

Maternal intention to breast-feed and breast-feeding outcomes in term and preterm infants: Pregnancy Risk Assessment Monitoring System (PRAMS), 2000–2003

Tarah T Colaizy^{1,*}, Audrey F Safflas² and Frank H Morriss Jr¹

¹Department of Pediatrics, University of Iowa, UIHC, 8809 JPP, 200 Hawkins Drive, Iowa City, IA 52242, USA:

²Department of Epidemiology, University of Iowa College of Public Health, Iowa City, IA, USA

Submitted 9 December 2010; Accepted 29 July 2011; First published online 22 September 2011

Abstract

Objective: To determine the effect of intention to breast-feed on short-term breast-feeding outcomes in women delivering term and preterm infants.

Design: Data from the US Centers for Disease Control and Prevention's Pregnancy Risk Assessment Monitoring System (PRAMS) for three states, Ohio, Michigan and Arkansas, during 2000–2003 were analysed. SAS 9·1·3 and SUDAAN 10 statistical software packages were used for analyses.

Setting: Arkansas, Michigan and Ohio, USA.

Subjects: Mothers of recently delivered infants, selected by birth certificate sampling.

Results: Of 16 839 mothers included, 9·7% delivered preterm. Some 52·2% expressed definite intention to breast-feed, 16·8% expressed tentative intention, 4·3% were uncertain and 26·8% had no intention to breast-feed. Overall 65·2% initiated breast-feeding, 52·0% breast-fed for ≥ 4 weeks and 30·8% breast-fed for ≥ 10 weeks. Women with definite intention were more likely to initiate (OR = 2·43, 95% CI 1·84, 3·21), to breast-feed for ≥ 4 weeks (OR = 7·12, 95% CI 5·95, 8·51) and to breast-feed for ≥ 10 weeks (OR = 2·75, 95% CI 2·20, 3·45) compared with women with tentative intention. Levels of intention did not differ between women delivering preterm and term. Women delivering at < 34 weeks were more likely to initiate breast-feeding (OR = 2·24, 95% CI 1·64, 3·06) and to breast-feed for ≥ 4 weeks (OR = 2·58, 95% CI 1·96, 3·41), but less likely to breast-feed for ≥ 10 weeks (OR = 0·55, 95% CI 0·44, 0·68), compared with those delivering at term. Women delivering between 34 and 36 weeks were less likely to breast-feed for ≥ 10 weeks than those delivering at term (OR = 0·63, 95% CI 0·49, 0·81).

Conclusions: Prenatal intention to breast-feed is a powerful predictor of short-term breast-feeding outcomes in women delivering both at term and prematurely.

Keywords

Breast-feeding

Preterm infant

Breast-feeding outcomes

Breast-feeding intention

Breast-feeding is an important public health practice that provides health benefits for both the breast-fed infant and the breast-feeding mother. Despite the advantages of breast-feeding for mothers, infants and population-level health, breast-feeding rates in the USA continue to fall below WHO recommendations and the US Healthy People 2020 goals^(1,2). Similar discrepancy between goals for optimal breast-feeding and breast-feeding behaviour are reported in Canadian, European and Australian populations as well⁽³⁾, despite the resource availability in these countries. Efforts to improve breast-feeding outcomes in developed countries must include research to elucidate the causes of suboptimal breast-feeding practices, at both the individual and societal levels.

Maternal prenatal beliefs and intentions about breast-feeding impact breast-feeding behaviours and outcomes. A series of small studies, including non-population based

samples of as many as 450 patients, show a positive association of prenatal intention to breast-feed with breast-feeding initiation^(4–9). A larger recent study of a prospectively enrolled representative UK cohort of mothers delivering term infants confirms this finding, and notes that intention is a stronger predictor than all other predictors combined⁽¹⁰⁾.

Preterm birth, defined as birth before 37 completed weeks of gestation, is a significant public health problem in the USA, where rates have increased by 20% from 1990 to 2007, from 10·6% to 12·7%⁽¹¹⁾. The benefits of breast-feeding for preterm infants are even greater than those experienced by term infants^(12–14); however, studies demonstrate consistently lower rates of breast-feeding initiation and shorter breast-feeding duration among mothers of preterm infants^(15–18). Breast-feeding intention in mothers of premature infants has been studied in a few convenience samples^(19–22), but the impact of intention on breast-feeding outcomes has not

*Corresponding author: Email tarah-colaizy@uiowa.edu

been investigated in this population, particularly not compared with a healthy term cohort.

We undertook an analysis of participants in the US Centers for Disease Control and Prevention (CDC) Pregnancy Risk Assessment Monitoring System (PRAMS) for the period 2000–2003, to determine the impact of prenatal breast-feeding intention on breast-feeding initiation and continuation to at least 4 and 10 weeks after delivery. We hypothesized that intention to breast-feed would powerfully predict breast-feeding success, after adjustment for multiple other factors associated with breast-feeding outcomes. We also chose to study the effect of prenatal intention on breast-feeding outcomes in mothers of preterm infants compared with mothers of term infants, given the high rate of preterm births.

Patients and methods

PRAMS is a multi-state surveillance project conducted by the CDC and participating state health departments. The PRAMS survey instrument is used to collect population-based information from women who had a recent live birth regarding their experiences, behaviours and attitudes before, during and immediately after delivery. A total of thirty-two states and New York City participated in PRAMS between 2000 and 2003. The primary means of data collection is a self-administered mailed questionnaire. The PRAMS sample, drawn from live birth certificate registries in each state, is a validated, stratified, multi-state random sample of all births. PRAMS data are statistically weighted to adjust for the complex survey design, non-coverage and non-response. A detailed explanation of PRAMS methodology may be found on the CDC website (<http://www.cdc.gov/prams/methodology.htm>).

We analysed the effect of prenatal intention to breast-feed on breast-feeding initiation and continuation among respondents from the three states (Arkansas, Michigan, Ohio) who were asked to respond to the following supplemental question to the PRAMS standard instrument: 'During your most recent pregnancy, what did you think about breast-feeding your new infant?' Potential responses were: (i) 'I knew I would breast-feed' (definite intention); (ii) 'I thought I might breast-feed' (tentative intention); (iii) 'I knew I would not breast-feed' (no intention); and (iv) 'I didn't know what to do about breast-feeding' (uncertain). This supplemental breast-feeding intention question was asked in only these three states during these years.

To assess breast-feeding initiation, we analysed the PRAMS question, 'Did you ever breast-feed or pump breast milk for your baby after delivery?' We chose two definitions of breast-feeding continuation: (i) breast-feeding at least 4 weeks; and (ii) breast-feeding at least 10 weeks. We chose 4 weeks to be consistent with the definition used in a previous report, to allow for comparison⁽²³⁾, and because breast-feeding through 4 weeks

predicts continued success^(24–26). Breast-feeding duration of greater than 10 weeks was also modelled because 95% of mothers completed the survey when the infant was 10 weeks old or older, allowing us to maximize our sample size for breast-feeding continuation. Breast-feeding duration was generated from responses to two PRAMS questions: 'Are you still breast-feeding or feeding pumped milk to your baby?' and 'How many weeks or months did you breast-feed or pump milk to feed your baby?'

Demographic variables associated with breast-feeding initiation and continuation in our previous study of this PRAMS cohort⁽¹⁶⁾ were modelled as potential confounders of the relationship between breast-feeding behaviour and recalled prenatal intention to breast-feed, including infant gestational age, maternal age, race, education, mode of delivery and Medicaid coverage in pregnancy. We also explored the relationship between parity and breast-feeding behaviour, as the breast-feeding behaviour of multiparous mothers is influenced by their prior parenting experience⁽²⁷⁾.

Statistical analyses

The SAS statistical software package version 9.2 (SAS Institute, Research Triangle Park, NC) was used for data manipulation and to conduct preliminary analyses. The SUDAAN statistical software package version 10 (RTI, Research Triangle Park, NC) was used to compute the accurate standard errors for final weighted analyses and statistical tests to account for the complex survey design.

In preliminary univariate analyses, we examined the relationship between three breast-feeding outcome variables and breast-feeding intention, as well as factors previously associated with breast-feeding in this population⁽¹⁶⁾. Weighted univariate logistic regression analysis was used to estimate the association of these variables with each outcome variable.

In weighted multivariate analyses, to determine the independent relationship between breast-feeding intention and breast-feeding behaviour, we constructed a separate multivariable logistic model for each of the three study outcomes, retaining variables associated with breast-feeding outcomes in the preliminary analyses. Women who initiated breast-feeding were included in the 4-week continuation analysis, and those who breast-fed for at least 4 weeks were included in the 10-week continuation analysis. We performed a weighted stratified Cochrane Mantel–Haenszel analysis of the relationship of breast-feeding intention with each of the three breast-feeding outcomes, adjusting for preterm delivery (yes, no).

Results

Descriptive analyses

The 16839 survey responses included 7317 from Arkansas, 3748 from Michigan and 5774 from Ohio. Surveys were

Table 1 Population characteristics of respondents: Pregnancy Risk Assessment Monitoring System (PRAMS), Arkansas, Michigan, and Ohio, 2000–2003 (sample: *n* 16 839, weighted count *n* 1 007 194)

Variable	<i>n</i> (unweighted)	% (weighted)
Breast-feeding intention		
Definite	7698	52.2
Tentative	3204	16.8
Uncertain	809	4.3
No intention	4625	26.8
Gestational age (weeks)		
<34	1890	2.2
34–36	2834	7.5
≥37	12 115	90.3
Primiparous		
	7144	41.0
Maternal age (years)		
≤19	2378	11.5
20–24	5029	25.9
25–29	4471	28.5
30–34	3230	22.9
≥35	1731	11.3
Maternal education (years)		
<12	3220	16.6
12	6313	33.6
>12	7157	48.8
Maternal race		
White	12 161	81.5
Black	4268	15.7
Other	410	2.8
Medical insurance		
Medicaid	7807	35.9
Not Medicaid	9025	64.1
Mode of delivery		
Caesarean section	5130	23.6
Vaginal	11 681	64.4
Initiated breast-feeding		
	10 117	65.2
Breast-feeding at 4 weeks		
% of entire population	7625	52.0
% of those who initiated	7625	79.2
Breast-feeding at 10 weeks		
% of entire population	5057	30.8
% of those who initiated	5057	73.0
State		
Arkansas	7317	13.4
Michigan	3748	30.1
Ohio	5774	56.5

completed a median of 74 d after the birth of the index baby. Table 1 shows the unadjusted numbers and weighted percentages for characteristics of the population. Of the sampled mothers, 9.7% delivered prematurely and 41.0% were primiparous; 65.2% initiated breast-feeding, 52.0% breast-fed for at least 4 weeks and 30.8% breast-fed for at least 10 weeks.

Overall, 52.2% of mothers expressed definite intention to breast-feed, 16.8% expressed tentative intention, 4.3% were uncertain and 26.8% expressed no intention to breast-feed. Primiparous and multiparous mothers were equally likely to express definite intention to breast-feed (52%), but primiparous mothers were more likely to express tentative intention than those with prior children (21% *v.* 13%, $P < 0.0001$); multiparous mothers were in turn more likely to express no intention to breast-feed (31% *v.* 21%, $P < 0.0001$).

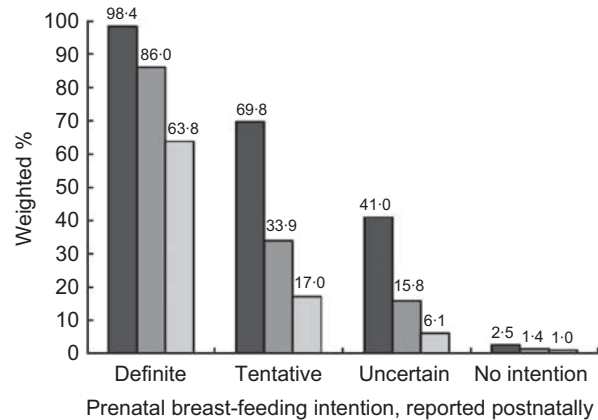


Fig. 1 Weighted breast-feeding outcomes (■, initiation; ▒, breast-feeding to at least 4 weeks; □, breast-feeding to at least 10 weeks) by level of prenatal breast-feeding intention, Pregnancy Risk Assessment Monitoring System (PRAMS), Arkansas, Michigan and Ohio, 2000–2003

Preliminary analyses of breast-feeding intention and duration

Definite breast-feeding intention was associated with factors known to be predictive of breast-feeding initiation, including older maternal age, higher level of maternal education, non-black race and non-Medicaid insurance (all P values < 0.0001). Of women with definite intention to breast-feed, 98.4% initiated breast-feeding, 86.0% breast-fed for at least 4 weeks and 63.8% breast-fed for 10 weeks. In contrast, 69.8% of women who tentatively thought they might breast-feed initiated, 33.9% breast-fed for at least 4 weeks and only 17.0% breast-fed for 10 weeks ($P < 0.0001$; Fig. 1).

As expected, when all other intention levels were compared with no intention to breast-feed, a strong and significant dose–response effect was noted for breast-feeding initiation ($P < 0.0001$).

We analysed the relationship of breast-feeding intention with each of the three breast-feeding outcomes, adjusting for preterm delivery (yes, no). The association of intention with all three breast-feeding outcomes was similar among both preterm and term respondents (data not shown) and statistically significant for both the preterm and term subgroups, as well as the population as a whole ($P < 0.001$ for all).

Breast-feeding intention and breast-feeding initiation

Breast-feeding intention was the strongest predictor of breast-feeding initiation, both in univariate analyses and after adjusting for other significant predictors (Table 2). Women who expressed definite intention were 26.6 times more likely to initiate breast-feeding than those with tentative intention before adjustment, and the magnitude of this association remained stable after adjustment, with an odds ratio of 24.3. This effect size is ten times larger than the next most significant predictor, premature birth.

Table 2 Breast-feeding intention and other predictors of breast-feeding initiation: Pregnancy Risk Assessment Monitoring System (PRAMS), Arkansas, Michigan, and Ohio, 2000–2003

Predictor	Breast-feeding initiation			
	Crude OR	95% CI	Adjusted OR†	95% CI
Breast-feeding intention				
Definite	26.6*	20.3, 34.8	24.3*	18.4, 32.1
Tentative	1.00	Ref.	1.00	Ref.
Uncertain	0.29*	0.23, 0.38	0.30*	0.23, 0.39
No intention	0.01*	0.01, 0.01	0.01*	0.01, 0.01
Gestational age (weeks)				
<34	1.22*	1.05, 1.43	2.24*	1.64, 3.06
34–36	0.92	0.78, 1.08	0.87	0.65, 1.17
≥37	1.00	Ref.	1.00	Ref.
Primiparous	1.38*	1.24, 1.53	1.38*	1.10, 1.71
Maternal age (years)				
≤19	0.37*	0.31, 0.44	0.72	0.48, 1.07
20–24	0.50*	0.43, 0.58	0.69*	0.51, 0.95
25–29	0.77*	0.67, 0.89	0.86	0.64, 1.16
30–34	1.00	Ref.	1.00	Ref.
≥35	0.92	0.76, 1.11	0.75	0.53, 1.07
Maternal education (years)				
<12	0.70*	0.61, 0.81	0.98	0.75, 1.28
12	1.00	Ref.	1.00	Ref.
>12	3.08*	2.75, 3.44	1.67*	1.32, 2.11
Maternal race				
White	1.00	Ref.	1.00	Ref.
Black	0.51*	0.46, 0.57	0.94	0.75, 1.19
Other	2.66*	1.79, 3.94	1.13	0.58, 2.20
Medicaid	0.39	0.35, 0.43	0.60	0.47, 0.75
Caesarean section	0.94	0.84, 1.05	NA	NA
State				
Arkansas	0.73*	0.66, 0.81	0.92	0.74, 1.14
Michigan	1.00	Ref.	1.00	Ref.
Ohio	0.78*	0.70, 0.87	0.93	0.75, 1.16

NA, variable not included in adjusted model.

* $P < 0.01$; OR of 1.00 indicates referent group (Ref.); all analyses are weighted.

†Final model contained intention, gestational age, parity, maternal age, maternal education, maternal race, Medicaid status and state of residence.

Women giving birth before 34 weeks were 2.24 times more likely to initiate breast-feeding than those delivering term infants. There was a trend towards lower breast-feeding initiation among mothers of infants born between 34 and 36 weeks' gestation compared with mothers of term infants.

Other predictors of breast-feeding initiation that remained significant after multivariable adjustment included parity, maternal age, maternal education and Medicaid status. Primiparous women were more likely to initiate breast-feeding than were those with previous births (OR = 1.38, 95% CI 1.10, 1.71). Women aged 20–24 years were less likely to initiate breast-feeding than were those aged 30–34 years. College education was associated with a 67% greater likelihood of breast-feeding initiation compared with completion of high school. Medicaid insurance status was associated with 60% lower likelihood of breast-feeding initiation compared with private insurance. The covariates of gestational age, parity, maternal age and education level, race, Medicaid insurance and state of residence were included in the adjusted model of intention and breast-feeding initiation because they were significant predictors in univariate analysis.

Breast-feeding intention and breast-feeding continuation for at least 4 weeks

Breast-feeding intention was the strongest predictor of breast-feeding continuation to at least 4 weeks (Table 3). Women who expressed definite intention to breast-feed were 7.53 times more likely to breast-feed for at least 4 weeks, compared with those who expressed tentative intention (OR = 7.53, 95% CI 6.37, 8.91), and the magnitude of this association changed little with adjustment.

Infant gestational age of less than 34 weeks was a significant predictor of breast-feeding for at least 4 weeks after adjustment; mothers delivering prior to 34 weeks were 2.58 times more likely to continue for 4 weeks than those delivering at term (OR = 2.58, 95% CI 1.96, 3.41). There was no difference in the odds of breast-feeding for at least 4 weeks among mothers of late preterm infants compared with mothers of term infants.

Other significant predictors of breast-feeding continuation to at least 4 weeks included parity, maternal age, maternal education and Medicaid status. In contrast to breast-feeding initiation, where primiparity was associated with increased odds of initiation, primiparous women were significantly less likely to continue to breast-feed for

Table 3 Breast-feeding intention and other predictors of continued breast-feeding at 4 weeks: Pregnancy Risk Assessment Monitoring System (PRAMS), Arkansas, Michigan, and Ohio, 2000–2003

Predictor	Breast-feeding for at least 4 weeks			
	Crude OR	95% CI	Adjusted OR†	95% CI
Breast-feeding intention				
Definite	7.53*	6.37, 8.91	7.12*	5.95, 8.51
Tentative	1.00	Ref.	1.00	Ref.
Uncertain	0.71*	0.49, 1.04	0.66	0.37, 1.18
No intention	0.87*	0.39, 1.17	0.83	0.55, 1.25
Gestational age (weeks)				
<34	1.24	0.97, 1.59	2.58*	1.96, 3.41
34–36	0.84	0.66, 1.06	0.98	0.74, 1.29
≥37	1.00	Ref.	1.00	Ref.
Primiparous				
	0.57*	0.50, 0.66	0.75*	0.63, 0.90
Maternal age (years)				
≤19	0.23*	0.18, 0.30	0.55*	0.38, 0.78
20–24	0.40*	0.33, 0.49	0.65*	0.51, 0.84
25–29	0.74*	0.60, 0.91	0.86	0.68, 1.09
30–34	1.00	Ref.	1.00	Ref.
≥35	1.25	0.92, 1.69	1.18	0.86, 1.63
Maternal education (years)				
<12	0.84	0.68, 1.05	1.11	0.85, 1.46
12	1.00	Ref.	1.00	Ref.
>12	2.37*	2.02, 2.77	1.55*	1.27, 1.88
Maternal race				
White	1.00	Ref.	1.00	Ref.
Black	0.67*	0.57, 0.80	1.1	0.89, 1.37
Other	1.38	0.90, 2.14	1.09	0.68, 1.74
Medicaid				
	0.43*	0.37, 0.49	0.64*	0.52, 0.78
Caesarean section				
	0.92	0.79, 1.08	NA	NA
State				
Arkansas	0.74*	0.66, 0.81	0.86	0.72, 1.02
Michigan	1.00	Ref.	1.00	Ref.
Ohio	1.05	0.90, 1.23	1.05	0.88, 1.26

NA, variable not included in adjusted model.

* $P < 0.01$; OR of 1.00 indicates referent group (Ref.); all analyses are weighted.

†Final model contained intention, gestational age, parity, maternal age, maternal education, maternal race, Medicaid status and state of residence.

4 weeks than were women with previous births (OR = 0.75, 95% CI 0.63, 0.90). Women younger than 24 years were less likely to breast-feed for 4 weeks than those aged 30–34 years. Women with some college education were more likely to breast-feed for 4 weeks compared with those who completed high school. Medicaid insurance status, compared with private insurance, was associated with lower odds of breast-feeding for at least 4 weeks. The covariates of gestational age, parity, maternal age and education level, race, Medicaid insurance and state of residence were included in the adjusted model of intention and breast-feeding continuation to at least 4 weeks because they were significant predictors in univariate analysis.

Breast-feeding intention and breast-feeding continuation for at least 10 weeks

Definite prenatal intention to breast-feed was the strongest predictor of breast-feeding continuation for at least 10 weeks, after adjustment for all other significant predictors. Women with definite intention to breast-feed were 2.75 times more likely to breast-feed for at least 10 weeks compared with those with tentative intention (Table 4).

Among women delivering premature infants, both those who delivered before 34 weeks and those who

delivered between 34 and 36 weeks were less likely to breast-feed for at least 10 weeks than were mothers delivering term infants. Relative to mothers of term infants, mothers of very preterm infants were only 55% as likely to breast-feed for at least 10 weeks, and mothers of late preterm infants were only 63% as likely.

Other significant predictors of breast-feeding continuation to at least 10 weeks included maternal college education, private insurance status and vaginal delivery. Maternal age less than 30 years was negatively associated with breast-feeding continuation to 10 weeks in the adjusted analysis. The covariates of gestational age, parity, maternal age and education level, race, Medicaid insurance, caesarean delivery and state of residence were included in the adjusted model of intention and breast-feeding continuation to at least 10 weeks because they were significant predictors in univariate analysis.

Discussion

In this large population-based and representative sample of newly delivered mothers from three US states, we found that prenatal intention to breast-feed was strongly

Table 4 Breast-feeding intention and other predictors of continued breast-feeding at 10 weeks: Pregnancy Risk Assessment Monitoring System (PRAMS), Arkansas, Michigan, and Ohio, 2000–2003

Predictor	Breast-feeding for at least 10 weeks			
	Crude OR	95% CI	Adjusted OR†	95% CI
Breast-feeding intention				
Definite	2.98*	2.41, 3.68	2.75*	2.20, 3.45
Tentative	1.00	Ref.	1.00	Ref.
Uncertain	0.64	0.36, 1.13	0.77	0.42, 1.42
No intention	0.98	0.42, 2.26	1.08	0.47, 2.52
Gestational age (weeks)				
<34	0.40*	0.33, 0.49	0.55*	0.44, 0.68
34–36	0.58*	0.46, 0.74	0.63*	0.49, 0.81
≥37	1.00	Ref.	1.00	Ref.
Primiparous	0.76*	0.65, 0.88	1.00	0.85, 1.18
Maternal age (years)				
≤19	0.26*	0.18, 0.30	0.39*	0.27, 0.57
20–24	0.42*	0.33, 0.49	0.55*	0.43, 0.70
25–29	0.67*	0.60, 0.91	0.71*	0.58, 0.87
30–34	1.00	Ref.	1.00	Ref.
≥35	1.18	0.92, 1.69	1.24	0.93, 1.64
Maternal education (years)				
<12	0.96	0.68, 1.05	1.21	0.91, 1.61
12	1.00	Ref.	1.00	Ref.
>12	2.07*	1.76, 2.44	1.43*	1.18, 1.73
Maternal race				
White	1.00	Ref.	1.00	Ref.
Black	0.72*	0.60, 0.86	1.01	0.81, 1.26
Other	1.29	0.86, 1.92	1.16	0.75, 1.80
Medicaid	0.48*	0.41, 0.56	0.75*	0.62, 0.92
Caesarean section	0.78*	0.66, 0.92	0.76*	0.63, 0.90
State				
Arkansas	0.63*	0.54, 0.74	0.76*	0.64, 0.89
Michigan	1.00	Ref.	1.00	Ref.
Ohio	0.93*	0.79, 1.09	0.95	0.80, 1.13

* $P < 0.01$; OR of 1.00 indicates referent group (Ref.); all analyses are weighted.

†Final model contained intention, gestational age, parity, maternal age, maternal education, maternal race, Medicaid status, caesarean delivery and state of residence.

and directly predictive of breast-feeding initiation and continuation. Women who reported definite intention to breast-feed were highly likely to succeed in doing so, as 98.4% initiated breast-feeding, while women with tentative intention were less successful, as only 69.8% initiated, and those who were uncertain were less successful still, as only 41.0% initiated. Compared with women who expressed tentative intention, women expressing definite intention to breast-feed were 26.6 times more likely to initiate breast-feeding, 7.1 times more likely to breast-feed for at least 4 weeks, and 2.8 times more likely to breast-feed for at least 10 weeks. Older maternal age, higher maternal education and higher socio-economic status (as indicated by insurance type) were also significant predictors of breast-feeding initiation and duration.

We found an important adjusted relationship of infant gestational age with breast-feeding outcomes. Mothers of preterm infants of gestational age up to 34 weeks were more than two times more likely to initiate and continue breast-feeding for at least 4 weeks than were mothers of term infants. However, these mothers were only 55% as likely as mothers of term infants to continue breast-feeding for at least 10 weeks. Given that the hospital stay for infants in this gestational age range is typically

6–20 weeks, this finding suggests that educational efforts in the neonatal intensive care unit to encourage breast milk expression and feeding were successful, but that support for continued breast-feeding at home was lacking. Mothers of late preterm infants (34–36 weeks) were significantly less likely to breast-feed for 10 weeks than were mothers of term infants. Our results echo those of Donath and Amir, who found that Australian women delivering at 35–36 weeks' gestation were less likely than those delivering at term to initiate breast-feeding (88.2% *v.* 92–93.9%) and that by 6 months of age, mothers of these late preterm infants were over twice as likely to have ceased breast-feeding as those delivering at term⁽²⁸⁾. The Australian results and ours suggest that late preterm infants, who represent two-thirds of the preterm infants born in the USA⁽¹¹⁾, are a group at high risk for breast-feeding failure.

Other authors have looked at the impact of prematurity on breast-feeding decisions in small convenience samples using primarily qualitative methods. Sweet studied a group of forty-four mothers of very-low-birth-weight infants in Australia in 2008, reporting that breast-feeding intention was developed early in pregnancy and that preterm birth did not change this intention⁽²²⁾. Lucas and co-workers reported that intention to breast-feed was

more common in mothers of preterm infants (mean birth weight 1370 g) who were older, married and delivered male infants, but that infant gestational age played no role⁽²¹⁾. Jaeger and colleagues and Kaufman and Hall reported that breast-feeding intention (or lack thereof) is established at the time of delivery of a preterm or sick infant, but that some women do change their mind and breast-feed when they initially planned to feed formula^(19,20). Social support from family, peers and medical providers can influence these decisions, and can influence breast-feeding duration⁽²⁰⁾. However, none of these studies looked at breast-feeding duration as a function of prematurity systematically and specifically, with a comparison to term infants, as we have done in our study.

Because of these findings, we conducted a stratified analysis of breast-feeding intention on all three breast-feeding outcomes adjusting for gestational age alone, and demonstrated that levels of intention did not differ by gestational age category, reinforcing the importance of infant gestational age in breast-feeding success. Based on our findings, mothers of preterm infants in all gestational age categories represent a group at risk for poor long-term breast-feeding outcomes.

Our study of a large representative sample of women from three US states reinforces findings found in recent smaller studies in other countries. In a cross-sectional sample of 450 pregnant Irish women who delivered term infants, positive intention to breast-feed was associated with an OR of 2.44 for breast-feeding initiation, compared with no intention⁽⁸⁾. A study of 341 Dutch mothers who delivered term infants also found prenatal intention to be associated with an OR of 4.05 for breast-feeding intention. The investigators described the factors involved in formation of a positive intention to breast-feed, including positive personal attitudes towards breast-feeding, negative personal attitudes toward formula feeding, positive social norms for breast-feeding at home and work, social support for breast-feeding at home and work, and high self-efficacy for breast-feeding. In fact, when these factors were included in models to predict breast-feeding initiation, no demographic variable remained a significant predictor, suggesting that breast-feeding behaviour depends mostly on factors related to social support and women's own self-efficacy and attitudes⁽⁹⁾.

Several other large-scale studies have also found a strong relationship between breast-feeding intention and behaviour. DiGirolamo and colleagues⁽²⁹⁾ used the 1993–1994 Infant Feeding Practices Survey to assess the impact of prenatal breast-feeding intention and breast-feeding behaviour in a sample of 1665 primarily white, well-educated US women, recruited in the third trimester of pregnancy. The investigators assessed breast-feeding behaviour for 12 months after delivery, comparing the prenatal predicted of duration of breast-feeding with the actual duration. They demonstrated that prenatal intention to breast-feed impacts breast-feeding behaviour. Women with no intention of breast-feeding were 405 times less likely to initiate breast-feeding than those

who intended to breast-feed for 12 months, and women who planned to stop before 2 months were 48 times more likely to have breast-fed for fewer than 10 weeks than were those who intended to breast-feed for at least 12 months⁽²⁹⁾. Donath and Amir⁽¹⁰⁾ analysed a large population-based sample of 10 548 women from the Avon Longitudinal Study of Pregnancy and Childhood, a prospective cohort study of women and children from the UK. At 32 weeks' gestation, women were asked to predict their duration of breast-feeding, and breast-feeding outcomes were monitored for 12 months after delivery. They found that anticipated breast-feeding duration was strongly predictive of breast-feeding behaviour. Women who intended to breast-feed longer, suggestive of greater commitment to breast-feeding, had higher rates of breast-feeding initiation: 96.6% of women who intended to breast-feed for at least 4 months initiated breast-feeding, while only 74.7% of those who intended to breast-feed for less than 4 weeks initiated⁽¹⁰⁾.

Although the PRAMS instrument does not allow us to match intended duration of breast-feeding to actual breast-feeding duration, if the responses to the PRAMS breast-feeding intention question are considered in an ordinal fashion, with a spectrum of definite intention, tentative intention, uncertain intention and no intention, our analysis also demonstrates that level of intention is important in predicting behaviour. Tentative and uncertain intention were associated with greater likelihood of breast-feeding initiation than no intention, but not of continuation at either 4 or 10 weeks, suggesting that a stronger degree of commitment resulted in longer-term breast-feeding success, similar to the results reported in the USA by DiGirolamo *et al.*⁽²⁹⁾ and in the UK by Donath and Amir⁽¹⁰⁾.

The major strength of our study lies in the robust sampling methods employed by PRAMS, which allowed us to evaluate the impact of breast-feeding intention on breast-feeding outcomes in a population representative of all live births in three US states over 3 years. In contrast to other studies of breast-feeding intention and subsequent breast-feeding behaviour, our sample was larger than all, and was one of only two studies utilizing a population-based sample. Our results are generalizable to much of the US population. Importantly, the PRAMS data allowed us to determine the impact of prematurity on breast-feeding outcomes, adjusting for breast-feeding intention, while previous studies have excluded premature infants, particularly those born before 34 weeks, by design.

Our study is subject to some limitations. PRAMS respondents are sampled only once, typically when the index infant is between 6 weeks and 6 months of age. As 95% of respondents in our sample returned the survey when their infants were 10 weeks or older, we were able to examine breast-feeding continuation to only 10 weeks. Additionally, breast-feeding intention information was collected postnatally and remote from the delivery of the infant. This may have created recall bias, as women may have tended to report their actual behaviour as their

'intention'. We were also unable to determine the effect of predicted breast-feeding duration on actual duration, as these questions are not part of the PRAMS instrument.

The determinants of breast-feeding behaviour are clearly multiple and include factors both intrinsic and extrinsic to mothers themselves. Our study adds to the body of knowledge regarding breast-feeding intention and subsequent breast-feeding behaviour. Our study provides a novel report of the impact of breast-feeding intention on breast-feeding outcomes in mothers delivering prematurely. We have demonstrated that intention to breast-feed, as reported postnatally, is an extremely powerful predictor of breast-feeding initiation, with an impact almost 12-fold greater than the next most significant factor, prematurity, and that intention strongly affects continuation to at least 4 weeks and at least 10 weeks. Large population-based prospective studies of prenatally reported intention to breast-feed are needed to verify the strength of this predictor of breast-feeding outcomes. Further research is needed into the factors influencing maternal intention to breast-feed, with the aim to develop interventions to promote development of positive intention to breast-feed prior to pregnancy or delivery.

Acknowledgements

T.T.C. received salary support from the National Institute of Child Health and Human Development to produce this manuscript, via a career development award (K23HD057232). None of the authors have any conflict of interest, real or perceived, to disclose in relation to this manuscript. T.T.C. designed the study, performed the statistical analysis and wrote the manuscript. A.F.S. assisted with the study design, statistical approach and manuscript editing. F.H.M. assisted in study design and manuscript editing.

PRAMS Working Group: Alabama – Albert Woolbright, PhD; Alaska – Kathy Perham-Hester, MS, MPH; Arkansas – Mary McGehee, PhD; Colorado – Alyson Shupe, PhD; Delaware – George Yocher, MS; Florida – Marie Bailey, MA, MSW, MPH; Georgia – Carol Hoban, PhD, MS, MPH; Hawaii – Mark Eshima, MA; Illinois – Theresa Sandidge, MA; Louisiana – Joan Wightkin; Maine – Tom Patenaude; Maryland – Diana Cheng, MD; Massachusetts – Hafsatou Diop, MD, MPH; Michigan – Violanda Grigorescu, MD, MSPH; Minnesota – Judy Punyko, PhD, MPH; Mississippi – Marilyn Jones, MEd; Missouri – Venkata Garikapaty, MSc, MS, PhD, MPH; Montana – JoAnn Dotson; Nebraska – Brenda Coufal; New Jersey – Lakota Kruse, MD; New Mexico – Eirian Coronado, MPH; New York State – Anne Radigan-Garcia; New York City – Candace Mulready-Ward, MPH; North Carolina – Paul Buescher, PhD; North Dakota – Sandra Anseth; Ohio – Connie Geidenberger; Oklahoma – Alicia Lincoln, MSW, MSPH; Oregon – Kenneth Rosenberg, MD; Pennsylvania – Tony Norwood; Rhode Island – Sam Viner-Brown, PhD; South Carolina – Mike

Smith; South Dakota Tribal – Christine Rinki, MPH; Texas – Kate Sullivan, PhD; Tennessee – David Law, PhD; Utah – Laurie Baksh; Vermont – Peggy Brozicevic; Virginia – Marilyn Wenner; Washington – Linda Lohdefinck; West Virginia – Melissa Baker, MA; Wisconsin – Katherine Kvale, PhD; Wyoming – Angi Crotsenberg; CDC PRAMS Team, Applied Sciences Branch, Division of Reproductive Health.

References

1. Maternal, Infant, and Child Health (editor) (2010) Developing Healthy People 2020: Proposed HP2020 Objectives. <http://www.healthypeople.gov/hp2020/objectives> (accessed June 2010).
2. World Health Organization (2002) Global Strategy on Infant and Young Child Feeding. *Fifty-fifth World Health Assembly, WHA55 A55/15*. Geneva: WHO.
3. Callen P (2004) Incidence and duration of breastfeeding for term infants in Canada, United States, Europe, and Australia: a literature review. *Birth* **31**, 285–292.
4. Coreil J & Murphy JE (1988) Maternal commitment, lactation practices, and breastfeeding duration. *J Obst Gyn Neonat Nurs* **17**, 273–278.
5. Cronenwett L, Stukel T, Kearney M *et al.* (1992) Single daily bottle use in the early weeks postpartum and breast-feeding outcomes. *Pediatrics* **90**, 760–766.
6. Lawson K & Tulloch MI (1995) Breastfeeding duration: prenatal intentions and postnatal practices. *J Adv Nurs* **22**, 841–849.
7. O'Campo P, Faden RR, Gielen AC *et al.* (1992) Prenatal factors associated with breastfeeding duration: recommendations for prenatal interventions. *Birth* **19**, 195–201.
8. Tarrant RC, Younger KM, Sheridan-Pereira M *et al.* (2010) The prevalence and determinants of breast-feeding initiation and duration in a sample of women in Ireland. *Public Health Nutr* **13**, 760–770.
9. Kools EJ, Thijs C & de Vries H (2005) The behavioral determinants of breast-feeding in The Netherlands: predictors for the initiation of breast-feeding. *Health Educ Behav* **32**, 809–824.
10. Donath SM & Amir LH (2003) Relationship between prenatal infant feeding intention and initiation and duration of breastfeeding: a cohort study. *Acta Paediatr* **92**, 352–356.
11. March of Dimes PeriStats (2010) March of Dimes PeriStats: Your online source for perinatal statistics. <http://www.marchofdimes.com/peristats/> (accessed June 2010).
12. Ip S, Chung M, Raman G *et al.* (2007) *Breastfeeding and Maternal and Infant Health Outcomes in Developed Countries. Evidence Report/Technology Assessment* no 153. Rockville, MD: Agency for Healthcare Research and Quality, US Department of Health and Human Services.
13. Schanler RJ, Hurst NM & Lau C (1999) The use of human milk and breastfeeding in premature infants. *Clin Perinatol* **26**, 379–398.
14. Schanler RJ (2001) The use of human milk for premature infants. *Pediatr Clin North Am* **48**, 207–219.
15. Ahluwalia IB, Morrow B, Hsia J *et al.* (2003) Who is breast-feeding? Recent trends from the pregnancy risk assessment and monitoring system. *J Pediatr* **142**, 486–491.
16. Colaizzi TT & Morriss FH (2008) Positive effect of NICU admission on breastfeeding of preterm US infants in 2000 to 2003. *J Perinatol* **28**, 505–510.
17. Furman L, Minich NM & Hack M (1998) Breastfeeding of very low birth weight infants. *J Hum Lact* **14**, 29–34.
18. Ryan AS, Wenjun Z & Acosta A (2002) Breastfeeding continues to increase into the new millennium. *Pediatrics* **110**, 1103–1109.

19. Jaeger MC, Lawson M & Filteau S (1997) The impact of prematurity and neonatal illness on the decision to breast-feed. *J Adv Nurs* **25**, 729–737.
20. Kaufman KJ & Hall LA (1989) Influences of the social network on choice and duration of breast-feeding in mothers of preterm infants. *Res Nurs Health* **12**, 149–159.
21. Lucas A, Cole TJ, Morley R *et al.* (1988) Factors associated with maternal choice to provide breast milk for low birthweight infants. *Arch Dis Child* **63**, 48–52.
22. Sweet L (2008) Birth of a very low birth weight preterm infant and the intention to breastfeed ‘naturally’. *Women Birth* **21**, 13–20.
23. Ahluwalia IB, Morrow B & Hsia J (2005) Why do women stop breastfeeding? Findings from the Pregnancy Risk Assessment and Monitoring System. *Pediatrics* **116**, 1408–1412.
24. Taveras EM, Capra AM, Braveman PA *et al.* (2003) Clinician support and psychosocial risk factors associated with breastfeeding discontinuation. *Pediatrics* **112**, 108–115.
25. Baxter J, Cooklin AR & Smith J (2009) Which mothers wean their babies prematurely from full breastfeeding? An Australian cohort study. *Acta Paediatr* **98**, 1274–1277.
26. Dubois L & Girard M (2003) Social determinants of initiation, duration and exclusivity of breastfeeding at the population level: the results of the Longitudinal Study of Child Development in Quebec (ELDEQ 1998–2002). *Can J Public Health* **94**, 300–305.
27. Li R, Ogden C, Ballew C *et al.* (2002) Prevalence of exclusive breastfeeding among US infants: the Third National Health and Nutrition Examination Survey (Phase II, 1991–1994). *Am J Public Health* **92**, 1107–1110.
28. Donath SM & Amir LH (2008) Effect of gestation on initiation and duration of breastfeeding. *Arch Dis Child Fetal Neonatal Ed* **93**, F448–F450.
29. DiGirolamo A, Thompson N, Martorell R *et al.* (2005) Intention or experience? Predictors of continued breastfeeding. *Health Educ Behav* **32**, 208–226.