Maternal and infant characteristics associated with human milk feeding in very low birth weight infants.

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Abstract:

This study identified maternal and infant characteristics predicting human milk (HM) feeding in very low birth weight (VLBW) infants whose mothers (n = 184) participated in a study of lactation counseling and initiated milk expression. Data were collected prospectively, by maternal interview and medical record review. During hospitalization, 159 (86%) infants received at least 50% HM proportion of feedings in the first 2 weeks of life, and 114 (62%) received some HM until the day of hospital discharge. Analysis showed plan to breastfeed was the strongest predictor of initiation and duration of HM feeding. Greater than 12 years of education, respiratory distress syndrome, Apgar score >6, and female gender were significant predictors, and no perinatal hypertensive disorder, white race, and mechanical ventilation were marginal predictors of HM feeding. Women with a high-risk pregnancy should be provided education about the benefits of breastfeeding for infants who are likely to be born prematurely. J Hum Lact. 25(4):412-419.

Keywords: human milk | lactation | low birth weight infants | lactation counseling | pediatrics | nutrition

Article:

Human milk (HM) feeding during hospitalization mitigates the short- and long-term morbidity experienced by premature infants.[1-13] Receipt of at least 50% HM proportion of enteral feedings early in life is associated with lower risk of necrotizing enterocolitis,[9,10] shorter time to full enteral feeding, and shorter duration of central line and parenteral nutrition.[11] Receipt of at least 50 mL/kg/d of HM for the first 4 weeks of life[12] and for the total hospitalization[13] is associated with a lower incidence of late-onset sepsis. In extremely low birth weight infants (birth weight <1000 g), incremental increases in HM intake are associated with higher scores on developmental indices as well as decreased risk of rehospitalization.[14]

The American Academy of Pediatrics (AAP)15 and the World Health Organization (WHO)16 recommend the use of HM for feeding premature infants. Despite these endorsements, women who deliver prematurely initiate breastfeeding less frequently than those who deliver at term, and among those who initiate breastfeeding, the duration is shorter.17 Thus, infants who would benefit most from HM tend to receive the least HM.

Previously, we reported a 94% lactation initiation rate in mothers of very low birth weight (VLBW) infants enrolled in a study comparing anxiety before and after lactation counseling.18 Among those whose intent was to formula feed, 84% initiated lactation. Lactation initiation, however, does not ensure consistent HM feeding or continuation of milk expression. To investigate this relationship, we further analyzed our data to determine if select maternal and infant characteristics were associated with duration of HM feeding in VLBW infants whose mothers initiated milk expression after delivery.

Patients and Methods

Study Site and Participants

The study was conducted in Winston-Salem, North Carolina, at Forsyth Medical Center, a referral center for women at high risk for obstetrical complications. Women who delivered singleton or multiple infants between May 2001 and August 2003 with birth weights between 700 and 1500 g were approached within 3 days of delivery and asked to participate in a study comparing anxiety levels before and after lactation counseling. 19 Exclusion criteria were illicit drug use during pregnancy, human immunodeficiency virus (HIV) infection, age younger than 18 years, and non-English speaking. The institutional reviews boards of Wake Forest University School of Medicine, Forsyth Medical Center, and the University of North Carolina at Greensboro approved the study, and all participants signed written informed consent.

Support for Lactation

A certified lactation consultant counseled study participants using a guide developed for this study, which included benefits of HM for premature infants, procedure for collection, storage and transport of milk to the neonatal intensive care unit (NICU), maternal diet, medications, and effects of smoking and birth control methods on lactation.

Mothers who decided to initiate lactation were given assistance with milk expression using a Medela Classic breast pump and a Medela Universal Breast Pump Kit. Mothers were assisted with procurement of an electric breast pump with intermittent suction either through rental or purchase or from the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) for use after hospital discharge. For mothers who were enrolled in WIC, the initial postpartum contact was made by the hospital lactation consultant to increase the possibility of getting a timely appointment for recertification and borrowing an electric breast pump. The WIC programs supplied Medela Classic, Medela Lactina, or Ameda Egnell SMB electric pumps

(Hollister, Inc, Libertyville, Illinois). Mothers who were not eligible for WIC and who stated that they could not afford an electric pump were loaned a Medela Classic electric pump free of charge. In addition, all mothers were instructed on the use of the manual breast pump that was part of the breast pump kit supplied by the hospital. Mothers were followed by the lactation consultant and provided with ongoing support as needed throughout their infant's stay in the hospital.

Enteral feedings of mother's own milk or of preterm infant formula when breast milk was not available were administered when the infant was determined to be stable by the attending neonatologist and advanced according to the established feeding guidelines for this NICU. Donor HM was not used. Milk intake was recorded for the entire hospitalization.

Data and Definitions

Mothers' educational attainment was obtained from a questionnaire completed by the mother. Data from infants' medical records were collected by a research assistant. The mother's infant feeding plan was recorded when the mother was admitted to the labor and delivery unit prior to delivery. For this study, mothers were classified as intending to breastfeed if they stated that they planned to breastfeed or combine breastfeeding with formula feeding. Mothers were classified as formula feeding if they stated that they planned to formula feed or were unsure at the time of admission to the hospital. Perinatal hypertensive disorder was defined as having a history of one of the following: chronic hypertension, preeclampsia, eclampsia, pregnancy-induced hypertension, or HELLP (hemolytic anemia, elevated liver enzymes, low platelet count) syndrome during pregnancy. Magnesium sulfate therapy included those who received the medication before or after delivery. Infants were considered to be small-for-gestational-age if their birth weight was less than the 10th percentile for gestational age.[20] Respiratory distress syndrome was defined as supplemental oxygen requirement at 24 hours of age.

Data Outcome Measures

The primary outcomes of interest for this analysis were (1) receipt of ≥50% HM proportion of enteral feedings during the first 2 weeks of life and (2) receipt of HM on the last day of hospitalization. Receipt of ≥50% HM proportion of enteral feedings during the first 2 weeks of life was chosen because we previously found that this dose was associated with a 6-fold decrease in the odds of developing necrotizing enterocolitis (NEC).[9]

Data Analysis

Only mothers who decided to initiate milk expression and their infants were included in this study. In cases of multiple gestation (n = 25), data from 1 randomly selected infant were included in the analysis. With HM intake as the outcome of interest, bivariate associations with maternal demographic and perinatal characteristics as well as infant characteristics were explored using chi-square analyses. From the bivariate analyses, variables associated with the outcome of

interest at $P < .2$ were selected for inclusion in a series of multivariate logistic regression analyses. A time oriented approach was used for selection of the order of entry of covariates into logistic models.21 With this approach, maternal and infant characteristics were included in the chronological order in which they were thought to occur. Maternal demographic factors, perinatal factors, and infant factors were entered in successive steps; variables associated with the outcome at $P < .1$ were retained in the model. Once a variable was selected for inclusion in the logistic model, it was retained in subsequent models. The results of the logistic models were expressed as odds ratios at the 95% confidence interval. Variables were considered statistically significant if the confidence interval (CI) did not include 1.0 or $P < .05$. Categorical data were described as proportions. Eight percent of the maternal educational level data were missing, and multiple imputations were used to replace missing values. Because of the high degree of colinearity between gestational age and birth weight, small-for-gestational-age (birth weight less than the 10th percentile for gestational age) was entered along with gestational age into multivariate analyses, and birth weight was not entered. SPSS-PC 15.0 software (SPSS, Chicago, Illinois) was used for data analyses.

Results

Of the 206 mothers approached about the study, 196 (95%) were enrolled. Of the 196 participants enrolled, 184 (94%) initiated milk expression after delivery and were included in this study. During hospitalization, 159 (86%) infants received at least 50% HM proportion of enteral feedings for the first 2 weeks of life. On the last day of hospitalization, 114 (62%) infants were still receiving some HM.

Bivariate associations between maternal demographic and perinatal characteristics as well as infant characteristics associated with the HM outcome variables are shown in Table 1. The characteristics associated with a greater likelihood of receiving ≥50% HM proportion of enteral feedings in the first 2 weeks of life included ethnicity, marital status, income, education, plan to breastfeed, no perinatal hypertensive disorder, infant gender, respiratory distress syndrome, and mechanical ventilation on day of life 3. The factors associated with the receipt of HM until the day of discharge were ethnicity, marital status, income, education, plan to breastfeed, maternal age, history of smoking during pregnancy, prenatal steroid therapy, cesarean delivery, birth weight, gestational age, infant gender, and 5-minute Apgar score.

HM Proportion of Enteral Feedings

Characteristics that predicted ≥50% HM proportion of enteral feedings during the first 2 weeks of life are shown in Table 2. Multivariate logistic regression analysis determined that white race, no perinatal hypertensive disorder, and mechanical ventilation on day of life 3 were marginally significant predictors, and greater than 12 years of education, intention to breastfeed, female infant, and respiratory distress syndrome were significant predictors for HM proportion of enteral feedings during the first 2 weeks of life.

The results of multivariate logistic regression analysis showing predictors of HM feeding until the day of hospital discharge are in Table 3. Ethnicity was a marginally significant predictor and plan to breastfeed, greater than 12 years of education, 5-minute Apgar score >6, and infant female gender were significant predictors of HM feeding until the day of hospital discharge. Compared to male infants, females had significantly higher gestational ages (females, median 29 weeks [interquartile range 27-31] vs males, 28 weeks [26-30], *P* = .001) and shorter lengths of hospitalization (females, 38 days [23-59] vs males, 48 days [32-79], *P* = .01); however, length of hospitalization was entered into the logistic model and was not a significant predictor of HM feeding until hospital discharge (odds ratio [OR] = 0.95; CI: 0.72-1.27; *P* = .74).

Discussion

In this study, a large majority of VLBW infants received some HM during their neonatal hospitalization, perhaps because all mothers received lactation counseling. By eliminating the initial barrier to breastfeeding a premature infant—failure to initiate milk expression—we were afforded an opportunity to study factors associated with more successful lactation in a cohort of mothers providing HM for their VLBW infants. Our major conclusion is that in such cohorts, mothers' initial plan to breastfeed is the most important predictor of more successful lactation.

Tables 1-3 are omitted from this formatted document.

Feeding intention is strongly associated with both initiation and duration of milk expression. This finding is consistent with that of Donath et al.[22] Feeding intention is potentially modifiable, and interventions to modify maternal feeding intention may be effective at increasing HM feeding in VLBW infants. To increase breastfeeding among this vulnerable group, pregnant women with a high risk of preterm delivery should be provided education about the benefits of breastfeeding infants who are likely to be born prematurely.

In this study and that by Miracle et al,[23] most mothers of VLBW infants who intended to formula feed but subsequently initiated milk expression reported that they did so out of concern for the health of their premature infant.[18,22] During counseling sessions for mothers who planned to formula feed, emphasis was placed on providing HM for the health benefits it would provide their infant. This approach resulted in the majority of infants (81%) receiving at least half of their early feedings as HM, which we have previously reported to be associated with a lower risk of NEC[9] and feeding intolerance.[11] The proportion of infants receiving HM at the time of discharge was lower (62%), which suggests that as the infant's condition improved, the perceived importance of providing HM may have diminished.

We previously reported an association between attributes indicative of social disadvantage and plan to formula feed.[18] An association between low socioeconomic status (SES) and a lower likelihood of breastfeeding has been reported in both full-term and preterm infants.[24-29] This

association was not found in the current study, perhaps reflecting a benefit of the lactation assistance from the hospital-based lactation consultants and county WIC programs.

In agreement with others,17,25,26,28,29 we found associations between ethnicity, education, and duration of HM feeding. We speculate that African American and lower educated mothers in the current study encountered barriers to frequent milk expression, the usual cause of short duration of HM feeding in VLBW infants, which lactation counseling did not address.

We did not observe an association between cigarette smoking during pregnancy and HM feeding duration. This is in contrast to the findings of several population based cohort studies.25,30-35 In addition, Hopkinson36 reported lower HM production in mothers who smoked cigarettes after delivery of a premature infant. During counseling sessions, mothers who smoked were told that smoking could decrease milk supply and were encouraged to smoke as little as possible, but they were not discouraged from milk expression. This may have had a positive effect on duration of HM feeding during hospitalization. However, we did not measure frequency or dose of cigarette smoking after delivery.

The association we observed between perinatal hypertensive disorders and HM proportion of enteral feedings at 2 weeks of life is consistent with the findings of Leeners et al,37 who reported that women with hypertensive disorders during pregnancy had a lower breastfeeding initiation rate (39%) compared to controls (49%). Leeners et al observed that women who developed HELLP syndrome and delivered infants before the 32nd gestational week with birth weight <1500 g were less likely to breastfeed. The authors speculated that the association between hypertensive disorders and a lower rate of breastfeeding was due at least in part to a higher rate of preterm delivery among mothers with hypertensive disorders. In the current study, among infants born to mothers who chose to initiate milk expression, those born to mothers with hypertensive disorders were less likely to receive at least 50% HM proportion of enteral feedings during the first 2 weeks of life. Despite lower HM feeding early in life, infants born to mothers with hypertensive disorders were as likely to receive HM until discharge as those born to mothers without a hypertensive disorder.

Our finding that female gender was predictive of HM proportion of feedings and duration of HM feeding is in contrast to other studies of VLBW infants in which no association was found between infant gender and intent to breastfeed28 or duration of HM intake.29 In our study, female infants had shorter lengths of hospitalization, and this may have increased the possibility that the mother could maintain lactation until infant hospital discharge.

Like Furman et al28 and Meier et al,38 we observed higher HM proportion of enteral feedings at 2 weeks of life in less mature infants. This may be due to the emphasis that was placed on the health benefits of HM during lactation counseling sessions. Paradoxically, we found that an Apgar score >6 was predictive of receiving HM until hospital discharge. This is in contrast to the

findings of Espy et al,27 who found that infants with "high biological risk" (ie, Apgar score ≤6) were more likely to receive HM during hospitalization than infants with higher Apgar scores.

Universal lactation counseling and assistance from a certified consultant were associated with the high rate of HM feeding in this sample. Similarly, Dweck et al39 found that a dedicated lactation consultant in the NICU increased the percentage of neonates receiving any HM, and Merewood et al40 reported a higher incidence of HM feeding after instituting lactation peer counselors in the NICU. Furthermore, in a large population-based study, health care provider encouragement compared to no provider intervention was associated with higher initiation and duration of breastfeeding regardless of maternal SES or initial feeding intention.41

Conclusions

In a sample of women who received lactation counseling after delivery of a VLBW infant and who decided to initiate milk expression, those who had planned to breastfeed before delivery provided more HM for their infants than those who had planned to formula feed. Among a number of demographic and medical variables, feeding intention was the strongest predictor of HM feeding during hospitalization. Mother's feeding plan is a factor that is identifiable during pregnancy and potentially modifiable. These study findings suggest that informational interventions are needed that increase the likelihood that pregnant women at risk of preterm delivery will plan, prenatally, to breastfeed. White race, 12 or more years of education, no perinatal hypertensive disorder, 5-minute Apgar score >6, female gender, and respiratory distress were associated with HM feeding during hospitalization. Research is needed to elucidate the mechanisms by which these factors promote successful lactation in mothers of VLBW infants.

Acknowledgments

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