Infant Bottle Propping among a Low-income Urban Population in Mexico[1]

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The prevalence of bottle propping (permitting an infant to drink from a bottle unattended) and the determinants of this practice at 1 week and 4 months of life were studied in a selected sample of urban women in Hermosillo, Mexico. The sample (n = 165) consisted of mothers planning to breast-feed who gave birth to healthy infants at one of two public hospitals. Data were obtained by interviewing women shortly before they were discharged from the hospital and at about 1 week and 4 months postpartum.

Among those mothers giving liquid breast milk substitutes to their infants, the percentage practicing bottle propping increased from 27% at 1 week (n = 20/74) to 67% at 4 months (n = 87/130). Women who practiced bottle propping at 1 week were significantly more likely to continue this practice at 4 months. Bottle propping was significantly more common, both at 1 week and 4 months, among women who had completely weaned their infants than among those who were still combining breast and formula feeding. Multivariate logistic regression indicated that 1-week risk factors for bottle propping were low socioeconomic status, being a multiparous single mother, and being a young mother (≤18 years old) with a female infant, while 4-month risk factors were complete weaning, delivery in a "nursery" (versus a "rooming-in") hospital, and lack of support by the mother's partner for breast-feeding.

While the possible health risks associated with early bottle propping have not been well defined, the extent of the practice observed in this study suggests that such risks deserve further investigation.

The subject of "bottle propping" (permitting an unattended baby to drink fluids from a bottle) early in life is an issue that has only rarely been addressed in either developed or developing countries. Nevertheless, potential health risks (including choking and dental lesions) associated with this practice make it important to document its prevalence and its determinants in different socioeconomic and cultural contexts.

While conducting an exploratory study on infant feeding practices in Hermosillo, Sonora, Mexico (1, 2), one of us (RPE) observed infants less than a month old who were left alone drinking liquid breast milk substitutes or other fluids. Pillows were used to place the bottle at the level of the neonate's mouth, since at this age a baby cannot hold a bottle with its own hands. This observation prompted us to include bottle propping as a component of a subsequent study directed primarily at implementing and evaluating an intervention promoting breast-feeding in a

public maternity ward (3) and also at identifying determinants of infant feeding practices (4) and of perceived insufficient milk (5). This article, which reports on the bottle propping component of the study, seeks to document the prevalence of bottle propping and its determinants among a sample of mothers and their infants in Hermosillo, Mexico, when the infants were approximately 1 week and 4 months old.

STUDY POPULATION AND METHODS

Study Design

The study, conducted in Hermosillo (capital of Northwest Mexico's Sonora State), dealt with a sample that included 165 healthy pregnant women residing in Hermosillo who planned partial or exclusive breast-feeding, who delivered vaginally without complications, and whose birth products were single healthy term infants (birth weight >2 500 grams, gestational age >37 weeks, 1 and 5 minute Apgar scores ≥7). Tubal ligation after delivery was an exclusion criterion.

The women delivered at two public teaching hospitals where most of the delivery and postpartum care was provided by medical interns. At one of the hospitals the infants remained separated from their mothers in a nursery room and were fed routinely with infant formulas ($n = 58$). At the other hospital the newborns roomed in with their mothers and formula supplementation was not allowed ($n = 107$). The socioeconomic status of the subjects at both hospitals was generally low,[5] and as Table 1 shows, the two groups exhibited a number of similar features with respect to maternal demography, marital status, birth order, education, socioeconomic status,[6] prenatal care, past breast-feeding experience and plans, and maternal and infant anthropometry.

Women considered candidates for the study were first interviewed shortly before they were discharged from the maternity ward. If selected, they were then reinterviewed at about 1 week (8 ± 2 days), 2 months (70 ± 7 days), and 4 months (135 ± 8 days) after delivery in their homes or at a clinic during times when their infants were being immunized. The initial hospital interview was used for sample selection and for collecting information about how the mother was planning to feed her infant. The structured follow-up interviews included questions on the mother's infant feeding practices (including a question on bottle propping), breast-feeding problems, and socioeconomic, cultural, and demographic circumstances. The interviews were extensively pretested during a 3-month pilot phase before initiation of the study,[7] and special care was taken to ensure that the bottle propping question was understood by all mothers. All of the interviews were conducted by four local women with college educations who had received training and by the field supervisor (RPE).

All the mothers delivering on a weekday (morning shift) between March and June 1989 who met our inclusion criteria were asked to participate in the study. Nearly all those (98%) who were asked

[5]Both of the hospitals targeted poor women without social security benefits. The populations served lived in periurban slums or poor inner-city neighborhoods; less than two-thirds of the subjects' homes were sewered.

[6]As indicated by whether or not the home was sewered.

[7]Pérez-Escamilla R. Effect of the maternity ward system on the lactation success of low-income urban Mexican women [Doctoral dissertation]. Davis, California: Department of Nutrition, University of California at Davis; 1991.

Table 1. Selected characteristics of the study subjects (mothers and infants), by delivery hospital. The figure shown is either the relevant percentage or the mean ± 1 standard deviation. None of the differences observed between the two groups were statistically significant ($P \leq 0.05$).

	NUR* (n = 58)	RI† (n = 107)
Maternal characteristics:		
Age	21.9 ± 4.5 years	22.0 ± 4.7 years
Marital status: single	24%	15%
Parity: primipara	35%	33%
Education (years completed)	7.7 ± 2.4 years	7.7 ± 2.6 years
House sewered	60%	59%
Employed at time of 4-month interview	19%	20%
Received prenatal care for study infant	87%	87%
Planning to breast-feed 6 months	64%	65%
Mothers breast-fed as infants	87%	94%
Height	156.3 ± 6.4 cm	156.5 ± 5.9 cm
Body mass index	25.5 ± 5.0 kg/m²	24.4 ± 3.9 kg/m²
Infant characteristics:		
Birth weight	3.27 ± 0.40 kg	3.30 ± 0.40 kg
Gender: female	48%	56%

*NUR = nursery.
†RI = rooming in.

to participate agreed to do so. At the time of the 1-week interview, 8 of the 165 study participants were lost to follow-up due to 2 infant hospitalizations, 5 unlocated addresses, and a refusal. Another 8 participants were lost at the time of the 2-month interview (6 could not be found and 2 refused to participate). At the time of the 4-month interview 2 more participants could not be found, but another 2 women who had dropped out at 2 months postpartum were recovered. The overall attrition rate was 10% (16/165) at the end of the study.

The birth weights of all the study infants were obtained from the medical records. Maternal height was measured without shoes, using a 90° head angle and a measuring tape graduated in millimeters.

Study Variables

Regarding the dependent variable, a woman was considered to practice bottle propping if she gave a positive answer to the question: "Do you ever leave your baby by himself drinking from a bottle?" This question was only asked of women who were giving liquid breast milk substitutes to their infants (74 at 1 week and 130 at 4 months).

With respect to independent variables, four socioeconomic status (SES) indicators representing house construction, belongings, sanitation, and wealth were obtained by entering 23 variables into a factor analysis with varimax rotation. More than 50% of the variance in the socioeconomic status variables was explained by these indicators, each of which had an eigen-

value greater than one (6).[8] The variables that loaded high (factor loading ≥0.40) with house construction (HOUSEMAT) were house material (tar paper shack = 0, concrete, other = 1), floor (dirt = 0, concrete, other = 1), wall (tar paper = 0, concrete = 1), and roof (tar paper = 0, concrete, other = 1). The variables that loaded high with sanitation (SANITARY) were maternal education (<6 or ≥6 years of school completed), crowding (number of persons/number of rooms), water heater, piped water, sewerage, toilet, and paved street (absence = 0, presence = 1). The variables that loaded high with belongings (BELONGS) were radio, television, blender, gas stove, iron, and refrigerator (absence from the household = 0, presence = 1). The variables that loaded high with wealth (WEALTH) were monthly income, wood stove, and car ownership. With the exception of wood stove, all the variables loaded positively with their respective factor. The three remaining variables (crowding in the room where the infant slept, presence of a water cooler in the household, and presence of a fan) did not load high with any of the four indicators.

Additional socioeconomic variables were also included in the analyses. These were formal maternal education,[9] urban/rural maternal background (the percentage of each mother's life spent living in Hermosillo),[10] full breast-feeding support, and the number of other grown women present. A woman was classed as receiving full breast-feeding support if her partner approved of her providing breast milk to her infant as its only source of milk. (In the case of subjects whose partners were not living in the house, the support of the subject's mother was used instead of her partner's.) The number of other grown women present was simply the number of women 16 years of age or older who were living in the subject's household.

Biologic variables considered, in addition to maternal age (see above), included parity (primipara or multipara), maternal height (in centimeters), infant gender, and infant birth weight (in grams). Maternal height was actually included for socioeconomic reasons, because it was considered a potential indicator of the mother's childhood socioeconomic background.

To examine how infant breast-feeding influenced bottle propping, a weaning variable was entered in the 4-month model to differentiate mothers who had stopped breast-feeding from those who were combining breast and formula feeding. This variable was not entered into the 1-week model because only 7 children had been weaned at that age.

Statistical Analyses

All analyses were conducted using the SAS statistical package (7). Between-hospital comparisons were done using Student's t-test for continuous variables

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[8]The eigenvalue provides a measure of how well each of the four socioeconomic indicators derived from the factor analysis represents the information of its predictors (i.e., mainly those SES variables that were found to be highly correlated with each of the SES indicators). An eigenvalue ≥1 states that the indicator adequately represents its predictors, while an eigenvalue <1 states that the indicator is not an adequate representation of its predictors.

[9]For theoretical reasons, there was strong interest in looking at the relationship between maternal education and bottle propping. Since the SANITARY indicator (which is the one where maternal education loaded most strongly) provided only a weak representation of maternal education, it was decided to include the latter as a single independent variable in the logistic regression analyses.

[10]Although data were not collected on the places where study women lived before moving to Hermosillo, informal inquiries about this matter indicated that most of those who had migrated to Hermosillo had come from either rural or smaller urban areas.

and the chi-square test for discrete variables.

Multivariate logistic regression (8) was used to identify determinants of bottle propping at 1 week and 4 months of age, following an analytic strategy developed to elucidate infant feeding determinants of the study population (4, 5). Main and interactive effects were identified following a backward stepwise multiple logistic regression (CATMOD PROCEDURE) using a P value higher than 0.10 as the criterion for variable removal. The correlation coefficients in the independent variable matrix were always below 0.4, suggesting that multicollinearity effects were unlikely to be present in the models. Nesting was used to interpret significant interactions. The sample size was maintained constant, and the changes in fit of the model were monitored throughout the stepwise procedure. The logistic regression results were expressed as odds ratios and their respective 95% confidence intervals, the odds ratio (OR) being a ratio approximating the relative risk of a particular outcome occurring when a given variable is present as opposed to absent.

RESULTS

Prevalence of Bottle Propping

At the time of the 1-week interview, 4% (7/157) of the study infants had been weaned completely from the breast, 43% (67/157) were being fed with both breast milk and formula, and 53% (83/157) were receiving breast milk as their only source of milk. By the time of the 4-month interview, these figures had changed to 58% (84/145) having been weaned completely, 32% (46/145) receiving breast milk and formula, and 10% (15/145) receiving breast milk only. (The 4-month denominator was 145 because, in addition to 16 of the 165 study women being lost to follow-up, 4 others had missing data on the bottle propping variable.)

Among the women who were providing their infants with breast milk substitutes, the proportion practicing bottle propping at 1 week postpartum was 27% (20/74). However, by 4 months postpartum this proportion had grown to 67% (87/130).

At the time of both interviews this practice was more common among women who had discontinued breast-feeding than among those combining breast and formula feeding. Specifically, at 1 week 57% (4/7) of the mothers who had stopped breast-feeding versus 24% (16/67) of those combining breast and formula feeding were bottle propping ($\chi^2 = 3.5$, $P = 0.059$). Similarly, at 4 months 77% (65/84) of those who had stopped breast-feeding, versus 48% (22/46) of those partially breast-feeding, were bottle propping ($\chi^2 = 11.7$, $P = 0.001$).

We also observed that women who practiced bottle propping at 1 week, compared to those who did not, were more likely to practice bottle propping at 4 months ($\chi^2 = 8.1$, $P = 0.004$).

Determinants of Bottle Propping

The logistic regression model based on the interview at 1 week (Table 2) indicates that mothers with relatively low socioeconomic status (as indicated by house construction materials) were significantly more likely to practice bottle propping than other mothers in the study sample. Likewise, unmarried multiparas were significantly more likely to practice bottle propping than unmarried primiparas. In addition, female infants were more likely to be left alone with a bottle if they had a young (≤18 years old) mother rather than an older mother.

Supplementing these findings, the logistic regression model based on the interview at 4 months (Table 3) indicates

Table 2. Reduced interactive model* of bottle propping[†] at about 1 week (8 ± 2 days) postpartum (backward multivariate logistic regression, $n = 71^‡$)[§]

Risk factor[‖]	Number	β (se)[¶]	P	OR (95% CI)**
Parity:				
Primipara = 1	27	−0.522 (0.464)	0.26	Not significant
Multipara = 2	44			
Maternal age:				
≤18 years = 1	13	0.606 (0.541)	0.26	Not significant
>18 years = 2	58			
House construction *materials:*				
< median = 1	34	1.269 (0.447)	0.004	12.6
> median = 2	37			(2.1−75.6)
Marital status:				
Single = 1	21	−0.052 (0.412)	0.90	Not significant
Married = 2	50			
Infant gender:				
Female = 1	40	0.182 (0.454)	0.69	Not significant
Male = 2	31			
Parity × marital *status*	*71*	*−1.063 (0.430)*	*0.01*	*Not applicable*
Maternal age × *infant gender*	*71*	*0.989 (0.452)*	*0.03*	*Not applicable*
Nested effects:				
Parity (single):				
Primipara = 1	*15*	*−1.585 (0.754)*	*0.03*	*0.04*
Multipara = 2	*6*			*(0.002−0.8)*
Parity (married):				
Primipara = 1	*12*	*0.541 (0.483)*	*0.26*	*Not significant*
Multipara = 2	*38*			
Maternal age (female infants):				
≤18 years = 1	*8*	*1.595 (0.655)*	*0.01*	*24.3*
>18 years = 2	*32*			*(1.8−333.6)*
Maternal age (male infants):				
≤18 years = 1	*5*	*−0.383 (0.751)*	*0.61*	*Not significant*
>18 years = 2	*26*			

*Full model: main effects = delivery hospital, wealth, belongings, sanitation, house construction, maternal height, maternal education (<6 years, ≥6 years), maternal age (≤18 years, >18 years), parity (primipara, multipara), urban/rural background, full breast-feeding support, women ≥16 years old in household, and infant gender; interactive terms = parity × marital status, maternal age × infant gender, parity × infant gender, marital status × infant gender, parity × house construction, marital status × house construction, maternal age × house construction.

[†]Bottle propping codes: yes = 1, no = 2.

[‡]Only includes cases where data were provided on all the multivariate model variables and where the mother was feeding liquid breast milk substitutes to her infant.

[§]Likelihood ratio of reduced model ($χ^2$, df): 53.5, 63 ($P = 0.80$).

[‖]Data are shown for parity, maternal age, marital status, infant gender, parity of married subjects, and age of mothers of male infants despite their lack of statistical significance because of their ties to significant relationships.

[¶]β = logistic regression parameter, se = standard error.

**OR = odds ratio, 95% CI = 95% confidence interval. These two parameters are reported only for those variables that were associated ($P ≤ 0.05$) with bottle propping. OR ± 95% CI = $e^{2(β ± 2se)}$. In all instances, the odds of bottle propping are expressed for the first level relative to the second level of the risk factor.

Table 3. Reduced interactive model* of bottle propping[†] at 4 months (135 ± 8 days) postpartum (backward multivariate logistic regression, N = 119[‡])[§]

Risk factor	Number	β (se)[∥]	P	OR (95% CI)[¶]
Weaning:				
Completely weaned = 1	76	0.792 (0.228)	0.0005	4.9
Partly breast-fed = 2	43			(2.0–12.2)
Delivery hospital:				
Nursery = 1	45	0.674 (0.247)	0.006	3.8
Rooming-in = 2	74			(1.4–10.3)
Breast-feeding support:				
No = 1	80	0.673 (0.260)	0.01	3.8
Yes = 2	39			(1.3–10.9)

*Full model: main effects = weaning, delivery hospital, wealth, belongings, sanitation, house construction, maternal height, maternal education (<6 years, ≥6 years), maternal age (≤18 years, >18 years), parity (primipara, multipara), urban/rural background, full breast-feeding support, women ≥16 years old in household, and infant gender; interactive terms = parity × marital status, maternal age × infant gender, parity × infant gender, marital status × infant gender, parity × house construction, marital status × house construction, maternal age × house construction.
[†]Bottle propping codes: yes = 1, no = 2.
[‡]Only includes cases where data were provided on all the multivariate model variables and where the mother was feeding liquid breast milk substitutes to her infant.
[§]Likelihood ratio of reduced model (χ^2, df): 125.0, 115 (P = 0.24).
[∥]β = logistic regression parameter, se = standard error.
[¶]OR = odds ratio, 95% CI = 95% confidence interval. In all instances, the odds of bottle propping are expressed for the first level relative to the second level of the risk factor.

that complete weaning (no breast-feeding), delivery at the nursery (versus rooming-in) hospital, and lack of a partner's support for breast-feeding were significant risk factors for practicing bottle propping at 4 months.

The odds ratios and 95% confidence intervals indicated by the models for the aforementioned relationships are shown in Tables 2 and 3.

DISCUSSION AND CONCLUSIONS

Bottle propping was a common practice among the women in this study sample, even as soon as the 1-week interview (6–10 days after delivery). Furthermore, it seems likely that our estimates are conservative with respect to the general population, since we selected only women who were planning to breast-feed. In addition, some bottle propping may have gone unreported, because a few women in the sample (in less than 1% of the interviews) denied bottle propping but then reversed themselves after we observed that their infants were drinking from a bottle alone while we were conducting the interview.

The fact that low social class (as indicated by housing construction materials) was related to bottle propping at 1 week could partly reflect the lack of social support characterizing the most disadvantaged sectors of society. Similarly, the finding that single multiparas were more likely to practice bottle propping at 1 week than single primiparas probably partly reflects the time pressures felt by multiparous women who did not have the support of a partner. The finding that young mothers (≤18 years old) were more likely than older mothers to resort to bot-

tle propping if their infants were female but not male could signal a gender bias among adolescent mothers.

At 4 months, exclusive formula feeding (as compared to a mixture of breast and formula feeding) was strongly and positively associated with bottle propping. (A similar trend was observed at 1 week, but this could not be tested in the multivariate model due to the small sample size.)

In addition, mothers delivering in the nursery hospital were more likely to practice bottle propping at 4 months than those mothers who delivered in the rooming-in hospital. Because the study populations delivering at both hospitals had strikingly similar socioeconomic, demographic, biologic, and breast-feeding attitude profiles, this finding could indicate an added benefit of rooming in.

The 4-month interviews also indicated that women who received support for breast-feeding from their partners (or from their mothers in the absence of partners) were less likely to leave their infants drinking alone from a bottle. This reinforces the notion that the partners, close relatives, and friends surrounding mothers should be targeted by infant feeding and health promotion efforts.

In general, the high prevalence of bottle propping found in this study strongly suggests a need for research on the practice's possible health risks. It has been suggested that bottle propping during infancy may increase the risk of choking. We have no knowledge of any studies or surveys casting light on this subject. However, various U.S. studies (most focusing on choking from toys, other solid objects, or unidentified causes) have pinpointed choking as an important contributor to accidental death during infancy and early childhood (9–13). One study found that choking accounted for 13% of unintentional injury-related deaths during the first year of life (14). Within our own study population, any such risks as-

sociated with bottle propping may have been heightened by the fact that many infants were commonly covered with a cheesecloth type of fabric to protect them from insects, which made them relatively hard to observe.

It is also possible that early bottle propping encourages bottle propping later, after the baby's first teeth have emerged, when putting the baby to sleep with a bottle is known to promote dental lesions. Another reason for discouraging bottle propping is that it probably reduces the baby's contact with a nurturing caretaker—and could thus impair its psychological development (15).

In conclusion, our results indicate that bottle propping was common as early as 1 week of age in the study population and that this behavior might have been determined partly by socioeconomic and cultural factors, as well as by the hospital environment where the child was born. Nevertheless, many questions regarding the issue of bottle propping remain largely unexplored and will only be answered through more studies. National surveys that collect data on infant feeding, such as the Demographic and Health Surveys (16, 17), could assist this process by including a question on bottle propping to document the prevalence of this practice around the world.

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Correction