The effect of maternity practices on exclusive breastfeeding rates in U.S. hospitals

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Abstract

The Baby-friendly Hospital Initiative (BFHI) includes a set of 10 evidenced-based maternity practices that when used together have been shown to improve breastfeeding outcomes. In 2007, the Centers for Disease Control and Prevention launched the Maternity Practices in Infant Nutrition and Care (mPINC) survey to assess and monitor these and other evidenced-based maternity practices. The purpose of this study was to explore individual maternity practices measured in the 2013 mPINC survey, along with hospital demographic information, and their relationships with exclusive breastfeeding (EBF) rates, using a sample of United States (U.S.) hospitals. We obtained mPINC survey data from 69 BFHI hospitals and 654 non-BFHI hospitals in the U.S., and EBF rates from The Joint Commission, a leading hospital accreditation agency. On the basis of linear regression analysis, we found that most maternity practices studied were significantly associated with EBF rates (max adjusted $R^2 = 14.9\%$). We found a parsimonious model with an adjusted R^2 of 47.3%. This study supports the need for a systematic approach in providing breastfeeding support as no one maternity care practice was able to explain the variability in EBF rates as well as a collection of maternity care practices.

KEYWORDS

baby friendly hospital initiative, breastfeeding, exclusive breastfeeding, joint commission, maternity care, maternity practices

1 | INTRODUCTION

The health benefits of breastfeeding are undisputed (Ip et al., 2007; Victora et al., 2016), yet most women in the United States (U.S.) are not meeting expert recommendations to breastfeed exclusively for about 6 months (American Academy of Pediatrics, 2012; Office of Disease Prevention and Health Promotion, 2018). Health care practices that mothers and newborn infants experience in the hospital have long been recognized as one of the most promising strategies to promote initiation, duration, and exclusivity of breastfeeding (Rollins et al., 2016; World Health Organization, 1989). The Baby-friendly Hospital Initiative (BFHI) recognizes hospitals' implementation of the *Ten Steps to Successful Breastfeeding* and compliance with the *International Code of Marketing of Breast-milk Substitutes* (World Health Organization, 2017). Globally and in the U.S., BFHI is recognized as improving

breastfeeding outcomes (Perez-Escamilla, Martinez, & Segura-Perez, 2016). However, 20 years after the inception of BFHI in the U.S., only 25% of annual births occur in BFHI-certified hospitals (Baby-Friendly USA, Inc., 2018a). The Maternity Practices in Infant Nutrition and Care (mPINC) survey conducted by the Centers for Disease Control and Prevention (CDC) in the U.S. has been used as a tool to improve hospitals' maternity care practices to optimally support breastfeeding (Grossniklaus et al., 2017), with an overarching goal of assisting hospitals in achieving the BFHI designation (CDC, 2018). The purpose of this study was to evaluate the relationship between individual maternity care practices measured within the mPINC survey that reflect hospitals' implementation of BFHI, along with the attainment of BFHI, and exclusive breastfeeding (EBF) rates. Evaluating individual maternity care practices in the hospital is a meaningful way to prioritize opportunities to improve breastfeeding care to positively influence

EBF rates. Although evaluating individual maternity care practices is important, research has shown a dose-response relationship with mothers' exposure to BFHI steps and breastfeeding outcomes (DiGirolamo, Grummer-Strawn, & Fein, 2008). Therefore, we created models to determine how well we could predict EBF using a combination of maternity care practices, the BFHI designation, and hospitals' demographic characteristics. As far as we are aware, this study is the first to use a standardized in-hospital definition of EBF applied across a large U.S. hospital sample to evaluate maternity care practices that optimally support EBF.

2 | METHODS

2.1 | Data sources

Data for this study were obtained from four sources: (a) the CDC (2013a) mPINC survey, (b) The Joint Commission (2016), (c) Baby-Friendly USA, Inc. (2018a), and (d) the United States Census Bureau (2014). Biennially, the CDC invites the approximately 3,300 birthing hospitals in the U.S. to complete a survey about the maternity care practices in their hospital (Perrine et al., 2015). The mPINC tool gathers information on maternity care practices within seven practice areas (domains). The seven domains include labour and delivery care, feeding of breastfed infants, breastfeeding assistance, mother-baby contact, discharge care, staff training, and structural and organizational aspects of care. Questions with categorical response variables included yes/no responses and Likert scales of four response types from *rarely* to *almost always* or *few* to *most*. The complete 2013 mPINC survey is available (CDC, 2013b). Hospitals' EBF rates were extracted from The Joint Commission's database for the time period of April 1, 2014, to March 31, 2015. We felt this date range was appropriate as we were interested in looking at how the data collected on hospitals' maternity care practices in 2013 were related to EBF rates in 2014. Effective January 1, 2014, The Joint Commission, a leading hospital accreditation agency in the United States, required hospitals they certify that have $\geq 1,100$ births annually to publically report their EBF rates (The Joint Commission, 2013). This new regulation provides nationwide data on in-hospital EBF rates using a standardized definition. The Joint Commission defined EBF as "a newborn receiving only breast milk and no other liquids or solids except for drops or syrups consisting of vitamins, minerals or medicines" (The Joint Commission, 2014, 2015b). This publically available data are reported as an aggregated "exclusive breast milk feeding" rate from a sample of eligible infants within the hospital population and expressed as a percentage. This sample excluded infants (a) admitted to the neonatal intensive care unit, (b) diagnosed with galactosaemia, (c) on parenteral nutrition, (d) who have died, (e) with a hospital stay > 120 days, (f) enrolled in clinical trials, (g) transferred to another hospital, or (h) who had some documented reason for not exclusively breastfeeding (The Joint Commission, 2015a). Baby-friendly USA is the accrediting body and the national authority of BFHI in the United States (Baby-Friendly USA, Inc., 2018b). As of April 2014, there were 171 BFHI hospitals in the U.S. Using this information, we identified 69 BFHI hospitals in our data set. As the EBF data represent hospital's

Key messages

- Most maternity care practices measured in the 2013 Maternity Practices in Infant Nutrition and Care survey and included in our analysis were significantly related to exclusive breastfeeding rates.
- No one maternity care practice was able to predict exclusive breastfeeding rates as well as a collection of practices.
- The Baby-friendly Hospital Initiative, which is a bundle of maternity care practices, is an important initiative to improve exclusive breastfeeding rates.

EBF rate over a 1-year period, we wanted to ensure that all hospitals had the BFHI designation at the same entry point into the EBF data set. Census tract data from the American Community Survey, conducted by the United States Census Bureau, were applied to the data set (United States Census Bureau, 2014). A census tract is a cluster of areas designed to have a population size of 1,200–8,000 people. This information represents the demographic information for the community surrounding the hospitals and provides a proxy for the patients served by the hospital. Although many factors influence patients' hospital utilization, studies have shown that travel distance is a significant determinant of hospital utilization (Friedman et al., 2015) and the majority of women deliver at their local hospital (Kozhimannil, Casey, Hung, Prasad, & Moscovice, 2016).

2.2 | Data set

The 2013 mPINC survey had a total of 2,797 respondents, of which 983 hospitals also appeared in The Joint Commission data set. Figure 1 describes the final hospital sample that included 723 hospitals, with 69 hospitals having achieved the BFHI designation as of April 1, 2014. The 2013 mPINC survey contained 57 questions of which 29 were excluded. Reasons for exclusion included (a) more than 100 hospitals were missing a response to the question ($n = 1$ question), (b) they were not related to healthy full-term infants ($n = 3$ questions), (c) they were related to discharge care ($n = 2$ questions), (d) they did not pertain to maternity care practices ($n = 15$ questions), (e) they were duplicate questions ($n = 6$ questions), or (f) there was insufficient evidence in the literature that the maternity care practice was related to EBF rates ($n = 2$ questions). Table 1 summarizes the evidence used to identify the maternity care practices that were included in our analysis. For purposes of analysis, we made the following changes to the original survey questions. Survey Question B11 related to facilities' written policy on breastfeeding was scored (0–10) using criteria outlined by the CDC (CDC, 2017b). This new policy variable was treated as a continuous variable, with a higher number indicating more breastfeeding policy elements. The second variable created represented lactation specialist (as defined by each respondent) availability for mPINC Survey Question B10. Hospitals that reported that a lactation specialist was "always" available either 5 days a week or 7 days a

^amPINC= Maternity Practices in Infant Nutrition and Care Survey, ^bEBF= Exclusive Breastfeeding Rate, ^cBFHI= Baby Friendly Hospital Initiative

FIGURE 1 Flow chart of final hospital sample included in analysis

week were placed into one of the following categories: “7 days a week” or “5 days a week.” Hospitals that did not report “always” having lactation specialists during those possible time frames were categorized as “not having availability.” The third and fourth variables were created by combining vaginal- and caesarean-specific continuous response survey questions to reflect a weighted average. These variables A13/A07 and A12/A06 account for the caesarean and vaginal birth rates at each hospital. These new predictor variables, A13/A07 and A12/A06, replaced the individual maternity care practices and are reported in Table 2. Only hospitals with complete answers to all 28 questions were included in our analysis. Demographic characteristics were added to represent the population served by each hospital. Demographic variables were calculated and expressed as a proportion of the population of interest. Variables representing race/ethnicity were composed of non-Hispanic White (White), non-Hispanic African American (African American), non-Hispanic Asian (Asian), and Hispanic. The population in poverty was defined as the proportion of the population that is below 200% of the poverty line. The education variables refer only to persons ≥ 25 years old with at least a bachelor's degree (proportion with bachelors) and those who never attended college (proportion without college attendance). Data related to hospitals' BFHI designation, caesarean section rate, and number of deliveries were also added as predictor variables. This study was certified as not human subjects research by the University of Wisconsin–Madison Institutional Review Board.

2.3 | Statistical analysis

Data analysis was performed with the R statistical package (Version 3.1.1) using RStudio[®] software (Version 0.99.902) as an interface (R Core Team, 2013). All potential predictors of EBF rate (maternity care practices, demographic characteristics, BFHI) will be referred to as

predictor variables. First, separate simple linear regression models were fit with EBF as the response variable and one predictor variable. When the predictor variable was categorical, this took the form of an analysis of variance with post hoc Tukey corrected pairwise comparisons of means.

Then, we used multiple linear regression to determine how much variability in EBF rates could be explained by a collection of variables. These multiple predictor variable models were selected using two different selection criteria. The first model used the Akaike information criterion (AIC) to determine which predictor variables were removed. The variable that lowered the AIC the most at each step was removed. The second model used the least significant *P* value as the criterion. For both criteria, the model selected was refit at each step with the removed variable eliminated. This process was repeated until the AIC could no longer be reduced by removing a variable (AIC method), or all variables had a *P* value of <0.05 (*P* value method). For these model building procedures, potential predictor variables included 26 maternity care practices, the BFHI designation, caesarean section rate, number of births, and hospital demographic data. An exhaustive model search that would have fit every model with every possible combination of predictor variables would have been preferred but was impractical given the large number of potential predictor variables. All models fit were checked graphically for adherence to the assumptions of linear regression. Normality of the residuals was checked using normal Q–Q plots, and constant variance was checked using residuals versus fitted values plots.

3 | RESULTS

The final data set included hospitals from all 50 states. The distribution of hospitals that responded to the 2013 mPINC survey was similar to

TABLE 1 Research used for selection of Maternity Practices in Infant Nutrition and Care (mPINC) survey questions

Domain ^a	Survey number	Survey question	Research used for selection of survey questions
Labour and delivery	A11, A05	How many mothers are encouraged to hold their infant for 30 min within 1 hr of a vaginal delivery and 2 hr after a caesarean delivery? ^b	Skin-to-skin contact improves breastfeeding outcomes (Moore et al., 2016; Stevens, Schmied, Burns, & Dahlen, 2014)
	A04, A10	Routine newborn procedures are done while mother holds infant. ^b	Procedures should take place while baby is skin to skin (Crenshaw, 2014; Holmes, McLeod, & Bunik, 2013)
	A12, A06	Percent infants put to breast within 1 hr after vaginal delivery and 2 hr after caesarean delivery. ^c	Assist mothers to initiate breastfeeding within 1 hr of birth (American Academy of Pediatrics, 2012; Baby-Friendly USA, I, 2016; Holmes et al., 2013)
Feeding breastfed infants	A07, A13 A20	Breast milk as the first feeding. ^c Percent of infants supplemented with something other than breast milk.	Use breast milk supplement only when medically necessary (American Academy of Pediatrics, 2012; Baby-Friendly USA, Inc., 2016)
Breastfeeding assistance	A15	Of breastfeeding mothers, how many are taught breastfeeding techniques?	Breastfeeding support is associated with improved duration and exclusivity of breastfeeding (McFadden et al., 2017)
	A16	How many mothers are taught to recognize infant's first signs of hunger?	
	A18	How many mother–baby couples are directly observed and assessed by staff for breastfeeding effectiveness?	
	A17	How often do maternity care staff advise breastfeeding women to limit the length of suckling at each feeding?	Limiting length of time on the breast can prevent infant from receiving high-calorie hind milk (Riordan & Wambach, 2010)
	A19	Do staff at facility use tool to assess breastfeeding effectiveness?	Scoring tools such as LATCH can identify risk factors for early breastfeeding cessation (Kumar, Mooney, Wieser, & Havstad, 2006; Riordan, 2001)
	A24	How many infants are given pacifiers?	Pacifier use is associated with decreased EBF rates (Buccini, Perez-Escamilla, Paulino, Araujo, & Venancio, 2017)
Mother–baby contact	A08, A14	Following delivery, infants are routinely taken to nursery. ^b	Preventing mother–baby separation in the hospital is essential to establishing successful breastfeeding (Crenshaw, 2014)
	A31	Percentage of infants who remain with their mother: ≥ 23 hr per day.	Rooming-in is associated with longer duration of breastfeeding (Murray, Ricketts, & Dellaport, 2007)
Staff training	B01	Hours nurses spend in breastfeeding training as new employees.	Breastfeeding outcomes are related to health care education (Ward & Byrne, 2011)
	B05	Hours staff members spent in breastfeeding education in the past year.	
	B03	How often are staff assessed for level of competency in breastfeeding management and support?	
Structural and organizational aspects of care	B11	Policy addressing 10 maternity care practice elements.	A hospital breastfeeding policy is associated with better breastfeeding outcomes (Li et al., 2014)
	A25	Facility receives free infant formula.	Gift acceptance is associated with changes in prescribing habits and should be avoided (Lieb & Scheurich, 2014)
	A01	Prenatal classes offered by staff or contracted personnel.	Attending prenatal education classes is associated with significant increases in breastfeeding rates at 6 months (Rosen, Krueger, Carney, & Graham, 2008)
	B10	Availability of lactation specialists.	Access to international board-certified lactation consultants during hospital stay is associated with breastfeeding rates (Castrucci et al., 2006)
	A22	Percentage of infants supplemented with formula reason: Doctor's orders	Hospital policies requiring providers orders for formula supplementation can help ensure the use of breast milk substitutes is medically necessary (Boban & Zakarija-Grkovic, 2016; Kellams, Harrel, Omage, Gregory, & Rosen-Carole, 2017)
	C02	Percentage of live births at facility that were caesarean delivered in the past year.	Caesarean births are associated with poor breastfeeding outcomes (Dewey et al., 2003; Hobbs et al., 2016)
	C01	Number of live births at the facility.	Relationship between volume and health outcomes (Halm, Lee, & Chassin, 2002)

Note. EBF, exclusive breastfeeding.

^aDomains were created by the Centers for Disease Control (CDC) and provide a structure to report data for individual maternity care practices measured in the mPINC survey.

^bSeparate mPINC survey questions for vaginal verses caesarean deliveries.

^cA12 and A06 along with A13 and A07 were combined in Table 2 and reflect weighted averages based on hospitals' caesarean section and vaginal birth rates. Refer to the CDC's website for the complete 2013 mPINC survey (CDC, 2013b).

TABLE 2 Partial results from simple linear regression models

Domain	Survey question	Predictor variable	$B \pm 95\% \text{ CI}^a$	$\text{Diff} \pm 95\% \text{ CI}^b$	$\text{Adj}^c R^2$
Feeding breastfed infants	A20	Percentage of infants supplemented with something other than breast milk	-0.347 ± 0.060^d		0.149
	A13/A07	Breast milk as first feeding after delivery	0.442 ± 0.087		0.120
Labour and delivery	A12/06	Percentage of infants put to breast within 1 hr after vaginal birth or 2 hr after caesarean birth	0.361 ± 0.064^d		0.142
	A04	Routine newborn procedures after vaginal birth done while mother holds infant (almost always > rarely)		22.165 ± 6.658^d	0.126
	A11	How many mothers are encouraged to hold their infant for 30 min within 2 hr of caesarean birth? (most > few)		21.013 ± 6.727^d	0.108
	A05	How many mothers are encouraged to hold their infant for 30 min within 1 hr of vaginal birth? (most > few)		31.430 ± 16.398^d	0.090
	A10	Routine newborn procedures after caesarean births done while mother holds infant (almost always > rarely)		14.877 ± 6.438^d	0.080
Mother–baby contact	A08	Following vaginal birth, are babies taken to nursery? (yes < no)		-15.373 ± 3.007^d	0.120
	A14	Following caesarean birth, are babies taken to nursery? (yes < no)		-12.403 ± 2.585^d	0.109
	A31	Percentage of infants remain with mother: 23+ hr per day	0.115 ± 0.032^d		0.067
Structural aspects of care	A25	Facility receives free infant formula (yes < no)		-11.882 ± 3.017^d	0.076
	C02	Percentage of live births at facility that were caesarean delivered in the past year	-0.567 ± 0.179^d		0.050
	B11	Baby-friendly hospital designation (BFHI > non-BFHI)	1.536 ± 0.635^d	13.567 ± 4.619^d	0.043
	B10	Policy addressing 10 maternity care practice elements		8.635 ± 4.310^d	0.030
	B10	Availability of lactation specialist (7 days a week vs. not available)			0.028
	A22	Percentage infants supplemented with formula reason: doctor's orders	0.110 ± 0.106^d		0.021
	A01	Prenatal classes offered by staff or contracted personnel (yes > no)		11.722 ± 7.048^d	0.013
Staff training	C01	Number live births at the facility (per 1,000 births)	-0.006 ± 0.009		0.001
	B01	Hours nurses spend on breastfeeding training as new employees		14.772 ± 10.361	0.038
	B05	(18 or more hours > less than 1 hr)		5.407 ± 6.896	0.001
	B03	Hours staff members spent in breastfeeding education in the past year		0.535 ± 4.492	-0.003
Breastfeeding assistance	B03	(3–4 hr > less than 1 hr)			
	B03	How often are staff assessed for level of competency in breastfeeding management and support? (less than once a year > at least once a year)			
	A19	Do staff at facility use a tool to assess breastfeeding effectiveness? (no < yes)		-9.736 ± 3.464^d	0.039
	A17	How often do maternity care staff advise breastfeeding women to limit length of feeding? (often < rarely)		-8.199 ± 5.997	0.027
	A24	How many infants are given pacifiers? (many < few)	-7.200 ± 4.778^d		0.019
	A18	How many mother–baby couples are directly observed by staff for breastfeeding effectiveness? (most > many)	5.790 ± 5.435		0.013
	A15	Of breastfeeding mothers, how many are taught breastfeeding techniques? (most > some/many)		6.931 ± 6.043	0.005
	A16	How many mothers are taught to recognize infant's first signs of hunger? (most > many)		4.891 ± 5.521	0.007
Demographics		Proportion without college attendance	-0.587 ± 0.113^d		0.125
		Proportion African American	-0.346 ± 0.072^d		0.108
		Proportion White	0.222 ± 0.051^d		0.090
		Proportion with bachelor's degree	0.341 ± 0.100^d		0.057
		Proportion living below poverty line	-0.233 ± 0.069^d		0.056
		Proportion Hispanic	-0.170 ± 0.078^d		0.020
		Proportion Asian	0.076 ± 0.155		0.000

Note. Exclusive breastfeeding rate was the response variable for all models. *P* values for all pairwise comparisons of the individual levels of categorical variables and for the overall analysis of variance (ANOVA) test are listed in Table S1. Results listed are unadjusted for covariates. Refer to the CDC's website for the complete 2013 mPINC survey (CDC, 2013b). Questions are specific to healthy full-term infants following an uncomplicated vaginal or caesarean birth.

^a*B* = regression coefficient for the continuous variables.

^bDiff = largest pairwise difference between category means from the Tukey multiple comparisons correction.

^cAdj *R*² = adjusted *R*² for continuous variables was obtained from the linear regression model and from an ANOVA for the categorical variables.

^d*P* value is <0.001.

TABLE 3 Maternity care practices remaining in the final multiple regression models chosen using two different model selection criteria

Survey number		Adjusted R^2 (%)
Model 1 ^a		47.3
A20	Percentage of infants supplemented with something other than breast milk	
A13/A07	Breast milk as first feeding after delivery	
A12/A06	Percentage of infants put to breast within 1 hr of vaginal birth or 2 hr after caesarean birth	
A04	Routine procedures after vaginal birth done while mother holds infant	
A31	Percentage of infants who remain with mothers: 23+ hr per day	
A08	Following vaginal birth, are babies taken to the nursery?	
A14	Following caesarean birth, are babies taken to the nursery?	
A22	Percentage of infants supplemented with infant formula: Doctor's orders	
A25	Facility receives free infant formula	
A01	Prenatal classes offered by staff or contracted personnel	
B03	How often are staff assessed for level of competency in breastfeeding management and support?	
A19	Do staff at facility use a tool to assess breastfeeding effectiveness?	
Model 2 ^b		46.9
All variables from above with the addition of the following:		
A10	Routine newborn procedures after caesarean births are done while mother holds infant	
B05	Hours staff members spent in breastfeeding education in the past year	

Note. Both models contained additional predictor variables pertaining to hospital demographics (not shown).

^aModel 1 was selected using Akaike information criterion as the criterion.

^bModel 2 was selected using P value as the criterion.

our sample with the exception of California, which was higher by percent in our sample than the mPINC sample. Among the hospitals retained in the data set for analysis, the highest percentage was from California (12%) followed by Texas (7%), Ohio (5%), Florida (5%), and New York (5%). All other states each contributed less than 5%.

Table 2 summarizes the relationship between individual maternity practices measured in the mPINC survey, BFHI designation, and demographic characteristics, and their relationship with EBF rates. Most predictor variables studied were significantly related to EBF rates with a range in adjusted R^2 of 1.3% to 14.9%. The predictor variables in each domain are ranked on the basis of the adjusted R^2 . The adjusted R^2 represents each predictor variable's ability to explain the variability in EBF using simple linear regression. The highest overall adjusted R^2 was for mPINC Survey Question A20 that asked facilities what percentage of healthy full-term infants are supplemented with something other than breast milk (adjusted R^2 = 14.9%). For the continuous variables, the regression coefficient (B) represents the percent change in EBF rates for each 1% change in the predictor variable. For example, for every 1% increase in hospitals reporting breast milk as first feeding after delivery, mPINC Survey Question A13/A07, there was a 0.4% increase in EBF rates. By contrast, for each 1% increase in hospitals reporting infants supplemented with something other than breast milk, mPINC Survey Question A20, there was a 0.3% decrease in EBF rates. All continuous predictor variables included in our analysis were significantly related to EBF rates ($P < 0.001$) with the exception of the number of live births at each hospital and the proportion of the population who identifies as Asian. For the categorical predictor variables, we reported only the largest category EBF mean differences (Diff) with the lowest P value. For example, hospitals with the BFHI designation had 13.6% higher EBF rates than had hospitals without the BFHI designation. By contrast, hospitals that reported receiving

free infant formula had 11.9% lower EBF rates than had hospitals that reported they did not receive free infant formula. Almost all categorical variables were significant with the exception of several maternity care practices in the staff training and the breastfeeding assistance domains. For more in-depth information on data for each categorical level, please see Table S1. Table 3 summarizes the maternity care practices that remained in the multiple linear regression models selected using each criterion, AIC or P value. The multiple linear regression models selected using the two different selection criteria were largely similar with respect to the predictor variables that remained. The adjusted R^2 for the model selected using AIC was 47.3%. The adjusted R^2 for the model selected using P value was 46.9%. To determine if our ability to predict the variability in EBF rates relied too heavily upon the maternity care practices most directly related to breastfeeding, we again selected a model using AIC, but excluded mPINC Survey Questions A13/07, A12/06, and A20 as potential predictor variables. The resulting model had an adjusted R^2 of 43.5%, a reduction of less than 5% in explanatory ability (model results not shown).

4 | DISCUSSION

To our knowledge, this is the first study to evaluate the relationship between individual maternity care practices and EBF rates, using a standardized in-hospital feeding definition of EBF, applied across a large sample of hospitals in the United States. This study found that most individual maternity care practices measured in the 2013 mPINC survey and included in our analysis were significantly related to EBF rates. This finding supports that the mPINC survey can be a useful tool for monitoring and assessing individual maternity care practices in order to positively influence EBF rates in birthing facilities. We found

that directions of effects for statistically significant maternity care practices were consistent with the literature. For example, we found higher EBF rates when hospitals reported that *most* versus *few* mothers were encouraged to hold their infant for 30 min following a caesarean section or vaginal delivery. This is consistent with study findings that show maternity care practices that promote skin-to-skin contact have been associated with better breastfeeding outcomes (Moore, Bergman, Anderson, & Medley, 2016). Similarly, we found a positive correlation between breast milk as first feeding following a caesarean section or vaginal birth and EBF rates in the hospital. This is what we would expect on the basis of mothers' physiological response to infants suckling at the breast and the establishment of milk production (Pang & Hartmann, 2007), and research on the relationship between breastfeeding initiation within 1 hr of birth and EBF rates (Perrine, Scanlon, Li, Odom, & Grummer-Strawn, 2012). Alternatively, maternity care practices measured in the mPINC survey that create barriers to the establishment of a milk production, such as the percentage of infants supplemented with something other than breast milk, were negatively associated with EBF rates. This is consistent with a study that found infants who were supplemented with something other than breast milk in the hospital were less likely to be breastfed at 6 weeks of age (DiGirolamo et al., 2008). The findings related to hospital demographics and EBF rates were consistent with our previous study (Patterson, Keuler, & Olson, 2017). When comparing the adjusted R^2 of the individual maternity practices, we found a higher adjusted R^2 with the maternity care practices measured in the feeding breastfed infants, labour and delivery, and mother–baby contact domains than in the staff training domain. This is what we would expect given the *moderate-* to *high-quality* evidence supporting maternity care practices such as skin-to-skin contact following birth, initiating breastfeeding within an hour of delivery, and preventing maternal and infant separation, compared with the *very low-quality* evidence supporting staff training published in the new breastfeeding guidelines for facilities providing maternity and newborn care (World Health Organization, 2017). Although information on the relationship between individual maternity care practices and EBF rates may be useful in prioritizing changes, it is the collective impact of these practices that we found had the greatest potential to influence EBF rates.

Consistent with the BFHI guidelines, our study reinforces the need for a systematic approach to support breastfeeding in the hospital (World Health Organization, 2017). We found that a collection of maternity care practices was better able to explain the variability in EBF rates than was any one individual maternity care practice. Research has shown a relationship between the number of BFHI practices a mother is exposed to and breastfeeding outcomes (DiGirolamo et al., 2008). Using both model selection criteria, we were able to build a model that explained nearly half of the variability in EBF rates. The majority of this explanatory ability was not primarily due to the maternity care practices directly pertaining to breastfeeding, such as mPINC Survey Question A13/A07 regarding breast milk as first feeding following delivery. This suggests that maternity care practices not directly related to breastfeeding also influence a mother's choice to exclusively breastfeed. Neither one of the multiple linear regression models selected using each of the criteria included BFHI designation. This was not surprising as the BFHI designation was likely represented

by some collection of maternity care practices already in the model. The key message from the multiple variable models is that a collection of maternity care practices was able to predict the variability in EBF rates better than any single practice, and no single maternity care practice dominated in the final model. Given the complicated nature of women's decision to breastfeed, we found it remarkable that we were able to explain nearly half of the variability in EBF rates using measurable maternity care practices while accounting for hospital demographic characteristics.

All mothers and infants have the right to high-quality health care services in order to achieve optimal breastfeeding outcomes (World Health Organization, 2017). An unintended finding in this study was the inconsistencies in hospitals' report of maternity care practices. This is especially pronounced regarding the difference in care experienced by mothers who deliver via caesarean section versus vaginally. For instance, most hospitals in our sample reported routine newborn procedures after a vaginal delivery are completed *often* or *almost always* while a mother holds the infant. In contrast, most hospitals in our sample reported routine procedures are completed *sometimes* or *rarely* following caesarean delivery. Caesarean births are associated with poor breastfeeding outcomes (Dewey, Nommsen-Rivers, Heinig, & Cohen, 2003; Hobbs, Mannion, McDonald, Brockway, & Tough, 2016). Our study supports this as we found that for every 1% increase in hospitals' reported caesarean rate, there was a 0.6% decrease in EBF rates, which was significant. Although many factors may be related to hospitals' ability to prevent mother–baby separation following a caesarean delivery, our findings support that the few hospitals in our data set that reported *almost always* versus *rarely* completed newborn procedures while mothers hold their infant were associated with EBF rates that were 15% higher ($P < 0.001$). Identifying opportunities to optimize breastfeeding care for mothers despite delivery modality may be an important strategy to positively influence breastfeeding outcomes.

The implications of this study relative to the newly revised *Ten Steps to Successful Breastfeeding* (World Health Organization, 2018a, 2018b) are with respect to the way in which the *Ten Steps* are operationalized, monitored, and assessed. The mPINC survey is a valuable tool to assist hospitals in assessing and monitoring their level of breastfeeding care along with helping hospitals align with the BFHI guidelines. Although there have been large increases in the percentage of hospitals in the U.S. that are BFHI certified, the majority of infants are being delivered in non-BFHI hospitals (Baby-Friendly USA, Inc., 2018a). Given the evidence around the BFHI and breastfeeding outcomes (Perez-Escamilla et al., 2016), public health initiatives and legislation aimed at increasing the number of BFHI hospitals should remain a high priority (Feldman-Winter et al., 2017; National Conference of State Legislatures, 2017). In addition, expansion of hospital regulatory agencies to evaluate maternity care practices as a part of accreditation may help ensure that all mothers have access to high-quality maternity care in order to optimize EBF rates.

A strength of this study is that it was a national hospital sample that utilized a standardized definition of EBF in the hospital. We were also able to include a large number of maternity care practices measured in the mPINC survey and explore their relationship with EBF rates in the hospital. Limitations of this study include that U.S. census

data for the community surrounding the hospital were used as a proxy for the demographics actually served by the hospital. In addition, hospitals that were marked as non-BFHI hospitals may have been in various stages of obtaining designation, and therefore, a dichotomous variable may not have fully represented the true impact of the BFHI hospital designation. Lastly, there are potential limitations with data obtained from the mPINC survey. One representative from each hospital is selected to complete the mPINC survey. To ensure that the information obtained by the hospital representative is accurate, the CDC takes additional steps to make sure that the survey is delivered to the person who is most knowledgeable about the maternity care and infant feeding practices (CDC, 2017a).

Future research might explore differences in hospitals implementation of various maternity care practices, especially those strongly associated with better breastfeeding outcomes. A study that evaluates hospitals' ability to implement certain maternity practices but not others may be valuable in identifying solutions for overcoming barriers to providing evidenced-based care. In addition, qualitative research that explores mothers' experience with the BFHI would be a useful way of evaluating how the programme, from a mother's experience, is effective.

5 | CONCLUSION

The mPINC survey is a valuable tool to assist birthing hospitals in identifying opportunities to improve individual maternity care practices in order to positively influence EBF rates. However, consistent with the BFHI, our study findings support that no one maternity care practice is as good as a collection of practices in explaining EBF rates in the hospital. Considering the complicated nature of mothers' decision to exclusively breastfeed, we were able to create a model using a collection of measurable items that was able to predict almost half of the variability in EBF rates. Studies that evaluate barriers and facilitators to implementing evidenced-based maternity care practices, especially across both delivery modalities, would be valuable in identifying solutions for overcoming barriers to evidenced-based care.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONTRIBUTIONS

JAP led the design of the study, statistical analysis, writing, revising, and final approval of manuscript. NSK guided the statistical analysis and contributed to writing and revising as well as final approval of the manuscript. BHO supervised the overall study and contributed

to the design, analysis, writing, revising, and final approval of the document.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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