Racial and Ethnic Disparities in the Use of Mother's Milk Feeding for Very Low Birth Weight Infants in Massachusetts

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Objective To examine the extent to which maternal race/ethnicity is associated with mother's milk use among hospitalized very low birth weight (VLBW) infants and maternal receipt of hospital breastfeeding support practices (human milk prenatal education, first milk expression <6 hours after delivery, lactation consultation <24 hours, any skin-to-skin care <1 month).

Study design We studied 1318 mother-VLBW infant pairs in 9 Massachusetts level 3 neonatal intensive care units (NICUs) between January 2015 and November 2017. We estimated associations of maternal race/ethnicity with any and exclusive mother's milk on day 7, on day 28, and at discharge/transfer and hospital practices. We estimated HRs comparing the probability of continued milk use over the hospitalization by race/ethnicity and tested mediation by hospital practices, adjusting for birth weight and gestational age and including hospital and plurality as random effects.

Results Mothers were 48% non-Hispanic white, 21% non-Hispanic black, and 20% Hispanic. Initiation of mother's milk was similar across groups, but infants of Hispanic mothers (hazard ratio [HR], 2.71; 95% CI, 2.05-3.59) and non-Hispanic black mothers (HR, 1.55; 95% CI, 1.17-2.07) stopped receiving milk earlier in the hospitalization compared with infants of non-Hispanic white mothers. Hispanic mothers had lower odds of providing skin-to-skin care at <1 month (OR, 0.61; 95% CI, 0.43-0.87) compared with non-Hispanic whites.

Conclusions Hispanic and non-Hispanic black mothers were less likely than non-Hispanic white mothers to continue providing milk for their VLBW infants throughout the NICU stay. *(J Pediatr 2019;204:134-41).*

The provision of mother's own breast milk plays a critical role in offsetting the adverse health consequences of preterm birth. Greater use of mother's milk is associated with reduced risks of late-onset bloodstream infections,[1,2] chronic lung disease,[3] and necrotizing enterocolitis (NEC)[4-6] and with better childhood neurodevelopment.[7,8] Racial/ethnic disparities in mortality and morbidities of very low birth weight (VLBW; ≤1500 g) are well recognized.[9-15] Mother's milk use also varies by race and ethnicity,[9,10,15-18] with non-Hispanic black[9,10,15-18] and Hispanic[9,10] mothers less likely than non-Hispanic white mothers to provide mother's milk for their VLBW infants. Thus, reducing racial/ethnic disparities in mother's milk use may be an effective strategy to reduce racial/ethnic disparities in health outcomes among VLBW infants.

Targeting interventions to reduce racial/ethnic disparities in mother's milk use requires an understanding of how these disparities unfold over the several months of hospitalization in the neonatal intensive care unit (NICU). However, most previous studies of racial/ethnic disparities in mother's milk use among VLBW infants in the US are limited by available data for only a single time point.[9,10,18-20] In addition, knowledge of specific, modifiable determinants of disparities in milk provision is needed to inform effective interventions. Some previous studies have identified social determinants of health that contribute to disparities in maternal milk provision,[10,16,17] but such factors are generally difficult targets for intervention. Hospital practices, including prenatal education on human milk benefits,[21] assistance with early milk expression,[22] early professional lactation support,[23,24] and skin-to-skin care,[25] are all effective in increasing mothers' ability to make milk longer, but how receipt of these evidence-based practices may differ by race/ethnicity is unknown. Furthermore, the extent to which disparities in receiving these hospital practices explain disparities in mother's milk use during hospitalization has not been examined previously.

Our objectives in the present study were to determine the extent to which maternal race/ethnicity is associated with initiation of mother's milk use among VLBW infants and its continuation over the NICU hospitalization, and to evaluate hospital breastfeeding support practices (ie, human milk prenatal education, first milk

NEC	Necrotizing enterocolitis
NICU	Neonatal intensive care unit
NPO	Nil per os
QI	Quality improvement
VLBW	Very low birth weight

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expression within 6 hours after birth, lactation consultation within 24 hours after birth, and any skin-to-skin care provided in the first month of life). We also aimed to explore the extent to which these hospital breastfeeding practices mediate relationships between maternal race/ethnicity and mother's milk use. We hypothesized that compared with non-Hispanic white mothers, non-Hispanic black and Hispanic mothers of VLBW infants would (1) initiate providing milk less often, (2) stop providing milk earlier in the hospitalization, and (3) receive hospital breastfeeding practices less often. Furthermore, we hypothesized that less receipt of hospital breastfeeding practices would partially explain the observed racial/ethnic disparities in the continuation of mother's milk use to NICU discharge or transfer.

Methods

We performed a secondary analysis of data collected between January 2015 and November 2017 in the context of a statewide quality improvement initiative by the Neonatal Quality Improvement Collaborative of Massachusetts. This collaborative comprises all 9 NICUs with birth centers in the state and focuses on increasing mother's milk use and reducing racial/ethnic disparities in mother's milk use among infants weighing ≤1500 g or at <30 weeks of gestation at birth. Eight of 9 hospitals began offering donor milk to VLBW infants when mother's milk was not available in 2010-2012, and the last hospital began doing so in 2014. All participating hospital-based teams collected data locally using standard definitions and submitted their data to a centralized REDCap database.[26]

For this analysis, from the centralized database of 1659 infants, we excluded those who died (n = 110), those with absolute contraindications to mother's milk (eg, infant milk-protein allergy, maternal substance abuse or HIV infection, expected adoption or foster case placement; n = 100), and those with unknown maternal race/ethnicity (n = 131), leaving 1318 mother-VLBW infant dyads. We examined these 1318 dyads for bivariate analysis (**Table I**) and further excluded those of "other race" (n = 59) for our multivariate analysis, leaving 1259 dyads. This analysis of deidentified data was determined to be non-human subjects research by the Institutional Review Board at Boston University Medical Campus.

Maternal race/ethnicity was abstracted by local teams from the medical records in the admission "face sheet" as (1) non-Hispanic white, (2) Hispanic of any race, (3) non-Hispanic black, (4) non-Hispanic Asian, and (5) all others.

Infant feeding information was abstracted from the medical records on days of life 7, 14, 21, 28, 42, 56, 70, and 84, and then at 24 hours before discharge/transfer using the following standard definitions: (1) exclusive mother's milk use: 100% of "base" milk was from the mother, with or without a fortifier (bovine or human); (2) any mother's milk use: any amount of mother's milk, with or without the addition of donor milk, formula, and/or any fortifier; (3) no mother's milk use: donor milk, formula, and/or bovine fortifier only; and (4) nil per os (NPO). For this analysis, we considered mother's milk use to occur when the infant was fed milk from the infant's own mother only, not donor milk. Mother's milk use was considered "initiated" if the infant received any mother's milk on day 7.

Teams collected medical record data regarding 4 modifiable hospital practices associated with the mother's ability to make milk longer, according to the following standard definitions: (1) written prenatal consultation note that included information about human milk benefits (indicated by "human milk," "breast milk," "mother's milk," "mother's own milk," or "breastfeeding,") by physicians or nurse practitioners only, among mothers who received prenatal consultations (yes/no); (2) first milk expression within 6 hours of birth, either by hand expression or by pumping (yes/no); (3) consultation note from an international board-certified lactation consultant within the first 24 hours after birth (yes/no); and (4) any skin-to-skin care documented at any time with the mother on any of 4 audit days (day of life 7, 14, 21, or 28) (yes/no).

Categorical covariates included birth hospital, plurality, and infant sex. Continuous covariates included birth weight, gestational age, and length of stay until the initial discharge or transfer. The presence of medical or surgical NEC or late-onset bacterial or fungal infection according to Vermont Oxford Network definitions[27] were recorded as categorical variables, and infant growth (weight for gestational age *z*-score change from birth until initial discharge or transfer) was recorded as a continuous variable.

Statistical Analyses

We examined bivariate associations of maternal race/ethnicity with mother and infant characteristics, mother's milk use outcomes, and hospital breastfeeding practices using the χ^2 test for categorical variables and ANOVA for continuous variables. We used mixed-effects logistic regression models to estimate ORs and 95% CIs for associations of maternal race/ethnicity with (1) any and exclusive mother's milk use at day 7, at day 28, and in the 24 hours before discharge/transfer and (2) our 4 hospital breastfeeding practices. We excluded infants who were NPO on day 7 (5.1%), on day 28 (2.8%), and in the 24 hours before discharge/transfer (2.5%) in our models examining those time points.

Among mother-VLBW infant pairs who initiated mother's milk use, we created Kaplan-Meier plots to illustrate differences by race/ethnicity in the time to cessation of mother's milk use over the entire duration of NICU hospitalization and used Cox proportional hazard models to estimate these differences. In all multivariate analyses, we adjusted for infant birth weight and gestational age and included hospital and plurality as random effects. We included hospital as a random effect, which adjusted for correlation between subjects within the same hospital who may receive similar breastfeeding support, because we were interested in the independent association of maternal race/ethnicity with mother's milk use and receipt of hospital-based practices. We included length of stay in models examining mother's milk use at discharge/transfer, because the length of stay—and thus the days that a mother provides milk—vary according to infant age at the time of discharge/transfer. We also included infant length of stay as a proxy for degree of clinical illness that may impact readiness for skin-to-skin

Table I. Infant and mother characteristics according to maternal race/ethnicity

Characteristics	All subjects (N = 1318)		Non-Hispanic white (N = 637)		Non-Hispanic black (N = 272)		Hispanic (N = 261)		Non-Hispanic Asian (N = 89)		*P* value*
Infant characteristics											
Birth weight, g, mean (SD)	1094	(289)	1129	(285)	1031	(301)	1053	(292)	1145	(262)	<.001
Gestational age, wk, mean (SD)	28.7	(2.8)	28.9	(2.7)	28.3	(3.0)	28.3	(2.77)	29.5	(2.9)	<.001
Birth weight for gestational age *z*-score, mean (SD)	–0.5	(1.0)	–0.5	(1.1)	–0.6	(1.0)	–0.5	(1.0)	–0.7	(1.1)	.277
Length of stay, d, mean (SD)	59.7	(37.2)	57.2	(36.1)	64.1	(38.9)	61.1	(38.8)	55.6	(33.9)	.037
Female sex, n (%)	658	(49.9)	312	(49.0)	149	(54.8)	131	(50.2)	36	(40.4)	.441
Multiple birth, n (%)	379	(28.8)	212	(33.3)	70	(25.7)	64	(24.5)	20	(22.5)	.012
Medical or surgical NEC, n (%)	94	(7.1)	36	(5.7)	34	(12.5)	16	(6.1)	6	(6.7)	.004
Any late-onset sepsis, n (%)	102	(7.7)	42	(6.6)	29	(10.7)	23	(8.8)	6	(6.7)	.163
Transferred to another hospital (vs discharged home), n (%)	457	(34.7)	236	(37.0)	82	(30.1)	97	(37.2)	23	(25.8)	.092
Mother's milk at specific time points, n (%)											
Day 7 any mother's milk	1019	(83.9)	504	(84.3)	199	(83.3)	200	(83.7)	65	(79.3)	.600
Day 7 exclusive mother's milk	796	(65.5)	401	(67.1)	160	(67.0)	144	(60.2)	47	(57.3)	.047
Day 28 any mother's milk	843	(81.9)	404	(83.6)	183	(81.7)	155	(73.8)	55	(87.3)	.003
Day 28 exclusive mother's milk	682	(66.3)	339	(70.2)	150	(67.0)	112	(53.3)	47	(74.6)	<.001
Discharge/transfer any mother's milk	805	(62.6)	436	(69.4)	150	(57.2)	120	(47.2)	56	(66.7)	<.001
Discharge/transfer exclusive mother's milk	589	(45.8)	333	(53.0)	110	(42.0)	79	(31.1)	40	(47.6)	<.001
Hospital breastfeeding practices, n (%)											
Prenatal consultation with education on human milk benefits†	553	(74.3)	247	(69.8)	127	(79.4)	110	(79.7)	30	(65.2)	.013
First milk expression within 6 h	475	(50.8)	247	(54.9)	88	(45.4)	83	(45.4)	31	(51.7)	.108
First lactation visit within 24 h	683	(67.7)	337	(70.2)	144	(65.8)	118	(60.8)	49	(75.4)	.102
Any skin-to-skin with the mother on day 7, 14, 21, or 28	805	(63.2)	417	(67.9)	157	(59.7)	140	(55.3)	47	(55.3)	<.001

Characteristics for the 59 infants with mothers with "other" racial/ethnic groups are not shown.
*ANOVA was used for continuous variables and the χ^2 test was used for categorical variables.
†The denominator for prenatal consultation with education regarding human milk benefits is the 744 VLBW infants whose mothers received a prenatal consultation.

care in models examining skin-to-skin care. Infants with non-Hispanic white mothers served as the reference group for all associations.

To explore potentially causal relationships among variables, we developed and tested a conceptual model in which racial/ethnic differences in hospital breastfeeding support practices mediate—at least in part—racial/ethnic disparities in mother's milk use at discharge (**Figure 1**; available at www.jpeds.com). First, we performed initial analyses examining associations of our predictor variable (maternal race/ethnicity) with the mediators (hospital-based practices) and of the mediators with outcomes (any/exclusive mother's milk use at discharge). Hispanic ethnicity was associated with both less frequent skin-to-skin care and lower mother's milk use (see Results). Thus, we examined the extent to which lower skin-to-skin care mediated the association of Hispanic ethnicity with lower mother's milk use with a Schluchter marginal regression approach to analyze data with binary outcomes and mediators.[28] This approach provides an estimate of the indirect effect of the mediator as the difference in the 2 coefficients, along with a robust estimate of the standard error of the indirect effect. All statistical analyses were conducted with SAS 9.4 (SAS Institute, Cary, North Carolina).

Results

The study cohort was 48% non-Hispanic white, 21% non-Hispanic black, 20% Hispanic, and 7% non-Hispanic Asian. Overall, >80% of infants received any mother's milk on day 7 and day 28, and 63% received any mother's milk at discharge/transfer. Participant characteristics are summarized in **Table I**.

In examining associations of racial/ethnic categories with mother's milk use at specific time points (**Table II**), we found that Hispanics had lower adjusted odds of any and exclusive mother's milk use on day 28 and at discharge/transfer compared with non-Hispanic whites. In addition, non-Hispanic blacks had lower odds of any and exclusive mother's milk use at discharge/transfer compared with non-Hispanic whites. Regarding hospital breastfeeding support practices, Hispanic mothers had lower odds of a first lactation visit within 24 hours after birth and lower odds of providing any skin-to-skin care in the first month compared with non-Hispanic whites. Non-Hispanic Asians also had lower odds of providing skin-to-skin care in the first month (**Table II**).

The emergence of racial/ethnic differences in continuing to provide maternal milk is shown in **Figure 2**. Among the 955 mothers who provided milk on day 7, Hispanics stopped providing milk for their infants earliest, followed by non-Hispanic blacks, followed by non-Hispanic whites and non-Hispanic Asians, who tracked similarly. Hispanics (adjusted HR, 2.71; 95% CI, 2.05-3.59) and non-Hispanic blacks (adjusted HR, 1.55; 95% CI, 1.17-2.07) were more likely than non-Hispanic whites to stop providing milk during the hospitalization.

To inform our mediation analysis, in addition to the associations of race/ethnicity (predictor) with hospital-based practices (mediators) shown in **Table II**, we also quantified relationships of hospital support practices (mediators) with any and exclusive mother's milk use at discharge (outcome) (**Figure 1**). We found that first milk expression at ≤6 hours was associated with higher odds of any mother's milk use at discharge (aOR, 1.46; 95% CI, 1.06-2.02), first lactation visit at ≤24 hours was associated with exclusive mother's milk use at discharge (aOR, 1.41; 95% CI, 1.03-1.92), and any skin-to-skin care in the first month was associated with any (aOR, 1.91; 95% CI, 1.46-2.50) and exclusive (aOR, 1.79; 95% CI, 1.36-2.37) mother's milk use at discharge. Thus, only 1 of our hypothesized mediators—skin-to-skin care in the first month—was significantly associated with both race/ethnicity (Hispanic vs non-Hispanic white; predictor) and with mother's milk use at discharge (outcome). Therefore, we examined a mediation model with Hispanic vs non-Hispanic white race/ethnicity and skin-to-skin care in the first month. We found that the association of Hispanic race/ethnicity with mother's milk use at

Table II. Associations of maternal race/ethnicity with mother's milk use at specific time points and with receipt of hospital-based practices*

Characteristics	Non-Hispanic black (N = 272), OR (95% CI)	Hispanic (N = 261), OR (95% CI)	Non-Hispanic Asian (N = 89), OR (95% CI)
Mother's milk at specific time points†		OR (95% CI)	OR (95% CI)
Day 7 any mother's milk	0.83 (0.53-1.32)	0.86 (0.53-1.34)	0.75 (0.39-1.44)
Day 7 exclusive mother's milk	0.91 (0.62-1.32)	**0.61 (0.43-0.88)**	0.70 (0.41-1.21)
Day 28 any mother's milk	0.87 (0.56-1.37)	**0.56 (0.36-0.85)**	1.36 (0.60-3.10)
Day 28 exclusive mother's milk	0.81 (0.55-1.18)	**0.44 (0.30-0.64)**	1.31 (0.68-2.50)
Discharge/transfer any mother's milk‡	**0.62 (0.44-0.85)**	**0.40 (0.29-0.55)**	0.88 (0.52-1.49)
Discharge/transfer exclusive mother's milk‡	**0.65 (0.47-0.90)**	**0.37 (0.26-0.52)**	0.83 (0.50-1.37)
Hospital breastfeeding practices†			
Prenatal consultation with education regarding human milk benefits	1.50 (0.88-2.55)	1.44 (0.82-2.54)	0.72 (0.33-1.54)
First milk expression within 6 h	0.74 (0.50-1.09)	0.74 (0.50-1.11)	0.86 (0.47-1.59)
First lactation visit within 24 h	0.75 (0.50-1.11)	**0.66 (0.43-0.97)**	1.31 (0.67-2.55)
Any skin-to-skin care with the mother on day 7, 14, 21, or 28‡	0.72 (0.51-1.02)	**0.61 (0.43-0.87)**	**0.52 (0.31-0.88)**

The multivariate analysis was restricted to 1259 mother-VLBW infant dyads with maternal race/ethnicities shown. "Other race" was excluded. Bold face type indicates P value < 05.
*Non-Hispanic white as reference (n = 637)
†Adjusted for gestational age (wk) and birth weight (g) and clustering by hospital and plurality. Infants that were NPO at each time point were not included in the respective models (day 7, 5.1%; day 28, 2.8%, discharge/transfer, 2.5%).
‡Additional adjustment for length of stay.

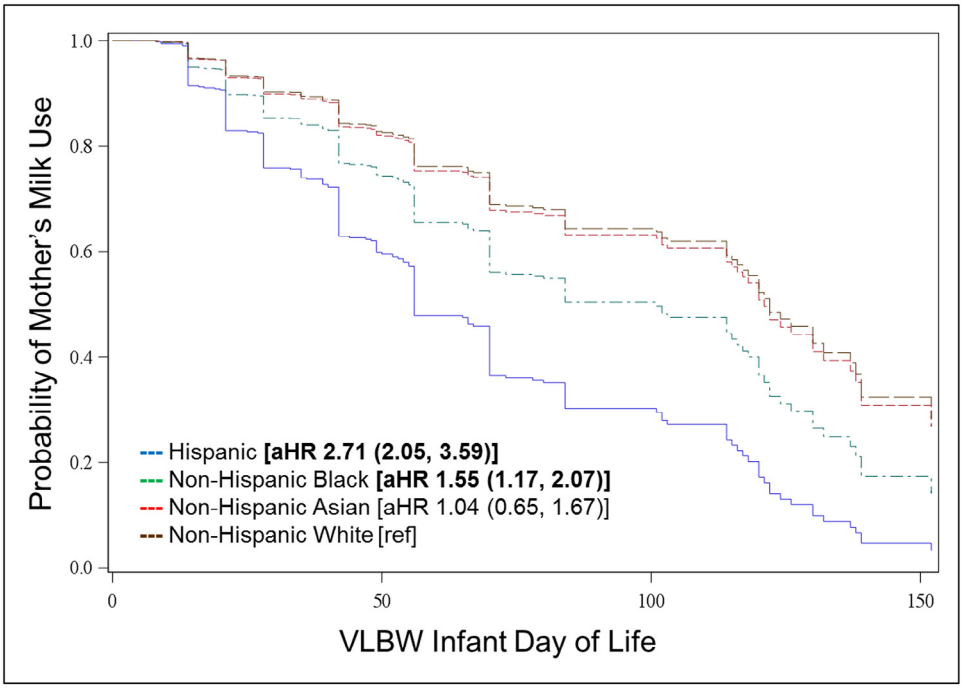

Figure 2. Adjusted Kaplan-Meier plot representing cessation in mother's milk use during the NICU hospitalization. aHR, adjusted Hazard Ratio. The analysis included 955 mothers who provided mother's milk by day 7. The Kaplan-Meier plot and Cox HRs are adjusted for infant birth weight, gestational age, and clustering by hospital and plurality. Bold type indicates $P < .05$.

discharge was weaker in models that included skin-to-skin care compared with models without skin-to-skin care (**Table III**), consistent with a mediating effect by skin-to-skin care. To quantify the extent of this mediating effect, we compared the standardized effect estimates and found that lower skin-to-skin care explained 6% of the total effect of Hispanic race/ethnicity on any mother's milk use at discharge/transfer and 15% of the total effect on exclusive mother's milk use at discharge/transfer (**Table III**).

Discussion

Among a contemporary statewide cohort of 1318 mother-VLBW infant pairs in Massachusetts, we found that Hispanic mothers stopped providing mother's milk earlier in the hospitalization compared with non-Hispanic whites, despite similar rates of initiation. Non-Hispanic black mothers were also more likely to stop providing mother's milk during the hospitalization, but this disparity was less marked. Modifiable hospital-based breastfeeding support practices also differed by race/ethnicity; for example, compared with non-Hispanic white mothers, Hispanic mothers were less likely to have their first lactation visit within 24 hours after birth and less likely to perform skin-to-skin care in the first month.

Mother's milk use over the entire duration of hospitalization is important to maximize health benefits; however, many previous studies of racial/ethnic disparities in mother's milk use among VLBW infants in the US are limited by examination of only a single time point, such as at initiation[7,19] or in the 24 hours before discharge or transfer.[9,10,18,20] Use of data on initiation of mother's milk[7,19] overestimates the provision of mother's milk over the entire hospitalization, because mothers of VLBW infants face many challenges in continuing to express milk for their infants over time. In contrast, data on mother's milk use in the 24 hours before discharge[9,10,18,20]

Table III. Mediation by skin-to-skin care of the association between Hispanic race/ethnicity and mother's milk at discharge

	Any mother's milk, OR (95% CI)		Exclusive mother's milk, OR (95% CI)	
Characteristics	**Model without mediator**	**Model with mediator**	**Model without mediator**	**Model with mediator**
Hispanic	**0.40 (0.29-0.55)**	**0.37 (0.23-0.61)***	**0.37 (0.26-0.52)**	**0.32 (0.19-0.53)***
Skin-to-skin care		**1.78 (1.23-2.59)**		**1.63 (1.12-2.38)**

Model adjusted for gestational age (wk), birth weight (g), length of stay, and clustering by hospital and plurality.
*When comparing standardized effect estimates, skin-to-skin care explains 6.4% of the total effect of Hispanic race/ethnicity on any mother's own milk use at discharge and 15.1% of that on exclusive mother's milk use at discharge.

underestimates use earlier in the course of hospitalization. Our study adds to the literature by painting a richer picture of how disparities in mother's milk use emerge across the entire hospitalization. This more nuanced understanding is a critical first step toward developing and implementing successful interventions to reduce such disparities.

Our finding that more Hispanic mothers of VLBW infants stopped producing milk for their infants by the time of hospital discharge compared with white mothers is consistent with the results of studies of California NICUs.[9,10] Our data show that the cessation in mother's milk use may begin before 1 month of hospitalization. Reasons for this disparity are likely multifactorial, because Hispanic mothers represent a culturally heterogeneous group and cultural differences in beliefs around breastfeeding vary among Hispanic mothers with different countries of origin.[29] Certain sociodemographic characteristics, including younger maternal age,[10,17] lower education attainment,[16] and Women, Infants, and Children Program eligibility,[17] have been associated with lower mother's milk use for VLBW infants, and these associations are seen disproportionately among Hispanic mothers, although we did not collect data on these factors in our study.

Rather than exploring cultural and socioeconomic mechanisms, in this study we focused on more easily modifiable hospital breastfeeding support practices. Our results are consistent with our hypothesis that disparities in Hispanics vs non-Hispanic whites in the receipt of hospital breastfeeding support would explain gaps in mother's milk use. Specifically, Hispanic mothers were less likely than non-Hispanic white mothers to receive a lactation visit in the first 24 hours and to provide skin-to-skin care in the first month. We speculate that language barriers among Spanish-speaking Hispanic mothers may have delayed lactation consultations, if interpreter services were needed and required extra time to arrange; however, a limitation is that we did not track maternal primary language. It is also possible that Hispanics performed skin-to-skin care less often than non-Hispanic whites because Hispanics faced greater barriers in visiting the hospital. Our mediation analysis demonstrated that 6% of the disparity between Hispanics and non-Hispanic whites in any mother's milk use and 15% of the disparity in exclusive mother's milk use were explained by the disparity in skin-to-skin care. Although the magnitude of these effects is modest, our results suggest that intervening to increase skin-to-skin care among Hispanic mother-VLBW infant pairs in the first month of life may reduce the disparity in maternal milk use. Further investigation is needed to assess the impact of skin-to-skin care on milk production among Hispanic mothers, as well as perceived barriers and facilitators to this practice.

The disparity between non-Hispanic black mothers and non-Hispanic white mothers, with less mother's milk use among non-Hispanic black mothers by hospital discharge, was similar to that reported in previous studies.[9,10,15,16] However, our rate of 57% of VLBW infants with non-Hispanic black mothers receiving any mother's milk at discharge/transfer was higher than previously published rates of 13%-51%.[9,10,15-18] It is possible that social and contextual effects, such as lower poverty rates and higher rates of medical insurance among non-Hispanic black mothers in Massachusetts compared with most other states,[30,31] may explain why non-Hispanic black mothers were more likely to produce milk until discharge compared with elsewhere. Providing milk for a preterm infant during a prolonged hospitalization necessitates close contact with the medical team and frequent breast pumping. Mothers living in poverty may have less support to sustain this for the duration of the NICU hospitalization. In Massachusetts, the percentage of women living below the national poverty level in recent years was 9% for non-Hispanic white women, 21% for non-Hispanic black women, and 32% for Hispanic women.[31] Nationally, this breakdown was 12% for non-Hispanic white women, 26% for non-Hispanic black women, and 24% for Hispanic women.[31] It is possible that the modestly lower rate of poverty among non-Hispanic black women and higher rate of poverty among Hispanic women in Massachusetts compared with national averages may help explain the racial/ethnic breakdown in mother's milk use that we found.

We were surprised that the rate of NEC was substantially higher, 13%, among non-Hispanic blacks, compared with 6%-7% among the other racial/ethnic subgroups, considering that the rate of mother's milk use was relatively higher among non-Hispanic blacks in our sample compared with other studies.[9,10,15-18] Because NEC was not our main outcome, we did not conduct multivariate analysis that may account for growth restriction[32] or hospital effects,[33] which may explain these differences. This finding highlights the importance of further investigation of racial/ethnic disparities in NEC.

In contrast with previously published studies, Brownell et al reported higher mother's milk use among non-Hispanic black mothers compared with non-Hispanic white mothers at hospital discharge in an inner-city cohort in Connecticut.[20] Hoban et al also reported that in an inner-city cohort in Chicago, non-Hispanic black mothers were more likely than non-Hispanic white mothers to produce ≥500 mL of milk by day 14.[34] We speculate that strong hospital breastfeeding support practices at these centers contributed to these findings.

Recent studies have reported that implementation of donor milk programs were associated with higher rates of mother's own milk at discharge among VLBW infants,[35-37] and that donor milk has been offered less often in NICUs located in postal codes with higher percentages of non-Hispanic black residents[38] and in safety-net NICUs,[39] both of which likely serve relatively high rates of underrepresented minorities. We believe that the impact of donor milk programs on provision of mother's milk was minimal in our Massachusetts cohort, because all participating hospitals, even those with larger populations of underrepresented minorities, initiated donor milk programs several years before data collection for this study.

Strengths of this study include the large number of subjects across 9 hospitals, with multiple measurements of mother's milk over the course of hospitalization. We carefully measured the receipt of important breastfeeding support practices for VLBW infants and performed a formal mediation analysis to examine mechanisms underlying racial/ethnic disparities in mother's milk use. Limitations of the study include

a lack of in-depth data on family sociodemographic factors, neighborhood-level factors, mothers' primary language, and other social determinants of health that may shed light on mechanisms behind the racial/ethnic disparities that we observed. Data on maternal race/ethnicity were collected from the medical records (vs self-report), such that misclassification of race/ethnicity was possible; however, this method is accurate for reporting of ethnicity and the large categories of racial groups (white, black, and Asian) that we used.[40] Our results in Massachusetts might not be generalizable to other areas of the US. We also did not collect data on breast pump type, frequency of pumping, and mode of delivery. We did not collect clinical data that may have impacted the ability to provide skin-to-skin care, such as pressors or ventilators, nor did we track mothers' presence at the bedside, such that we were not able to measure skin-to-skin care only in situations when mothers were present at the bedside. We did not collect data on transportation difficulties, visitation policies, or other factors that may have impacted mothers' ability to visit their infants and/or pump milk.

In conclusion, increased mother's milk use represents a promising approach to offset the adverse sequelae of prematurity. In a large Massachusetts VLBW cohort, initiation of mother's milk did not vary by racial/ethnic group, but substantial disparities emerged over the course of hospitalization. Further investigation is needed regarding hospital practices that support mothers of underrepresented minority groups in providing milk, not only in the early stages of milk production, but also throughout the infant's hospitalization. ■

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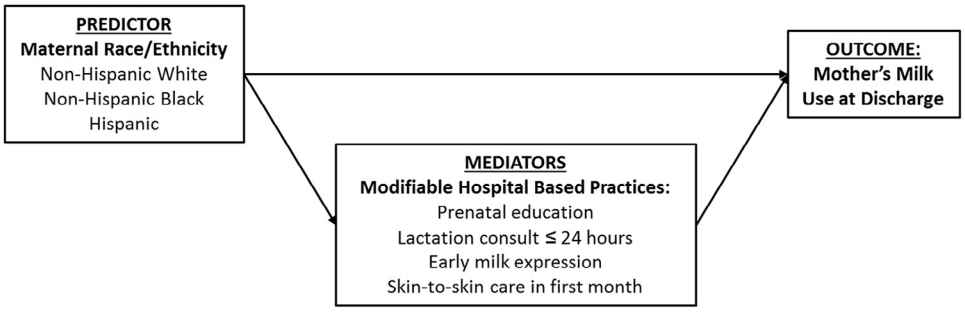

Figure 1. Conceptual mediation model. This figure shows our conceptual model, in which hospital breastfeeding practices partially mediate the relationships of maternal race/ethnity with mother's milk use for VLBW infants. We hypothesized that non-Hispanic black and Hispanic mothers received less breastfeeding support practices, which may explain why these mothers have lower mother's milk use.