrates that the CEASE intervention effectively increases delivery of evidence-based cessation assistance in the pediatric office to mothers who breast feed.

There are important limitations to this study. The statistical tests were not specifically powered for the research questions posed in this article as this was a secondary analysis of data collected for the CEASE trial.²⁰ Despite this limitation, interpretation of the statistically significant results add to the limited knowledge base about associations between breast feeding and smoking cessation. This study demonstrates that an existing evidence-based intervention deployed within the pediatric setting is capable of effectively delivering smoking cessation assistance to breast-feeding mothers. The exit interview also relied on maternal self-report, which may not reflect the true incidence of smoking and breast-feeding behaviors. This study was not able to specifically assess how the length of time until weaning is associated with smoking behavior, the average length of time mothers stay quit according to breast-feeding status, nor did it assess the frequency of quit attempts among mothers in different breast-feeding categories. Other factors not controlled for in this analysis such as working status, partner attitude, and parity may affect breast-feeding status. Results should be interpreted cautiously where small sample sizes were used. Interpretation of cross-sectional analyses should not assume causality.

Clinicians' opinions about using NRT during breast feeding were not formally assessed, though a 2005 survey of AAP-member pediatricians demonstrated that most were unsure if NRT was safe to use while breast feeding.²⁸ Clinicians participating in the CEASE intervention were trained to provide NRT prescriptions to household members who smoked but were not specifically trained about prescribing NRT to mothers who were concurrently smoking and breast feeding. There is limited information available from leading health care organizations about when NRT should be recommended to breast-feeding mothers nor have large-scale studies been conducted to determine the comparative effectiveness and safety of NRT compared to smoking among mothers who are breast feeding.²⁸ Guidance presented in a 2013 Clinical Report published by the AAP Committee on Drugs states that NRT use is "compatible with breast feeding" if the dose is less than the number of cigarettes smoked.²⁹ The use of gum or lozenges as opposed to longer-acting patches is also recommended for breast-feeding mothers.²⁹ Clinical decision making is less well-defined if mothers require higher doses of NRT to stop smoking or are not successful in quitting with short-acting NRT products. As nicotine from NRT is known to pass into breast milk³⁰ and uncertainty exists for clinicians about how to decide when the relative benefits of NRT use outweigh the risk to breast-fed infants from continued maternal smoking, more research focused on informing clinical decision making in this area would be particularly useful for programs such as CEASE. More detailed guidance, if it were available, from leading health care organizations regarding how to manage NRT for breast-feeding women would likely have increased the provision of NRT beyond the percentages observed in this study.

This study demonstrated that the CEASE program enhanced delivery of tobacco control assistance to breast-feeding mothers who

smoke after pregnancy. Previous research shows women who return to smoking soon after pregnancy are more likely to remain smokers; accordingly, there is great value in identifying mothers who quit smoking during pregnancy and delivering assistance to them postpartum.³¹ A 2010 World Health Organization report highlights that most women who quit smoking during pregnancy will eventually return to smoking but also notes the return to smoking is typically delayed among mothers who breast feed.³² The CEASE intervention is well-positioned for child health care providers to identify mothers during this critical time window while they are breast feeding to increase the chances that they receive assistance to quit smoking and remain quit.

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Declaration of Interests

None declared.

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