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Special Policies Are Needed to Promote Breastfeeding Among Low Birth Weight Infants[1]

Linda S. Adair and Barry M. Popkin

Department of Nutrition
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina 27516

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WELLSTART INTERNATIONAL

Expanded Promotion of Breastfeeding Program

3333 K Street, NW, Suite 101

Washington, DC 20007

USA

Tel (202)298-7979 ■ Fax (202)298-7988

B

TABLE OF CONTENTS

ABSTRACT v

EXECUTIVE SUMMARY vii

INTRODUCTION 1

DESIGN AND METHODS 2
- **Sample** 2
- **Data** 2
- **Analysis Methods** 3

RESULTS 5
- **Descriptive Results** 5
- **Concordance of Feeding Intentions and Practices** 7
- **Initiation of Breastfeeding** 8
- **Infant Feeding Patterns in the First Six Months** 11
- **Mother's Perceptions of the Size of the Infant** 12
- **Hospital Policies** 12

DISCUSSION 13

LITERATURE CITED 15

ENDNOTES 17

TABLES

Table 1 Characteristics of women delivering in different settings 5
Table 2 Comparison of feeding patterns among LBW and normal weight infants in different delivery settings 6
Table 3 Concordance of breast-feeding intentions and practices among CLHNS women: Predicted probabilities of membership in groups are affected by place of delivery and LBW 8
Table 4 Determinants of the likelihood of never initiating breast-feeding: Results from multinomial logistic regression 9
Table 5 Predicted probability of never initiating breast-feeding among CLHNS women 10
Table 6 Predicted probability of breast-feeding patterns among CLHNS women 11

ABSTRACT

The focus of this study was the relationship of low birth weight (LBW)[2] to concordance of mother's feeding intentions during pregnancy with actual feeding practices; initiation of breastfeeding; and patterns of feeding in the first six months. Data came from the Cebu Longitudinal Health and Nutrition Survey, which followed 3,080 mother-infant pairs from urban and rural communities of Metro Cebu, Philippines. Logistic regression was used to estimate the effects of LBW on feeding practices, controlling for place of delivery (home, public or private health facility); receipt of free infant formula samples; infant sex; urban residence; primiparity; education level and age of the mother; and family income and assets. Birth of a LBW infant significantly decreased the likelihood that women would initiate breastfeeding. Of particular note is the finding of this decreased likelihood among women who during pregnancy had stated an intention to breastfeed. In a comparison of six-month feeding patterns, it was also found that LBW increased the likelihood of not breastfeeding or weaning before six months. Among breastfeeding mothers, LBW increased the likelihood of full breastfeeding for six months compared to patterns characterized by earlier supplementation with other foods and liquids. The negative relationship of LBW to breastfeeding was strongest when births took place in private or public health facilities.

EXECUTIVE SUMMARY

Low birth weight (LBW) continues to be a major concern in developing countries, where, on average, 19% of infants are born weighing less than 2,500g. LBW infants suffer higher rates of morbidity and mortality, and many continue to be growth-retarded throughout childhood. Given the known nutritional and health-promoting effects of human milk, promotion of breastfeeding is of particular importance for these vulnerable infants.

Very little is known about how LBW infants in developing countries are fed. The few available research reports suggest that LBW infants are less likely to be breastfed at all or are breastfed for shorter periods of time. This situation may occur if LBW is associated with feeding problems related to poorly developed sucking reflexes or other health problems of the infant at birth, or because mothers' perceptions of the size and capabilities of their infants affect their feeding decisions. LBW infants born in hospitals may be subject to policies which single them out for special care. In these instances, mothers and infants may be separated for prolonged periods of time. This delayed contact may impair or prevent the establishment of breastfeeding. Thus, different patterns of feeding LBW infants may be established based on the place of delivery.

To understand how LBW influences infant feeding, its effects must be isolated from other factors that affect feeding. Therefore, this assessment of LBW included controls for maternal age, parity, education, socioeconomic status, place of delivery, receipt of free infant formula sample, place of residence, and the infant's sex and gestational age. Nearly 3,000 infants from Cebu, the second largest city in the Philippines were studied. The infants were part of a longitudinal community-based health and nutrition survey conducted from 1983-1986 by researchers from the University of North Carolina at Chapel Hill, and the University of San Carlos in Cebu. Data were collected by interviewing mothers during pregnancy, immediately after birth, and every two months thereafter for a period of two years. Information on health facilities was gathered during surveys of hospital and clinic personnel. Infants were weighed at birth and within six days of birth. Gestational age was determined from the date of the mother's last menstrual period for the majority of infants, but in the case of LBW infants or those whose mothers had pregnancy complications, the Ballard method was used to assess gestational age clinically within 120 hours of birth. LBW occurred in 11.5% of the infants in the study. About 28% of LBW infants were born preterm (fewer than 37 weeks gestation).

Three different feeding outcomes were examined:

1. ***Concordance of breastfeeding intentions and practices***

One way to understand how biological and other factors in the perinatal period affect feeding behaviors is to explore the role of breastfeeding intentions and their concordance with actual feeding practices. During the baseline survey, mothers were asked how they planned to feed their infant. Their intentions were compared to actual feeding practices and four groups were defined:

a. Intended to breastfeed and did breastfeed, n = 2498 (84.5%)
b. Intended to breastfeed but did not breastfeed, n = 85 (2.9%)
c. Did not intend to breastfeed but did breastfeed, n = 260 (8.8%)
d. Did not intend to breastfeed and did not breastfeed, n = 112 (3.8%)

Of particular interest is the second group, since condition of the infant at birth or other barriers to breastfeeding encountered at delivery may have caused the mother to change her mind about the feeding method.

2. ***Initiation of breastfeeding***

A categorical variable indicates whether or not the mother ever initiated breastfeeding, either in the first several days after birth or subsequently. Earlier studies of the Cebu sample showed that women may discard colostrum

and not initiate breastfeeding for several days. Only 6.75% of mothers in this sample never initiated breastfeeding.

3. *Patterns of feeding in the first six months of life*

Infants were classified into four groups based on overall feeding patterns during the first six months.

a. Fully breastfed for at least six months, n = 388 (14.1%)
b. Fully breastfed for more than two but fewer than six months, then mixed fed, n = 1321 (47.9%)
c. Mixed fed throughout, n = 307 (11.1%)
d. Not breastfed or weaned early, n = 741 (26.9%)

Infants were considered fully breastfed if, based on a 24-hour food recall, they received fewer than 20 kilocalories from supplemental foods. In most cases, such infants were receiving "tastes" of weaning foods or sweetened liquids such as herbal teas. Infants were considered to have been weaned early if they initiated breastfeeding, but were totally weaned from the breast before six months of age. Infants were considered not breastfed if they never initiated breastfeeding.

An analysis method was used that allows estimation of how each independent variable (e.g., LBW, infant's sex, all of the other confounders listed above) affects the likelihood of a particular outcome (e.g., never being breastfed or being fully breastfed for six months). Results are expressed as relative risk ratios (RRR) with corresponding 95% confidence intervals (CI). To assist in the interpretation of results, the effects of specified conditions were simulated, principally LBW versus normal birth weight and place of delivery.

Feeding practices differed considerably by place of delivery, because some of the same factors that influenced women's choice of feeding method also influenced her choice of where to deliver. Thus, women with more income and education were more likely to deliver in private hospitals, less likely to have LBW infants, and less likely to breastfeed. Breastfeeding prevalence was highest among women who delivered at home. Therefore place of delivery was taken into account in all of the analyses. About 18% of the infants in the study were born in public hospitals, 21% were born in private hospitals, and the remaining 61% were born at home.

Within a facility category (public, private, home), there was a consistent trend of lower percentages of LBW compared to normal weight infants initiating breastfeeding, or of continuing to breastfeed at two, four, and six months. This trend was most marked among infants born in public facilities. However, within each place of delivery, there was also a trend toward increased prevalence of *full breastfeeding* in LBW infants at all ages. That is, when LBW infants were breastfed, they were more likely to be fully breastfed. These results were confirmed by the multivariate analysis.

Breastfeeding intentions versus practices

LBW more than tripled the likelihood of not breastfeeding among women who intended to do so (RRR = 3.13). This effect of LBW is slightly stronger for LBW-preterm (RRR = 3.37) than for LBW-term infants (RRR = 2.86). Other factors that were significantly related to mothers not following through with their intention to breastfeed included delivery in a private hospital, being given a free sample of infant formula after delivery, and being a first-time mother. We also found a significant negative effect on breastfeeding of the mother's perception that her infant was small, suggesting independent effects of infant biology and mothers' perceptions.

Initiation of breastfeeding

LBW infants were 40% less likely ever to be breastfed compared to normal weight infants. This effect was stronger for term-LBW than for preterm-LBW infants. Delivery in a private health facility, older maternal age, higher levels of maternal education, higher household income and assets, and delayed first contact between mother and infant after birth also significantly decreased the likelihood of ever breastfeeding.

Infant feeding patterns in the first six months

In the analysis of factors related to feeding groups, the chances of following one feeding pattern were compared with the chances of following each other feeding pattern. LBW: (1) more than doubled the likelihood of not breastfeeding or of early weaning compared to mixed feeding for six months (RRR = 2.22); (2) increased by nearly 50% the likelihood of not breastfeeding or early weaning compared to full breastfeeding for at least two but less than six months (RRR = 1.49); and, (3) doubled the likelihood of full breastfeeding for six months compared to mixed feeding for six months (RRR = 2.02). In all delivery settings, the probability of never breastfeeding or weaning early was higher in LBW compared to normal weight infants. The multivariate analyses also confirmed that LBW infants who are breastfed are more likely to be fully breastfed.

In summary, LBW strongly and consistently affected infant feeding practices. Giving birth to a LBW infant was a deterrent to breastfeeding. Place of delivery was particularly important: LBW had a larger impact on feeding decisions of mothers who deliver away from home in private or public health facilities. However, in cases where mothers still elected to breastfeed, LBW status increased the likelihood that mothers would fully breastfeed their infant. LBW infants tend to undergo a period of catch-up growth in the first two months of life, particularly if they are fully breastfed and thus well-nourished and more protected from infectious diseases. In this population, fully breastfed infants weighed more in the first four months of life as compared to infants with other feeding patterns. The good growth performance of fully breastfed infants may serve to reinforce the mother's breastfeeding behavior.

The research findings should have important health implications for infants born in less developed countries. A lower incidence of breastfeeding among LBW infants is an unfortunate consequence because of the greater health risks they face. The health risks are related in part to biological characteristics of the LBW infant, but also to poor environmental conditions that contribute to LBW and poor postnatal outcomes. Given the proven nutritional and immunological superiority of breastmilk, breastfeeding is of special importance to the LBW infant, or as Indian physician Narayanan has stated, breastmilk is a "passport to life."

Program and policy implications

Based on this research, program and policy implications can be stated as follows:

- Efforts must be made to single out and eliminate policies that hinder the establishment of breastfeeding in clinical settings. Such policies would benefit all infants, regardless of birth weight status.
- Special policies are needed to promote breastfeeding of LBW infants.
- Enhanced education and encouragement of mothers of LBW infants is needed to address their concerns about the infant's size and capabilities, as well as their special needs.

INTRODUCTION

Low birth weight (LBW) continues to be a problem of particular concern for developing countries, where the estimated overall prevalence of LBW is 19% (World Health Organization 1992) and in some countries, up to 50% of infants are born weighing less than 2,500 g (World Health Organization 1984). As a group, LBW infants are less able to cope with the stresses of the postnatal environment. How they are fed represents a significant determinant of their survival.

An extensive and often controversial literature exists concerning the feeding of LBW infants in developed countries, but it deals almost exclusively with preterm infants or those weighing less than 1,500 g (American Academy of Pediatrics 1985, Churella et al. 1985, Steichen et al. 1987, Verronen 1985). In developing countries, very little is known about how LBW infants are fed. Furthermore, the relevant issues are very different (Narayanan 1986). First, in lower income countries, early preterm infants have little chance of survival in the absence of special care facilities. Second, in contrast to developed countries where most LBW is accounted for by prematurity, the majority of LBW infants in developing countries are mature, but small-for-gestational-age (Villar and Belizan 1982). Many, particularly those who weigh more than 2,000 g, require no special care (Narayanan, 1986).

The question of how LBW infants in developing countries are fed is an important one. Some research has suggested that LBW infants are less likely to be breastfed at all or are breastfed for shorter periods of time (Barros et al. 1986, Butz and DaVanzo 1981, World Health Organization 1981). Given its proven beneficial effects in reducing morbidity and mortality, breastfeeding is of special importance to infants already at risk because of LBW (Popkin et al. 1986).

The small amount of available data on feeding of LBW infants in developing countries is based primarily on retrospective data and is mostly descriptive, usually presenting only the prevalence of breastfeeding among infants of different weights at birth. Furthermore, there is no consistency in results from different populations. For example, the WHO Collaborative Study on Breastfeeding (World Health Organization 1981) found no relationship between birth weight and the prevalence of breastfeeding in Ethiopia, Nigeria, Zaire, Guatemala, and India, nor was a relationship found in Machakos, Kenya (Renquist et al. 1985). In contrast, among urban poor and rural subjects in Chile, a lower percentage of LBW infants were breastfed at three months of age compared to infants whose weights exceeded 2,500 g at birth (World Health Organization 1981). In an urban Brazil population, infants weighing less than 2,000 g at birth were less likely to have been breastfed in the first week of life and throughout the entire first year (Barros et al. 1986). None of these studies differentiated immature LBW infants from those with intrauterine growth retardation.

To date, there have been no systematic studies of how birth weight interacts with other factors known to influence breastfeeding. Physical conditions which influence the infant's ability to suck are likely to prohibit or complicate the initiation of breastfeeding or affect its duration. Before 33 weeks gestation, the infant's sucking reflexes are ineffective, and between 34 and 36 weeks may be inefficient or poorly coordinated. Even in mature infants, there is a relationship between sucking behavior and birth weight (Pollitt et al. 1978). Mothers may also differ in their responses to an infant who does not suck well. Their perceptions of the size and capabilities of their infants and their reactions to the stimuli they receive from their infants may influence their decisions about breastfeeding. Thus, factors such as LBW may alter feeding choices, even among mothers who were strongly inclined to breastfeed their infants.

LBW infants born in hospitals may be subject to policies which single them out for special care (Popkin et al. 1984). When this occurs, mothers and infants may be separated for prolonged periods of time. This delayed contact may impair or prevent the establishment of breastfeeding (de Chateau and Wiberg 1977, Salariya et al. 1978). Thus, different patterns of feeding LBW infants may be established based on the place of delivery.

Finally, numerous studies have shown that birth weight and breastfeeding are both associated with socioeconomic status and education of the mother (Adair et al. 1993, Forman 1984, Popkin et al. 1983). The confounding

effects of variables such as these must be sorted out to determine the relationship between birth weight and patterns of breastfeeding.

This study examined feeding of LBW infants in the Philippines. We used data from a community-based survey that included infants born at home as well as in public or private health facilities. Our major objectives included the following:

1) To compare feeding patterns among LBW versus normal weight and term-LBW versus preterm-LBW infants, with special attention to the concordance of feeding intentions and feeding practice, initiation of breastfeeding, and patterns of feeding in the first six months of life;

2) To determine the extent to which place of delivery (home or hospital) influenced the feeding of LBW and preterm infants; and

3) To assess, in a multivariate context, the relative importance of LBW compared with other biological, sociodemographic, and economic factors as a determinant of feeding patterns.

DESIGN AND METHODS

Sample

Data were collected during the Cebu Longitudinal Health and Nutrition Survey. This was a prospective, community-based survey which followed women from mid-pregnancy to 24 months postpartum. The initial sample included all pregnant women in 33 randomly selected barangays (smallest administrative units) of Metro Cebu. Metro Cebu is one of the most rapidly growing and developing areas of the Philippines, with a current population of about 1.9 million. The Cebu sample is drawn from an ecologically and socioeconomically diverse population. About one-quarter of participants lived in rural communities, some of which were in isolated mountainous areas. The remainder were residents of urban or peri-urban communities with varying levels of modernization, but fairly high exposure to modern media. All data were collected using procedures approved by the University of North Carolina School of Public Health Institutional Review Board for research involving human subjects.

Our target analysis sample consisted of 3,080 single live births occurring in a one-year time period (1983-84). Acceptable birth weight data were available for 3,022 infants, and gestational age was known in 2,891 of these infants. Among infants with birth weight and gestational age data, 334 (11.55%) were LBW, and of LBW infants, 93 (27.8%) were preterm (completed gestational age of fewer than 37 weeks, range was 25-36 weeks). Infants were assessed at birth, and at bi-monthly intervals until they reached 24 months of age.

Data

During the pregnancy baseline survey, extensive background socioeconomic and demographic data were collected. Within three to six days of birth, a birth information survey was conducted to identify the place of delivery, birth attendant, type of delivery, complications of labor and delivery, and timing of first mother-infant contact. Infant weight was initially measured by birth attendants who were provided with project scales and instructed in their use. Project interviewers subsequently weighed infants during the birth information survey. All scales were regularly checked and calibrated. The Ballard method was used to assess gestational age clinically of all LBW infants, all infants whose mothers had complications such as bleeding during pregnancy, and all infants whose mothers were uncertain about the date of their last menstrual period (Ballard et al. 1979). When both Ballard and last menstrual period estimates of gestational age are available, the Ballard estimates were used as the most accurate representation. Previous analyses have shown a high level of agreement between these two measures in the Cebu sample.

Infant-feeding data were collected during the birth information survey and subsequent bi-monthly interviews with mothers. At each interview, mothers were asked whether they breastfed, and to recall all foods and liquids fed to the infant in the past 24 hours. For the same period, detailed information was collected on the types, quantities, and method of preparation of all foods and liquids given to infants. Mothers were also asked to recall general feeding patterns (exclusive breastfeeding, feeding of non-nutritive liquids, nutritive liquids, solids, and semi-solid foods) seven days prior to each interview.

Using a health facilities survey administered to hospital and clinic personnel, we gathered information on facility practices related to infant feeding. Personnel were asked questions about receipt and distribution of infant formula, rooming-in policies, breastfeeding education, policies regarding feeding of water and formula, etc.

Analysis Methods

While Cebu data were available for the first 24 months of life, we focused our work on the first six months, since this is the time period during which LBW is likely to influence infant-feeding patterns, and full breastfeeding is rare in this population after six months. Furthermore, in preliminary analyses, we found no consistent effects of LBW on feeding patterns after six months.

We defined three feeding outcomes for analysis. The analysis samples for the three outcomes differ in size because the feeding pattern analysis requires that infants have complete data for the first six months, and because of missing data critical to the definition of the outcome.

1. *Concordance of breastfeeding intentions and practices* (n=2,955)

One major way to understand how biological and other factors in the perinatal period affect feeding behaviors is to explore the role of breastfeeding intentions (cf Stewart et al. 1991) and their concordance with actual feeding practices. During the baseline survey, mothers were asked how they planned to feed their infant. Their intentions were then compared to actual feeding practices, and defined four groups:

a. Intended to breastfeed and did breastfed, n=2,498 (84.5%)
b. Intended to breastfeed but did not breastfeed, n=85 (2.9%)
c. Did not intend to breastfeed, but did breastfeed, n=260 (8.8%)
d. Did not intend to breastfeed, and did not breastfeed, n=112 (3.8%)

Of particular interest is the second group, since condition of the infant at birth or other barriers to breastfeeding encountered at delivery may cause the mother to change her mind about feeding.

2. *Initiation of breastfeeding* (n=2,991)

A dichotomous variable indicates whether or not the mother ever initiated breastfeeding, either in the first several days after birth or subsequently. Studies of prelacteal feeding patterns in the Cebu sample (Fernandez and Popkin 1988) showed that women may discard colostrum and not initiate breastfeeding for several days. Only 6.75% of mothers in this sample never initiated breastfeeding.

3. *Patterns of feeding in the first six months of life* (n=2,757)

Infants were classified in groups based on overall feeding patterns during the first six months. Results were first analyzed based on six groups in which infants who never breastfed were differentiated from those who were weaned early, and those who fully breastfed for only two months were in a different group than those fully breastfed for four months. We found no differences in the determinants of never breastfeeding versus early weaning, nor did we find differences in predictors of two versus four months of full breastfeeding. Thus while there may be important policy reasons to identify these groups separately for studies of infant growth and morbidity, none of the variables of interest in the present analysis significantly differentiated the groups. These results provided the rationale for a simplification to only four groups:

a. Fully breastfed for at least six months, n=388 (14.1%)

b. Fully breastfed for more than two but fewer than six months, then mixed fed, n=1,321 (47.9%)
c. Mixed fed throughout, n=307 (11.1%)
d. Not breastfed or weaned early, n=741 (26.9%)

Infants were considered fully breastfed if, based on the 24-hour food recall, they received fewer than 83 kj (20 kcal) from supplemental foods. In most cases, such infants were receiving "tastes" of weaning foods or sweetened liquids such as herbal teas. For this analysis, we focused on the dominant feeding pattern, and ignored the frequent switching of feeding methods typical in this sample (Zohoori et al. 1993). For example, infants reported to be fully breastfed at two and six months, but who received more than 83 kj/day from supplemental foods or liquids at four months, were still considered to be fully breastfed for six months. Infants were considered to have been weaned early if they initiated breastfeeding, but were totally weaned from the breast before six months of age. Infants were considered not breastfed if they never initiated breastfeeding.

Multinomial logistic regression models were used to predict membership in the different groups (categories of each outcome variable). A review of the estimated coefficients allowed an assessment of how each independent variable in the model affected the likelihood of membership in each group. Coefficients were exponentiated to calculate relative risk ratios (RRR) for a one-unit change in each independent variable. Risk was measured for a comparison of each category to a reference category. All possible intergroup comparisons were made and used to calculate the predicted probability of membership in each feeding category. For each model, the primary independent variable of interest was LBW. LBW-term births also were compared with LBW-preterm births.

Since infant birth weight and mothers' decisions about where to deliver and how to feed the infant are highly interrelated, several potentially important statistical problems were taken into consideration. The effects of *confounding* were controlled by including place of delivery (home, public, or private facility); receipt of a free sample of infant formula at delivery; sex of the infant; place of residence (urban or rural); primiparity; education level and age of the mother; and, household income and assets. However, inclusion of these variables does not eliminate potential biases associated with *endogeneity*. Variables are considered endogenous to a model when they are jointly determined by a set of common, underlying, unobservable variables. Consider the case where a mothers "innate healthiness" affects both the likelihood that she will breastfeed her infant, and whether the infant is LBW. In a multiple regression model, error terms associated with estimates of feeding, and of LBW will be correlated. If we ignore these relationships, we may mistakenly attribute part of the variation in feeding practices to LBW, when in fact, it should be attributed to the unmeasured maternal health status. (See additional examples of endogeneity bias in the article by Briscoe et al. 1990). Note that if the variables are observable and measurable, then they are potential confounders and can be included in the model as control variables. It was hypothesized in this study that LBW and place of delivery variables would be endogenous to our feeding models.

Economists have developed approaches to correct for endogeneity of explanatory variables, which involve the use of instrumental variables (see Briscoe et al. 1990, Cebu Study Team 1991, and Maddala 1988 for further information, and another example of use of the instrumental variables approach). An "instrument" or variable predicted from a set of strictly exogenous factors, is substituted in the model for the actual value of the variable. In this study, the assumption of endogeneity of the LBW and place of delivery variables was tested using the Hausman test (Hausman 1978), which requires that both the instrument and actual values of the variable be included in the model. When the instrument has a statistically significant coefficient, it is considered endogenous to the model. Using this method, place of delivery but not LBW was found to be highly endogenous in all of the models. This indicates that unmeasured factors such as the innate healthiness of the mother affect the delivery decision and the likelihood that the infant is LBW. Accordingly, all models were specified with place of delivery instruments, but actual values for all other variables.

RRRs and 95% confidence intervals (C.I.) were calculated for each independent variable in the models. Then, to assist in the interpretation of results, the likelihood of membership in each of the groups was predicted based on mean values of the independent variables. Finally, the effects of specified conditions, principally LBW versus normal birth weight and place of delivery were simulated.

RESULTS

Descriptive Results

Table 1 presents characteristics of sample women in strata defined by place of delivery (at home, in public or private hospitals or clinics). The decision of where to give birth is an important maternal choice, conditioned by a wide range of sociodemographic factors. Women who gave birth at home were significantly more likely than mothers delivering in health facilities to be from rural communities, have less education, and lower household income and assets. In addition, higher parity women were more likely to deliver at home. Exposure to formula industry practices varied considerably by place of delivery. Mothers delivering in private hospitals were most likely to receive free formula samples, and had significantly longer hospital stays. In other work (Adair et al. 1993), we showed that such practices decreased the duration of breastfeeding. Finally, delayed first contact between mother and infant after birth occurs more frequently in health facilities, especially private facilities which are more likely to have newborn nurseries. Table 1 also shows differences in the prevalence of LBW among sample infants born in different settings. A higher percentage of LBW infants were born in public facilities, which tended to serve populations at the highest risk for LBW (eg., primiparae, younger women, women with complications of pregnancy, and women from communities with higher disease prevalence).

Table 1
Characteristics of women delivering in different settings

Mother's Characteristics	Place of Delivery		
	Home (n=1843)	Public Facility (n=545)	Private Facility (n=634)
Age (years)[a]	26.1 ± 6.1	25.3 ± 5.7	26.6 ± 5.7
Education (years completed)[b]	6.0 ± 2.8	7.7 ± 2.8	10.0 ± 3.3
Urban (%)[c]	65.4	93.2	94.2
Parity[c]	2.52 ± 2.32	1.96 ± 1.93	1.75 ± 1.98
Primiparous (%)[c]	17.2	23.8	28.2
Held baby in first 4 hours (%)[b]	74.5	32.2	14.6
Received a sample of infant formula (%)[b]	4.2	26.9	68.5
Duration of hospital stay (days)[b]	na	2.52 ± 1.72	3.04 ± .96
% LBW[a]	11.0	15.3	9.9
% Preterm (<37 weeks)[d]	13.3	15.7	12.2

Values are means ± Standard Deviation
Statistical comparisons based on ANOVA for continuous variables or Chi-Square for categorical variables, $p<.05$:
[a]public differs significantly from home and private
[b]all intergroup differences are significant
[c]home differs significantly from public and private
[d]no significant differences

Table 2 shows comparisons of feeding practices in LBW versus normal weight infants by place of delivery. Within each facility, we tested for significant differences in the distribution of feeding practice by birth weight status. Within a facility category, there is a consistent trend of lower percentages of LBW compared to normal weight infants breastfeeding at each point in time. These differences, while similar across the three delivery settings, were most often statistically significant in public facilities. Within each place of delivery, there was a trend toward increased prevalence of *full* breastfeeding in LBW infants at all ages. For infants born in public facilities, there was a highly significant difference in the prevalence of full breastfeeding of LBW versus normal weight infants at six months. The lowest overall prevalence of breastfeeding occurred in private facilities, where mothers are typically more educated and come from higher income households. The basis for these associations can be best understood after multivariate analyses which account for other factors known to influence feeding.

Table 2
Comparison of feeding patterns among LBW and normal weight infants in different delivery settings

	Place of Delivery								
	Home			Public Facility			Private Facility		
	NBW	LBW	p	NBW	LBW	p	NBW	LBW	p
Feeding Patterns n =	1641	202		462	83		571	63	
Ever breastfed (%)	96.6	93.0	.013	93.2	90.0	ns	85.4	79.3	ns
Breastfed at 2 months (%)	90.5	90.6	ns	83.9	75.7	.08	66.2	64.2	ns
Breastfed at 4 months (%)	87.4	84.9	ns	77.4	67.6	.07	58.1	61.4	ns
Breastfed at 6 months (%)	85.0	82.8	ns	73.1	58.2	.01	51.7	50.0	ns
Breastfed at 12 months (%)	70.8	68.3	ns	60.0	46.0	.03	37.1	33.3	ns
Fully breastfed at 2 months (%)	71.8	74.6	ns	60.8	59.5	ns	34.2	37.7	ns
Fully breastfed at 4 months (%)	58.3	60.3	ns	43.5	45.6	ns	23.3	22.5	ns
Fully breastfed at 6 months (%)	18.1	19.0	ns	10.6	22.4	.009	4.7	4.6	ns

Table 2 cont'd

Feeding Patterns	Place of Delivery					
	Home		Public Facility		Private Facility	
	NBW	LBW	NBW	LBW	NBW	LBW
n =	270	33	45	15	23	2
Fully breastfed for six months (%)	17.7	18.2	10.8	21.4	4.5	3.9
n =	834	99	205	22	147	14
Fully breastfed for >2 but <6 months then mixed-fed (%)	54.7	54.7	49.2	31.4	28.7	27.9
n =	161	11	48	2	80	5
Mixed-fed for 6 months (%)	10.6	6.1	11.5	2.9	15.6	9.6
n =	260	38	119	31	262	31
Never breast-fed or weaned early (%)	17.1	21.0	28.5	44.3	51.2	59.6

p based on ANOVA, comparison of means.
For breastfeeding patterns, Chi-square = 18.7, p<.000
NBW = Normal birth weight
LBW = Low birth weight
ns = not significant

Concordance of Feeding Intentions and Practices

The reference group for the multinomial logistic regression was women who intended to breastfeed and did breastfeed. LBW dramatically increased the likelihood of not breastfeeding among women who intended to do so (RRR=3.13, p<0.000, 95% C.I. 1.75-5.60). This effect of LBW is slightly stronger for LBW-preterm (RRR=3.37, p=0.002, 95% C.I. 1.23-9.28) compared to LBW-term infants (RRR=2.86, p=0.019, 95% C.I. 1.45-5.64). Other factors significantly associated with not breastfeeding in those mothers who had intended to do so included delivery in a private hospital, receipt of a sample of formula after delivery, and primiparity.

For a clearer interpretation of results, we predicted the probability of membership in each of the groups under specified conditions.[3] Results based on multivariate analyses are presented in Table 3. The overall probability of intending to, but not breastfeeding a normal birth weight infants was 2.2%, while for a LBW infant, this probability was increased to 6.3% (7.1% for LBW-preterm infants, and 6.0% for LBW term infants). The effect of LBW appeared most dramatic in private facilities, where the predicted probability of not breastfeeding when mothers intended to do so was 16.7% for LBW versus 6.1% for normal birth weight infants.

Table 3
Concordance of breastfeeding intentions and practices among CLHNS women: Predicted probabilities of membership in groups are affected by place of delivery and LBW

Group	NBW	LBW	LBW-preterm	LBW-term
Intended, breastfed	85.0	82.9	82.5	82.8
Intended, did not breastfeed	2.2	6.3	7.1	6.0
Did not intend, breastfed	8.9	8.3	8.8	8.3
Did not intend, did not breastfeed	3.8	2.6	1.6	3.1

By Facility: Predicted probability of intending to breastfeed but not breastfeeding		
Facility	**NBW**	**LBW**
Home	0.6	3.0
Public	1.3	4.0
Private	6.1	16.7

Numbers represent predicted probability (%) of membership in specified group
NBW = Normal birth weight
LBW = Low birth weight

Initiation of Breastfeeding

The initiation of breastfeeding model had the same specification as the intention-practice model. The full set of results is presented in Table 4. LBW increased by 67% the chances of never breastfeeding. Comparison of term and preterm LBW infants showed a significant effect of LBW-term delivery, but not of LBW-preterm delivery. Other significant predictors of never breastfeeding included delivery in a private facility, maternal education, maternal age, and household income and assets. Predicted probability of never breastfeeding based on the multivariate models is presented in Table 5. Note that within each facility category, LBW decreased the probability that a mother would initiate breastfeeding. Furthermore, LBW-term infants were less likely to be breastfed than LBW-preterm infants.

Table 4
Determinants of the likelihood of never initiating breastfeeding: Results from multinomial logistic regression

1. LBW model					
Number of observations = 2976; $Chi^2(12) = 152.89$, $p<.000$; Log Likelihood = -627.419; Pseudo $R^2 = 0.1086$					
	RRR	S.E.	z	P > z	95% C.I.
LBW	1.67	0.38	2.25	0.02	1.07-2.62
Public delivery	4.15	3.72	1.59	0.11	0.71-24.09
Private delivery	5.44	2.16	4.28	0.00	2.50-11.83
Formula sample	1.36	0.24	1.80	0.07	0.97-1.92
Male infant	0.83	0.13	-1.22	0.22	0.61-1.12
Urban	1.42	0.48	1.03	0.30	0.73-2.74
Primiparous	1.32	0.25	1.46	0.14	0.91-1.90
Low education	0.52	0.15	-2.23	0.02	0.30-0.92
Young (<20 yrs)	0.34	0.15	-2.47	0.01	0.14-0.80
Old (>35 yrs)	1.50	0.42	1.46	0.14	0.87-2.61
Lowest SES	0.46	0.12	-3.08	0.00	0.28-0.75
Middle SES	0.75	0.14	-1.53	0.12	-.51-1.08

Continued

Table 4 Cont'd

2. LBW model-term versus LBW preterm model					
Number of observations = 2847; Chi^2 = 146.90, p<.000; Log Likelihood = -613,798; Pseudo R^2 = 0.1069					
	RRR	S.E.	z	P > z	95% C.I.
LBW-term	1.75	0.45	2.15	0.03	1.05-2.91
LBW-preterm	1.46	0.66	0.84	0.40	0.60-3.55
Public delivery	4.85	4.38	1.74	0.08	0.83-28.57
Private delivery	6.10	2.46	4.50	0.00	2.77-13.34
Formula sample	1.37	0.24	1.78	0.07	0.97-1.92
Male infant	0.84	0.13	-1.17	0.27	0.62-1.14
Urban	1.32	0.45	0.83	0.41	0.68-2.57
Primiparous	1.30	0.25	1.39	0.17	0.90-1.88
Low education	0.55	0.16	-2.03	0.04	0.31-0.98
Young (<20 yrs)	0.35	0.15	-2.41	0.02	0.15-0.82
Old (>35 yrs)	1.44	0.41	1.26	0.21	0.82-2.52
Lowest SES	0.48	0.12	-2.78	0.00	0.29-0.79
Middle SES	0.77	0.15	-1.33	0.19	0.53-1.13

LBW = Low birth weight
RRR = Relative risk ratio (for a 1-unit change in the corresponding variable, expressed relative to the "initiated breastfeeding" category
C.I. = Confidence interval
SES = Socioeconomic status based on household income and asset tertiles

Table 5
Predicted probability of never initiating breastfeeding among CLHNS women

Place of Delivery	NBW	LBW	LBW-preterm	LBW-term
Home	2.9	4.8	4.1	4.7
Public	8.3	13.0	12.9	14.7
Private	12.7	19.4	18.9	21.3
All	6.0	9.5	8.7	9.9

Numbers represent predicted probability (%) of membership in specified group
NBW = Normal birth weight
LBW = Low birth weight

Infant Feeding Patterns in the First Six Months

Multinomial logistic regression models allowed for the identification of significant predictors of membership in each of the four feeding pattern groups. LBW significantly (1) increased the likelihood of not breastfeeding or of early weaning compared to mixed feeding for six months [RRR=2.22, p=0.003, 95% C.I.=1.30-3.79], (2) increased the likelihood of not breastfeeding or early weaning compared to full breastfeeding for at least two but less than six months [RRR=1.49, p=0.012, 95% C.I.=1.09-2.03], (3) increased the likelihood of full breastfeeding for six months compared to mixed feeding for six months [RRR=2.02, p=0.016, 95% C.I.=1.09-2.03].

Predicted probability of each feeding pattern by place of delivery for normal versus LBW infants, based on the multivariate model is presented in Table 6. The effects of LBW can be seen by comparing the LBW and normal birth weight columns within each place of delivery. The overall pattern was the same across all sites. The predicted probability of never breastfeeding or weaning early was higher in LBW compared to normal weight infants.

Table 6
Predicted probability of breastfeeding patterns among CLHNS women

Feeding Pattern	Place of Delivery					
	Home		Public Facility		Private Facility	
	NBW	LBW	NBW	LBW	NBW	LBW
Fully breastfed 6 mos	16.3	20.3	30.2	38.4	1.5	1.6
Fully breastfed for >2 but <6 mos, then mixed-fed	56.1	51.3	47.6	40.3	19.5	15.1
Mixed fed for 6 mos	13.0	8.1	5.0	2.9	12.7	6.6
Never breastfed or weaned early	14.6	20.3	17.1	21.9	66.3	76.7

Overall effects of LBW-term versus LBW-preterm deliveries			
	NBW	LBW-preterm	LBW-term
Fully breastfed 6 mos	13.8	18.2	15.1
Fully breastfed for >2 but <6 mos, then mixed-fed	49.1	42.3	44.7
Mixed fed for 6 mos	11.5	5.1	7.3
Never breastfed or weaned early	25.6	34.3	32.8

Numbers represent predicted probability (%) of membership in specified group
NBW = Normal birth weight
LBW = Low birth weight

Consistent with the frequencies of the different feeding patterns presented in Table 2, the multivariate analyses also showed that if women elected to breastfeed, LBW increased the probability of full breastfeeding for six months. This was true for home and public facility deliveries. Among private deliveries, LBW had no impact on the likelihood of full breastfeeding for six months, probably because full breastfeeding is a relatively rare practice among women delivering in this setting.

The effects of term versus preterm delivery were examined in general since a further breakdown by place of delivery resulted in a very small number of preterm LBW infants in each place. The RRRs for term and preterm LBW deliveries were similar for most intergroup comparisons, but because the standard errors were larger for the estimates of the LBW-preterm effect because of the small number of infants in this category, the RRRs for LBW-preterm tended not to reach statistical significance.

These predictions were based on the use of instrumental variables for place of delivery. Using instruments, unbiased estimates of the effects were obtained, but it was noted that some of coefficients for place of delivery were very large. The resulting predicted probabilities of full breastfeeding in the public facility group were higher than would be expected based on observation of actual feeding practices in the sample. To try to understand the basis of this result, the models were estimated using actual values for place of delivery instead of instruments. For home deliveries, the results were very similar. For public facility deliveries, the predicted probability of full breastfeeding for six months was quite close to the expected value. The most important result of this comparison relates to the LBW findings. The magnitude and direction of the effects of LBW were the same. That is, regardless of whether instrumental variables were used, a consistent finding was that LBW significantly increased the probability that an infant would never be breastfed or weaned early.

Mother's Perceptions of the Size of the Infant

Mothers were asked whether they thought their infant was of normal size, big, or small at birth. This information was used in an effort to sort out the effects of mother's perceptions of the infant from biological factors that influence feeding decisions. About 18% of mothers thought their infant was small, and of these, 40% were actually LBW. We looked at the effects of mother's perceptions by substituting "small" for LBW in the models, and by adding "small" to the model with LBW, to measure the independent effect of mother's perceptions. We found no significant effects of mothers' perceptions on initiation of breastfeeding. In the breastfeeding intention model, both "small" and LBW significantly predicted membership in the group who intended to breastfeed but did not breastfeed, suggesting independent effects of infant biology and mothers' perceptions. In the feeding pattern analysis, "small" was statistically significant, but LBW was not significant when both terms were included in that model.

Hospital Policies

Within categories of facilities, there was little variation in practices related to infant feeding. Between facility types there was considerable variation. Private hospitals were most likely to receive and distribute formula samples, and to offer all infants other liquids in the first several days of life. "Rooming in" was more prevalent in public hospitals. All facilities claimed to have personnel instructing mothers on the initiation and maintenance of breastfeeding. However, within facilities, no information on specific treatment of LBW infants was obtained. Thus, while important facility effects on breastfeeding practices in general were found, specific practices affecting LBW infants in particular could not be identified.

It was initially hypothesized that delayed contact with LBW infants would reduce the likelihood of establishing breastfeeding. A significant association of delayed first contact with infants and reduced likelihood of breastfeeding in general was found, but no significant interaction with LBW. Furthermore, there were no significant differences within facilities in the proportion of LBW versus normal weight infants who had early contact with their mothers.

DISCUSSION

The set of analyses presented here shows a strong and consistent effect of LBW on infant feeding practices. Giving birth to a LBW infant was a deterrent to breastfeeding, but in cases where mothers still elected to breastfeed, the infant's LBW status increased the likelihood that mothers would fully breastfeed their infant. Important effects of place of delivery, showing a larger impact of LBW on feeding decisions of mothers who deliver away from home in private or public health facilities were also found.

These analyses were unable to identify clearly the underlying reasons for the LBW effect on feeding. However, some important clues from the comparison of characteristics of facilities, as well as some of the multivariate findings, were determined.

First, a strong effect of LBW among women who had intended to breastfeed their infant was found. This strongly suggests that the mother's plans were altered either by the biological condition of the infant at birth (such as poor infant health, or poor sucking ability in preterm infants), by her perceptions of the ability of the infant to breastfeed or the appropriateness of breastfeeding for a small infant, or by barriers to breastfeeding encountered in the postnatal environment. No additional information on the infant's health status at birth was obtained, but the possible role of mother's perceptions was explored, and showed that controlling for actual LBW, a mother's perception that her infant was small tended to increase the likelihood that she would not breastfeed, even when she intended to do so. In earlier work, it was shown that the duration of breastfeeding is increased when the infant has a high ponderal index or relative fatness. This was interpreted as an effect of positive feedback to the mother. If she perceived that her infant was doing well, she was more likely to continue to breastfeed (Adair et al. 1993). This is also relevant to our finding that mothers who chose to breastfeed a LBW infant were more likely to breastfeed that infant *fully*. It is known that LBW infants tend to undergo a period of catch-up growth in the first two months of life, particularly if they are fully breastfed and thus well nourished and more protected from infectious diseases (Adair 1989). In other analyses of growth of infants with different feeding patterns, it was found that fully breastfed infants weighed more in the first four months of life. The good growth performance of fully breastfed infants may serve to reinforce the mother's breastfeeding behavior.

The second set of clues relates to hospital policies. While specific information on policies related to possible differential treatment of LBW infants was not obtained, dramatic differences in general policies can be shown which relate to feeding by place of delivery, and in turn, significant effects of place of delivery on feeding. Early mother-infant contact is one important aspect of postnatal care that affects the initiation and success of breastfeeding. Dramatic differences were found in the percentage of women who had early contact with infants across delivery settings, with private facilities having the lowest prevalence of early contact. Differences were not found in the percentage of LBW infants with early contact, nor was a significant interaction of LBW with early contact in our multivariate models found. Thus lack of early contact was not shown to be a factor which can explain the decreased likelihood of breastfeeding among LBW infants in particular.

A second policy which varied substantially across delivery setting is the provision of free samples of infant formula to mothers. Only 4% of mothers who delivered at home received a free sample, while 27% who delivered in public hospitals, and 68% who delivered in private hospitals received samples. In the present analysis, receipt of a sample significantly increased the likelihood of not initiating breastfeeding or weaning early compared to the feeding patterns involving full breastfeeding. In a previous work (Adair et al. 1993) it was also shown that receipt of a sample decreased the duration of breastfeeding. However, no significant effect was found of an interaction of LBW and receipt of formula, suggesting that this policy does not single out LBW infants.

An important strength of the Cebu study is that it is community based, and allows for a comparison of home births and those that occur in a wide range of public and private facilities. Furthermore, by controlling for a number of factors that we know influence choice of place of delivery as well as feeding practices, the study assures that true estimates of the effects of LBW status were obtained.

The research findings should have important health implications for infants born in less developed countries. A lower incidence of breastfeeding among LBW infants is an unfortunate consequence because of the greater health risks they face. The health risks are related in part to biological characteristics of the LBW infant, but also to poor environmental conditions that contribute to LBW and poor postnatal outcomes. Given the proven nutritional and immunological superiority of breastmilk, breastfeeding is of special importance to the LBW infant, or as Narayanan (1986) has stated, a "passport to life." Efforts must be made to single out and eliminate policies that hinder the establishment of breastfeeding in clinical settings. Such policies would benefit all infants, regardless of birth weight status. Furthermore, special policies are needed to promote breastfeeding of LBW infants. Enhanced education and encouragement of mothers of LBW infants should address their concerns about the infant's size and capabilities, as well as their special needs.

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ENDNOTES

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2. Definition of Abbreviations:
   C.I. = confidence interval
   LBW = low birth weight
   RRR = relative risk ratio

3. The full set of results from the multinomial logistic regressions includes coefficients, relative risks, significance levels and confidence intervals for each model. The results were too voluminous to present here. Readers who would like to see the full set of results may request them from the author:

Linda S. Adair
Carolina Population Center
University of North Carolina
University Square, CB# 8120
123 W. Franklin St.
Chapel Hill, NC 27516-3997
Phone: 919-966-4449
Fax: 919-966-6638

WELLSTART INTERNATIONAL

Wellstart International is a private, nonprofit organization dedicated to the promotion of healthy families through the global promotion of breastfeeding. With a tradition of building on existing resources, Wellstart works cooperatively with individuals, institutions, and governments to expand and support the expertise necessary for establishing and sustaining optimal infant feeding practices worldwide.

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Wellstart's *Lactation Management Education (LME) Program*, funded through USAID/Office of Nutrition, provides comprehensive education, with ongoing material and field support services, to multidisciplinary teams of leading health professionals. With Wellstart's assistance, an extensive network of Associates from more than 40 countries is in turn providing training and support within their own institutions and regions, as well as developing appropriate in-country model teaching, service, and resource centers.

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Wellstart International is a designated World Health Organization Collaborating Center on Breastfeeding Promotion and Protection, with Particular Emphasis on Lactation Management Education.

For information on corporate matters, the LME or National Programs, contact:
Wellstart International Corporate Headquarters
4062 First Avenue tel: (619) 295-5192
San Diego, California 92103 USA fax: (619) 294-7787

For information about the EPB Program contact:
Wellstart International
3333 K Street NW, Suite 101 tel: (202) 298-7979
Washington, DC 20007 USA fax: (202) 298-7988