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Infant feeding-related maternity care practices and maternal report of breastfeeding outcomes

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Abstract

Background: Evidence-based maternity practices and policies can improve breastfeeding duration and exclusivity. Maternity facilities report practices through the Maternity Practices in Infant Nutrition and Care (mPINC) survey, but individual outcomes, such as breastfeeding duration and exclusivity, are not collected.

Methods: mPINC data on maternity care practices for 2009 were linked to data from the 2009 Pregnancy Risk Assessment Monitoring System (PRAMS), which collects information on mothers' behaviors and experiences around pregnancy. We calculated total mPINC scores (range 0–100). PRAMS data on any and exclusive breastfeeding at 8 weeks were examined by total mPINC score quartile.

Results: Of 15,715 women in our sample, 53.7% were breastfeeding any at 8 weeks, and 29.3% were breastfeeding exclusively. They gave birth at 1016 facilities that had a mean total mPINC score of 65/100 (range 19–99). Care dimensions subscores ranged from 41 for facility discharge care to 81 for breastfeeding assistance. In multivariable analysis adjusting for covariates, a positive relationship was found between total mPINC score quartile and both any breastfeeding (quartile 2: OR 1.40 [95% CI 1.08–1.83], quartile 3: OR 1.50 [95% CI 1.15–1.96], quartile 4: OR 2.12 [95% CI 1.61–2.78] versus quartile 1) and exclusive breastfeeding (quartile 3: OR 1.41 [95% CI 1.04–1.90], quartile 4: OR 1.89 [95% CI 1.41–2.55] versus quartile 1) at 8 weeks.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Conclusions: These data demonstrate that evidence-based maternity care practices and policies are associated with better breastfeeding outcomes. Maternity facilities may evaluate their practices and policies to ensure they are helping mothers achieve their breastfeeding goals.

Keywords

breastfeeding; mPINC; PRAMS

INTRODUCTION

Maternity care facilities, such as hospitals and birth centers, play a key role in breastfeeding outcomes. Evidence-based maternity care practices and policies have been associated with higher rates of breastfeeding initiation,¹ duration,²⁻⁴ and exclusivity.^{1 4 5} As such, national and international efforts have been developed to improve breastfeeding-related maternity care. One example is the *Ten Steps to Successful Breastfeeding (Ten Steps)*, which are part of the Baby-Friendly Hospital Initiative of the World Health Organization and the United Nations Children's Fund.⁶ These evidence-based practices and policies are designed to support breastfeeding and provide optimal care for mothers and infants.

The Centers for Disease Control and Prevention (CDC) developed the biennial Maternity Practices in Infant Nutrition and Care (mPINC) survey to monitor and examine changes in breastfeeding-related practices and policies at maternity care facilities in the United States (U.S.) and U.S. territories.⁷ These facility-level data have been used to document improved trends in national maternity care practices.^{8, 9}

However, the mPINC survey lacks information on individual breastfeeding outcomes, such as breastfeeding duration and exclusivity. Without these data, it is not possible to determine whether maternity care practices influence mothers' breastfeeding behaviors. One state study that linked mPINC survey data with birth certificate and newborn screening databases demonstrated a positive association between breastfeeding rates at 24–48 hours and evidence-based clinical care practices.¹⁰ Other studies have examined breastfeeding outcomes and maternal-reported maternity care practices,^{2, 11, 12} but no national studies have examined facility-reported maternity care practices and breastfeeding outcomes. In this study, we sought to determine, on a multistate population level, whether facility-reported, breastfeeding-related maternity care practices and policies (as determined by mPINC score) were associated with the maternal-reported breastfeeding outcomes of duration and exclusivity.

METHODS

Data for this analysis were obtained from maternity care facility reports of routine practices and policies related to infant feeding to the 2009 mPINC survey, as well as from maternal reports of breastfeeding status (duration and exclusivity) at 8 weeks postpartum to the 2009 Pregnancy Risk Assessment Monitoring System (PRAMS) for 22 states.

Data collection methods for the mPINC survey have been described elsewhere.⁷ In brief, CDC administered a survey in 2009 to all maternity hospitals and birth centers (hereafter,

maternity care facilities) in the United States and U.S. territories. Information about routine maternity care and infant feeding policies and practices were collected through Web-based or paper surveys from each facility, specifically from the staff person identified as most knowledgeable about the policies and practices at that facility, with input from others as necessary. Survey items were categorized into seven care dimensions: (1) labor and delivery care, (2) feeding of breastfed infants, (3) breastfeeding assistance, (4) contact between mother and infant, (5) facility discharge care, (6) staff training, and (7) structural and organizational aspects of care delivery (Table 1). We calculated subscores for each care dimension (range 0–100), then averaged these subscores to calculate a total mPINC score (range 0–100). Additional details about mPINC scoring has been reported previously.¹³ Higher total mPINC scores and care dimension subscores indicate better adherence to evidence-based, breastfeeding-related practices and policies at maternity care facilities. In 2009, the response rate for the mPINC survey was 82%.

PRAMS is a surveillance system of CDC and state health departments that collects information about maternal behaviors and experiences before, during, and after pregnancy.¹⁴ Detailed methods for PRAMS have been described elsewhere.¹⁵ In brief, each year, participating states draw a stratified, systematic sample from their state birth certificate file, sampling 1300 to 3400 women with a recent live birth. Most states oversample for low birth weight, and some oversample for particular racial/ethnic groups. Selected women are contacted by mail approximately 2 to 4 months after birth to complete a standardized questionnaire. If there is no response after multiple mailings, women are contacted and interviewed by phone. Standardized data collection tools are used to allow comparability across states. Because mothers' survey responses are linked to items extracted from birth certificates, the PRAMS analytic dataset contains both maternal responses and selected state vital statistics data. PRAMS data are weighted for sample design, noncoverage, and nonresponse using state-specific vital statistics data.

We contacted the 29 participating PRAMS states that had a weighted response rate of at least 65% (the minimum response rate threshold for release of data) in 2009 to request access to hospital of birth, a variable that is collected by PRAMS but not released in the standard dataset available to researchers. Six states did not grant access to hospital of birth, and one state did not provide information on covariates because of concerns about inadvertent disclosure. Thus, seven states were excluded from our analysis. Twenty-two states were included in this analysis: Alaska, Arkansas, Colorado, Delaware, Illinois, Maine, Massachusetts, Michigan, Minnesota, Mississippi, Nebraska, New Jersey, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Washington, and Wyoming. Because each state uses a different coding scheme for hospital of birth, hospital name and address were used to link hospital of birth from PRAMS to the mPINC survey data.

In PRAMS, mothers were asked, “Did you ever breastfeed or pump breast milk to feed to your new baby after delivery, even for a short period of time?” (yes/no). Those who responded “yes” were asked, “Are you currently breastfeeding or feeding pumped milk to your new baby?” (yes/no). Those who responded “no” were asked, “How many weeks or months did you breastfeed or pump milk to feed your baby?” Those who responded “yes” were also asked, “How old was your new baby the first time he or she drank liquids other

than breast milk (such as formula, water, juice, tea, or cow’s milk)?” All mothers were asked, “How old was your new baby the first time he or she ate food (such as baby cereal, baby food, or any other food)?” For our sample, the earliest a survey was completed was just over 8 weeks postpartum, so we categorized our outcomes according to whether the mother was breastfeeding or providing pumped milk at 8 weeks (any breastfeeding, yes/no) and whether the mother introduced liquids or food before 8 weeks (exclusive breastfeeding, yes/no). The definition of exclusive breastfeeding for this analysis is consistent with the World Health Organization’s definition of exclusive breastfeeding, meaning no liquids or solids other than breast milk were given to the infant.¹⁶

The primary predictor was total mPINC score (range 0–100), with higher scores indicating practices and policies more supportive of breastfeeding. We categorized total mPINC score by quartile as follows: quartile 1 (score <55), quartile 2 (score 55–64), quartile 3 (score 65–74), and quartile 4 (score ≥75).

Covariates included maternal age (<25, 25–29, 30–34, ≥35 years); maternal race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Asian, Other); maternal education (<high school, high school, >high school); maternal prepregnancy body mass index (BMI) (<18.5, 18.5–24.9, 25.0–29.9, ≥30 kg/m²); marital status (married, other); participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) (yes/no); any smoking during pregnancy (smoker, nonsmoker); parity (primiparous, multiparous); plurality (singleton, twins or other multiple); and vaginal delivery (yes/no). With the exception of WIC (a PRAMS questionnaire variable), all other covariate data were taken from the birth certificate.

A total of 17,750 mothers from the included PRAMS states gave birth in a maternity care facility that participated in the 2009 mPINC survey. Mothers who had missing information for one or more of the covariates (n=1533) or breastfeeding outcomes (n=593) and who gave birth in a facility that was missing data for total mPINC score (n=63) were excluded. Because these exclusion criteria were not mutually exclusive, the final analytic sample for this study was 15,715 women.

Analyses were conducted in SAS 9.4 (SAS Institute, Cary, NC) and the survey package in R^{17, 18} to account for the complex sampling design of PRAMS, when necessary. Breastfeeding at 8 weeks is an individual-level variable, while total mPINC score is a facility-level variable. Therefore, women who gave birth in the same maternity care facility are assigned the same mPINC total score. To account for this nesting (women within facilities), we used multilevel logistic regression models^{19, 20} to assess the relationship of the total mPINC score by quartile to any and exclusive breastfeeding at 8 weeks, adjusting for the covariates described previously. We also ran models that treated mPINC score as a continuous variable. We accounted for both the nesting and PRAMS survey design—including nonresponses, noncoverage weights, PRAMS finite population correction factor, and sampling stratum—by using the ‘withReplicates’ function in the survey package in R.¹⁸ Standard errors were estimated using replication sampling,^{21, 22} an approach that estimates the variance of a population parameter by using a large number of samples (with replacement) to calculate the parameter of interest. The variability across these samples

provides an estimate of the standard error of the regression coefficients for the fixed effects of the multilevel models.

Any and exclusive breastfeeding rates at 8 weeks were plotted compared to the total mPINC score, as a continuous variable, for each facility with 4 women giving birth in 2009. Here, the unit of analysis was the maternity care facility. We used lowess (locally weighted scatterplot smother),²³ a method that makes no assumption about the shape of the association, to summarize the relationship of the total mPINC score to any and exclusive breastfeeding at 8 weeks.

RESULTS

Of the 15,715 women in our sample, a majority were non-Hispanic white (65.7%), had more than a high school education (58.7%), had a normal BMI (50.0%), were married (63.1%), did not participate in WIC (54.7%), did not smoke during pregnancy (88.0%), were multiparous (59.1%), had a singleton pregnancy (98.8%), and had a vaginal birth (67.4%) (Table 2).

Mothers gave birth at 1016 maternity care facilities, including 1004 hospitals and 12 birth centers (Table 3). A majority of these facilities were nonprofit (69.0%), followed by government (17.6%), private (11.7%), and military (0.5%). Only 7.5% of facilities were teaching hospitals. Facilities ranged in size (as determined by the annual number of births). The mean total mPINC score for the 1016 maternity care facilities in 2009 was 65 (range 19–99) (Table 3). Mean care dimension subscores were 63 for labor and delivery care, 78 for feeding of breastfed infants, 81 for breastfeeding assistance, 71 for contact between mother and infant, 41 for facility discharge care, 51 for staff training, and 69 for structural and organizational aspects of care delivery (Table 3).

Among mothers who delivered at a maternity care facility with a total mPINC score in the lowest quartile (<55), 43.6% were breastfeeding any at 8 weeks (Table 4). Any breastfeeding improved with each quartile: 51.6% of mothers in quartile 2 facilities, 54.1% in quartile 3 facilities, and 61.5% in quartile 4 facilities were breastfeeding at 8 weeks. After controlling for covariates, a higher mPINC score was also associated with any breastfeeding at 8 weeks. Compared with women in quartile 1, the odds of any breastfeeding were 1.40 times greater for those in quartile 2 (95% CI 1.08–1.83), 1.50 times greater for those in quartile 3 (95% CI 1.15–1.96), and 2.12 times greater for those in quartile 4 (95% CI 1.61–2.78). The percentage of women breastfeeding exclusively at 8 weeks also increased by quartile. Among quartile 1 facilities, 20.4% of mothers were exclusively breastfeeding at 8 weeks compared to 27.1% in quartile 2 facilities, 30.1% in quartile 3 facilities, and 36.1% in quartile 4 facilities. Similar results were seen for regression modeling after adjusting for covariates. Compared to women in quartile 1 facilities, the odds of exclusive breastfeeding at 8 weeks were 1.41 times greater for women in quartile 3 facilities (95% CI 1.04–1.90) and 1.89 times greater for those in quartile 4 facilities (95% CI 1.41–2.55). In models that treated total mPINC score as a continuous variable, each 20-point increase in mPINC score increased the odds of any breastfeeding (OR 1.48) and exclusive breastfeeding at 8 weeks (OR 1.43); $P < 0.0001$ for both associations.

Figure 1 shows the relationship of total mPINC score to breastfeeding at 8 weeks for the 734 (of 1016) facilities in which 4 women gave birth. The lowess-smoothed lines indicate strong associations between mPINC score and the prevalence of both any breastfeeding and exclusive breastfeeding at 8 weeks.

DISCUSSION

A continuous, moderately strong association was observed between total mPINC score and the odds that a mother was breastfeeding any at 8 weeks and was breastfeeding exclusively at 8 weeks. The odds of breastfeeding any at 8 weeks and of breastfeeding exclusively at 8 weeks were highest among women who delivered at hospitals in the highest quartile of total mPINC scores compared to those who delivered at hospitals in the lowest quartile. These data suggest that women who deliver in maternity care facilities that report using more practices and policies that are supportive of breastfeeding have better breastfeeding outcomes, as measured by any and exclusive breastfeeding at 8 weeks.

These facility-reported data are consistent with studies of maternal-reported data that have demonstrated that evidence-based maternity care practices, such as those outlined in the *Ten Steps*, are positively associated with increased breastfeeding duration. A recent systematic review of 58 articles found a positive association between the number of *Ten Steps* used by a facility and breastfeeding outcomes, such as increased rates of any and exclusive breastfeeding duration.²⁴ Although the total mPINC score does not directly align with the *Ten Steps*, it does capture many of the practices and policies recommended in the *Ten Steps*. Understanding the relationships between care obtained during childbirth hospitalization and breastfeeding outcomes can help improve maternity care in the United States. In recent years, many hospitals have implemented the *Ten Steps*, and some have sought to be designated as a Baby-Friendly Hospital.⁶ In 2007, only 1.8% of births in the United States were at maternity care facilities designated as Baby-Friendly.²⁵ Since then, ongoing efforts by maternity care facilities—as well as efforts funded by CDC, such as Best Fed Beginnings²⁶ and EMPower Breastfeeding²⁷—have increased the number of facilities with the Baby-Friendly designation, which in turn increased the percentage of U.S. births at Baby-Friendly facilities to 22.2% in 2017.²⁸ Continued improvements in maternity care will likely have a positive effect on national breastfeeding rates.

After completing the mPINC survey, all participating maternity care facilities receive a facility-specific benchmark report that compares their total score and care dimension subscores to the scores of all facilities nationwide, all facilities in their state, and all facilities of a similar size.¹³ These individualized reports allow facilities to identify their strengths, as well as the areas where they can improve. Maternity care facilities can use these reports to identify areas for improvement to support optimal breastfeeding outcomes among their patients and, therefore, should be aware of their facility's mPINC score.²⁹ Using practices and policies that are evidence-based could help improve rates of any and exclusive breastfeeding.

The mPINC data are a census of all hospitals and birth centers that provide maternity care in the United States and U.S. territories, and PRAMS is a robust surveillance system

that collects information from thousands of postpartum women. By using data from these sources, our study was able to examine maternity care practices and policies at >1000 facilities and analyze how these practices and policies might affect breastfeeding outcomes for >15000 women. Despite the strengths of these data sources, neither is based on or verified by in-facility observation nor medical chart review; mPINC data are from facility report and PRAMS data are from maternal report. We conducted several types of sensitivity analyses to determine if the observed results were being influenced by our analytic decisions. First, we added hospital characteristics (annual births, facility ownership, teaching status) as covariates to our model. Although the results were not significantly altered by this change, additional missing data were introduced, which reduced the sample size, and these results are not presented. Next, we excluded a large number of women (11%) because of missing data on either breastfeeding status, mPINC score, or the covariates. To assess if these exclusions affected our results, we used multiple imputation.³⁰ Although the only variables available to construct the imputation model were those in the regression model, these analyses indicated that the exclusion of women with missing data had very little effect on our findings. Finally, we reran the analyses, limiting the sample to women who had ever breastfed. Odds ratios were slightly modified, but still significant, suggesting that the effect of improved hospital practices on breastfeeding outcomes evaluated in this study was not just from improvements in breastfeeding initiation.

CONCLUSION

Women who delivered at maternity care facilities with higher mPINC scores, which measured practices and policies supportive of breastfeeding, are more likely to breastfeed their infants and to be exclusively breastfeeding at 8 weeks postpartum, compared to women who delivered at facilities with lower scores. Maternity care facilities might consider examining their practices and policies to ensure that they are providing optimal support to help mothers achieve their breastfeeding goals.

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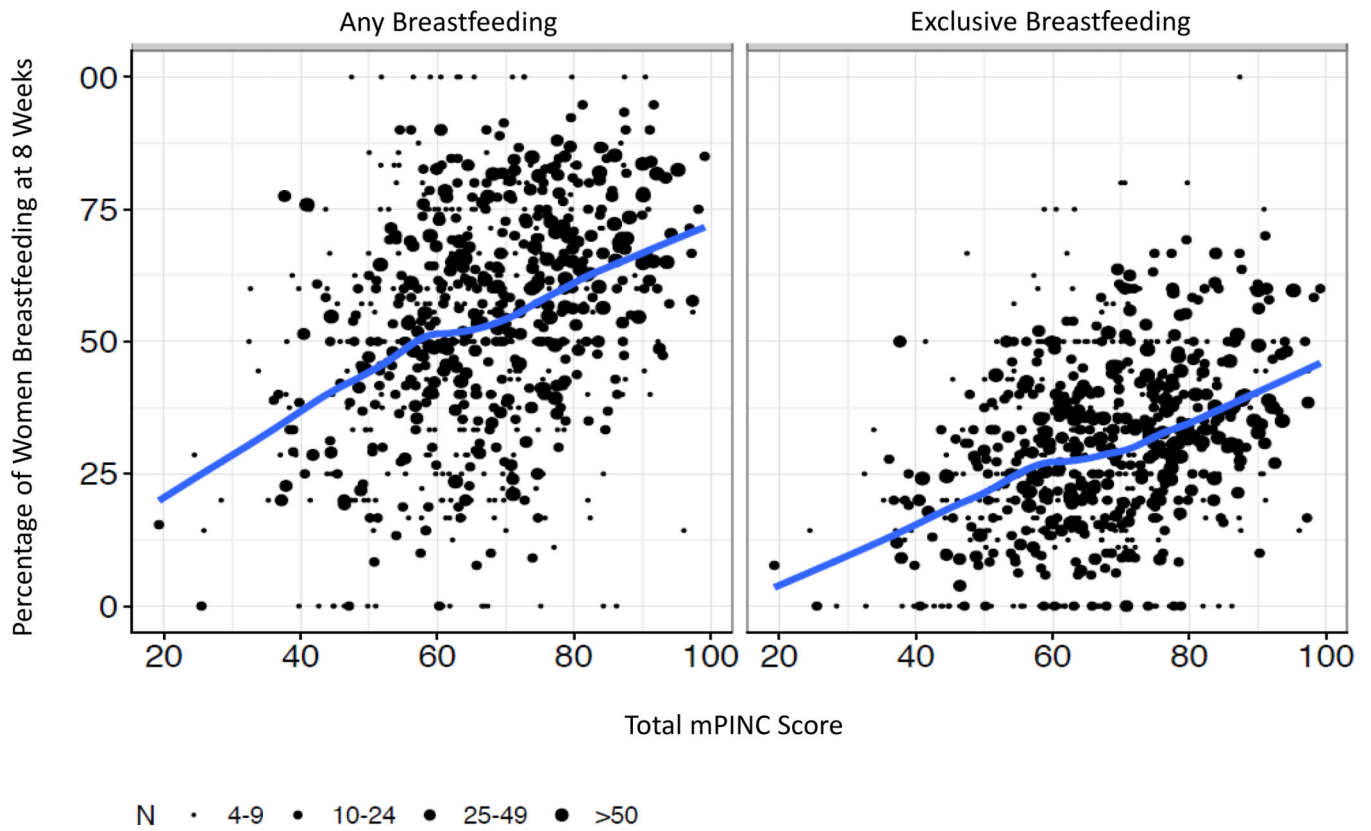


Figure 1. Relation of mPINC score to breastfeeding at 8 wk for the 734 (of 1016) hospitals that had 4 women. The size of the points is proportional to the number of women in the hospital (see legend), and the estimated line was smoothed using LOWESS.

Table 1:

Care dimensions for the Maternity Practices in Infant Feeding and Care (mPINC) survey

Care Dimension	Measure
Labor and Delivery Care	Initial skin-to-skin contact Initial breastfeeding opportunity Routine procedures performed skin-to-skin
Feeding of Breastfed Infants	Initial feeding received after birth Supplementary feedings
Breastfeeding Assistance	Documentation of infant feeding decision Breastfeeding advice and counseling Assessment and observation of breastfeeding sessions Pacifier use
Contact Between Mother and Infant	Separation of mother and infant during transition Patient rooming-in Instances of mother-infant separation
Facility Discharge Care	Assurance of ambulatory breastfeeding support Distribution of “discharge packs” containing infant formula
Staff Training	Preparation of new staff Continuing education Competency assessment
Structural and Organizational Aspects of Care Delivery	Breastfeeding policy Communication of breastfeeding policy Infant feeding documentation policy Employee breastfeeding support Facility receipt of free infant formula Prenatal breastfeeding instruction Coordination of lactation care

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Table 2.

Demographic characteristics of mothers completing a PRAMS questionnaire who delivered at a maternity care facility participating in mPINC, United States[^], 2009

	N ^{^^} (% [*])
Total	15,715 (100)
Maternal age (years)	
<25	5,209 (33.1)
25–29	4,709 (29.0)
30–34	3,760 (24.5)
35	2,037 (13.3)
Maternal race/ethnicity	
Non-Hispanic white	8,725 (65.7)
Non-Hispanic black	2,143 (10.6)
Hispanic	2,292 (16.9)
Asian	1,076 (3.7)
Other	1,479 (3.1)
Maternal education	
<High school	2,339 (14.2)
High school graduate	4,123 (27.1)
>High school	9,253 (58.7)
Maternal BMI [†] (kg/m ²)	
<18.5	707 (4.2)
18.5–24.9	7,984 (50.0)
25.0–29.9	3,793 (24.2)
30	3,231 (21.7)
Married	9,769 (63.1)
WIC ^{††} participation	7,306 (45.3)
Non-smoker	13,629 (88.0)
Multiparous	9,034 (59.1)
Plurality	
Singleton	15,388 (98.8)
Multiples	327 (1.2)
Vaginal delivery	10,766 (67.4)

[^] Includes 22 states: Alaska, Arkansas, Colorado, Delaware, Illinois, Maine, Massachusetts, Michigan, Minnesota, Mississippi, Nebraska, New Jersey, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Washington, and Wyoming.

^{^^} Women with missing information for covariates were excluded.

^{*} Weighted prevalence

[†] Body Mass Index

^{††} Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

Table 3.

Characteristics of maternity care facilities that participated in the mPINC survey in which mothers participating in PRAMS gave birth, United States[^], 2009

	N ^{^^} (%) or Mean [range]
Total	1016 (100)
Facility ownership	
Private hospital	119 (11.7)
Government hospital	179 (17.6)
Nonprofit hospital	701 (69.0)
Military hospital	5 (0.5)
Birth center	12 (1.2)
Teaching hospital	
Yes	76 (7.5)
No	928 (91.3)
Not applicable (i.e., birth center)	12 (1.2)
Facility size (annual number of births)	
1–249	185 (18.2)
250–499	172 (16.9)
500–999	224 (22.0)
1000–1999	222 (21.9)
2000–4999	174 (17.1)
5000	16 (1.6)
Missing	23 (2.3)
mPINC Score	
Total Score	65 [19–99]
Subdomain scores	
Labor and delivery care	63 [0–100]
Feeding of breastfed infants	78 [0–100]
Breastfeeding assistance	81 [27–100]
Contact between mother and infant	71 [8–100]
Facility discharge care	41 [0–100]
Staff training	51 [0–100]
Structural and organizational aspects of care delivery	69 [3–100]

[^] Includes 22 states: Alaska, Arkansas, Colorado, Delaware, Illinois, Maine, Massachusetts, Michigan, Minnesota, Mississippi, Nebraska, New Jersey, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Washington, and Wyoming.

^{^^} Hospital information for women with missing information for covariates was excluded.

The prevalence and odds of breastfeeding (any and exclusive) at 8 weeks, by quartile of total mPINC score, United States[^], 2009

Table 4.

Quartile of mPINC total score	Number of hospitals	Number of mothers	Any breastfeeding at 8 weeks		Exclusive breastfeeding at 8 weeks	
			% [*]	Adjusted OR [‡] (95% CI)	% [*]	Adjusted OR [‡] (95% CI)
Quartile 1 (<55)	245	2251	43.6	--	20.4	--
Quartile 2 (55–64)	259	3635	51.6	1.40 (1.08, 1.83)	27.1	1.30 (0.98, 1.72)
Quartile 3 (65–74)	265	3593	54.1	1.50 (1.15, 1.96)	30.1	1.41 (1.04, 1.90)
Quartile 4 (75)	247	6236	61.5	2.12 (1.61, 2.78)	36.1	1.89 (1.41, 2.55)
Total	1016	15715	53.7		29.3	

[^] Includes 22 states: Alaska, Arkansas, Colorado, Delaware, Illinois, Maine, Massachusetts, Michigan, Minnesota, Mississippi, Nebraska, New Jersey, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Washington, and Wyoming.

[‡] Adjusted for: maternal race/ethnicity, maternal age, maternal education, maternal body mass index, marital status, WIC participation, smoking status, parity, plurality, and vaginal delivery

^{*} Unadjusted weighted prevalence