

The Effects of Early Pacifier Use on Breastfeeding Duration

Cynthia R. Howard, MD, MPH*; Fred M. Howard, MD‡; Bruce Lanphear, MD, MPH||; Elisabeth A. deBlicke, MPA*; Shirley Eberly, MSS; and Ruth A. Lawrence, MD*

ABSTRACT. *Objective.* To evaluate the effects of pacifier use and the timing of pacifier introduction on breastfeeding duration, problems, and frequency.

Methods. A cohort of 265 breastfeeding mother–infant dyads was followed prospectively. Maternal interviews were conducted at delivery, 2, 6, 12, and 24 weeks, and thereafter every 90 days until breastfeeding ended. Information was obtained regarding pacifier use, infant feeding, use of supplemental foods and breastfeeding frequency, duration, and problems. The effect of pacifier introduction by 6 weeks of age on breastfeeding duration was evaluated with Kaplan-Meier and Cox proportional hazards models. The effect of the timing of pacifier introduction (≤ 2 weeks and ≤ 6 weeks) on breastfeeding duration at 2 and 3 months was evaluated using logistic regression modeling.

Results. A total of 181 mothers (68%) introduced a pacifier before 6 weeks. In adjusted analyses, pacifier introduction by 6 weeks was associated with a significantly increased risk for shortened duration of full (hazard ratio, 1.53; 95% confidence interval: 1.15, 2.05) and overall (hazard ratio, 1.61; 95% confidence interval: 1.19, 2.19) breastfeeding. Women who introduced pacifiers tended to breastfeed their infants fewer times per day, with significant differences noted at 2 (8.1 ± 2.6 vs 9.0 ± 2.3) and 12 weeks' (6.3 ± 2.0 vs 7.4 ± 1.6) postpartum. At 12 weeks postpartum, women who introduced pacifiers also were more likely to report that breastfeeding was inconvenient and that they had insufficient milk supplies. Pacifier use begun either before 2 weeks or before 6 weeks' postpartum was not significantly associated with breastfeeding duration at 2 and 3 months.

Conclusions. Pacifier use was independently associated with significant declines in the duration of full and overall breastfeeding. Breastfeeding duration in the first 3 months' postpartum, however, was unaffected by pacifier use. Women who introduced pacifiers tended to breastfeed their infants less frequently and experienced breastfeeding problems consistent with infrequent feeding. Findings from this study suggest that the decreases in breastfeeding duration associated with pacifier use may be a consequence of less frequent breastfeeding among women who introduce pacifiers to their infants. *Pediatrics* 1999;103(3). URL: <http://www.pediatrics.org/cgi/content/full/103/3/e33>; *breastfeeding, pacifiers.*

ABBREVIATIONS. HR, hazard ratio; CI, confidence interval.

From the Departments of *Pediatrics, †Obstetrics and Gynecology, and §Biostatistics, University of Rochester School of Medicine and Dentistry and the Children's Hospital Medical Center, Rochester, New York; and the ||Department of Pediatrics, University of Cincinnati, Cincinnati, Ohio. Received for publication Mar 20, 1998; accepted Nov 12, 1998. Reprint requests to (C.R.H.) Department of Pediatrics, Rochester General Hospital, 1425 Portland Ave, Rochester, NY 14621. PEDIATRICS (ISSN 0031 4005). Copyright © 1999 by the American Academy of Pediatrics.

An infant must learn to attach and suckle properly at the breast during the first few days of life to successfully establish breastfeeding.^{1,2} Early oral experiences that require sucking mechanics different from those required for breastfeeding are believed to contribute to the development of improper latch and subsequent breastfeeding failure—a problem described as nipple confusion.²⁻⁴ The avoidance of pacifiers was included as 1 of 10 steps for successful breastfeeding in the 1990 Innocenti Declaration on maternity services and breastfeeding, and many experts recommend that mothers who are breastfeeding avoid exposing their infants to artificial suckling experiences including use of pacifiers.⁵⁻⁷

Exposure to artificial nipples among breastfed infants remains commonplace in routine newborn care in hospitals throughout the United States.^{5,6,8} A number of observational studies and one randomized trial have evaluated the effect of pacifier use on breastfeeding. Although the majority of evidence indicates that pacifier use is associated with significant declines in breastfeeding duration,^{2,9-11} two studies dispute a causal association between pacifiers and shortened breastfeeding duration.^{12,13} Most published studies of pacifier use have examined the effects on breastfeeding duration in less developed countries. Although pacifier use is common in developed countries,¹⁴ there are no published reports of the effects of pacifier use on the duration of breastfeeding in a cohort of US mothers and infants. Additionally, many factors known to influence breastfeeding duration, including cultural practices, prenatal education, hospital practices, and postpartum support, are likely to vary between less developed countries and the United States. Therefore, it remains unclear whether pacifier use should be actively discouraged.

It also has been hypothesized that the timing of exposure to artificial nipples is important in mediating effects on breastfeeding.^{2-4,15} Thus, according to this hypothesis, mother–infant dyads who begin pacifier use before breastfeeding is well established incur a higher risk for problems than do couplets who have successfully established breastfeeding before pacifier introduction. A randomized clinical trial of restricted supplemental formula and pacifier use during the first 5 days of life demonstrated no significant effects on breastfeeding.¹³ Longer periods of avoidance, however, have not been assessed.

The purpose of this analysis was to evaluate the effects of pacifier use on breastfeeding duration in a cohort of US mother–infant dyads and the influence

that timing of pacifier introduction exerts on any associated declines in breastfeeding duration.

METHODS

Data from a cohort of 265 breastfeeding mother–infant dyads participating in a larger randomized clinical trial of obstetric influences on infant feeding choices and breastfeeding duration were analyzed.¹⁶ A brief summary of the methods used to develop this cohort is presented.

A total of 547 consecutive pregnant women presenting for their first prenatal visit were randomized to receive one of two distinct educational packs about infant feeding, one containing formula company produced materials (commercial) and the other containing materials with similar subject matter but selected to eliminate all forms of formula advertising (noncommercial). Both packs contained information about infant feeding emphasizing breastfeeding as optimal infant nutrition, and neither contained information about pacifiers. Packs were distributed to women at the end of their first prenatal visit.

Two randomly assigned study groups of expectant mothers were formed over a 7-month period (12/94–6/95) from three independent, obstetric practices in six clinical offices in and around the Greater Rochester, NY, area. Clinical sites for this study included one urban site, four suburban sites, and one rural site. Each obstetric practice comprised five to six obstetrician/gynecologists, each of whom performed deliveries exclusively at Rochester General Hospital, a level II, 526-bed community hospital affiliated with the University of Rochester School of Medicine and Dentistry. Obstetric practices were selected based on an affiliation with Rochester General Hospital, the proportion of obstetric patients choosing to breastfeed, and willingness to participate in the clinical trial. To obtain cooperation of the obstetricians, they were informed of the study hypothesis but were blinded to group assignment. Their staff, including those responsible for prenatal education, were blinded to both the hypothesis and group assignment.

Randomized women were tracked throughout pregnancy. Of the 547 women randomized at first prenatal visit, 444 women presented for delivery at Rochester General Hospital. Approximately 19% of the cohort was lost because of miscarriage, moving out of the area, or problems necessitating delivery in a tertiary care setting. In the immediate postpartum period, a research assistant blinded to group assignment interviewed women regarding planned and actual use to date of a pacifier, family composition, workforce participation, familial support, and personal beliefs/choices regarding infant feeding methods. Mothers who chose to breastfeed their infants were asked additional questions about their breastfeeding experience in the hospital, problems, and goals. Maternal (prenatal and hospital) and infant (hospital) chart reviews were conducted on all participants. Demographic data were collected on participants using electronic birth certificate records. Details of the methods of this trial are presented elsewhere.¹⁶

Women who chose to breastfeed their infants and delivered term, healthy infants were recruited to participate in a postpartum follow-up study of breastfeeding. Of the 311 women who chose to breastfeed their infants, 15 women refused follow-up, 15 were deemed ineligible because of complications resulting in preterm delivery or prolonged maternal or infant hospitalization, 14 ended breastfeeding before hospital discharge, and 2 were missed because of failure of the study team to identify them as enrolled subjects during the postpartum hospitalization. These women did

not differ significantly from those retained to follow-up for race ($P > .5$), age ($P > .7$), marital status ($P = .10$), or educational attainment ($P = .06$), but they had significantly lower socioeconomic status ($P = .01$).

This cohort of 265 breastfeeding mother–infant dyads was followed with serial telephone interviews conducted by nurse interviewers blinded to the study hypothesis and group assignment. Interviews were conducted at 2, 6, 12, and 24 weeks' postpartum, and every 90 days thereafter until breastfeeding ended. Standardized interviews with categorical and quantitative responses were used. At each telephone contact, extensive information was gathered regarding infant feeding including breastfeeding frequency, duration, and maternal and infant problems; proportion of diet composed of breast milk; and timing of introduction and use of various supplemental foods and/or liquids. Additionally, mothers were questioned at each contact regarding regular (daily) use of a pacifier while the infant was breastfed.

At each contact, nurses offered to answer any infant, maternal care, or breastfeeding question. Advice regarding pacifier use was offered only if a mother questioned the use of a pacifier specifically. Consistent with postpartum hospital instruction and breastfeeding protocols used by the hospital breastfeeding support line, women were encouraged to avoid pacifier use until breastfeeding was well established, generally at 3 to 4 weeks of age.

Analysis

Data were entered and analyzed using SAS, BMDP, and Epi Info version 6.¹⁷ Statistical tests used to compare sociodemographic characteristics (Tables 1 and 2) included Student's t test, χ^2 test, and Fisher's exact test as appropriate.¹⁸ Analyses of breastfeeding problems and frequency were examined using χ^2 tests and Student's t test, respectively. Kaplan-Meier and Cox proportional hazards survival analyses were used in unadjusted and adjusted analyses of the effect of pacifier use on breastfeeding duration.¹⁹ Logistic regression modeling was used to evaluate the effect of pacifier timing on breastfeeding duration.²⁰ Significance levels were not adjusted for multiple comparisons.

Breastfeeding terms and definitions used in this study are modifications of those recommended by The Interagency Group for Action on Breastfeeding.²¹ Breastfeeding duration is defined by the following categories 1) full and 2) overall. Full breastfeeding includes the infrequent use of water, juice, or ritualistic feeds. Infants are primarily breastfed and do not receive daily supplements. Overall breastfeeding is defined as the length of time an infant receives any breastfeedings.

Pacifier information was collected at all scheduled contacts. A continuous pacifier introduction variable was constructed based on the interview date when pacifier use was first identified. Because of the structure of the question used to determine introduction (use before breastfeeding cessation), analyses of full duration are subject to some underestimation of effects associated with pacifier use. To account for this, we have conducted very limited evaluations of this outcome, confining the majority of analyses to overall duration. Analyses of overall duration are not subject to these concerns.

To evaluate the effect of pacifier introduction while adjusting for other predictors of breastfeeding duration, Cox proportional hazard models were developed. Models were developed using the following possible predictors of breastfeeding duration: maternal race, maternal education, paternal education, maternal age, socioeconomic status,²² marital status, parity, mode of delivery, previous breastfeeding experience, timing of feeding method selection,

TABLE 1. Characteristics of Study Participants by Pacifier Use

Characteristic	Pacifier Introduction After 6 Weeks/Never $n = 84$		Pacifier Introduction by 6 Weeks $n = 181$		P Value
	Mean	Standard Deviation	Mean	Standard Deviation	
Maternal age (y)	31.2	4.5	30.0	4.6	.06
Socioeconomic status ²²	70.2	22.0	71.4	21.3	.70
Maternal education (y)	14.3	1.9	14.6	1.9	.25
Paternal education (y)	14.5	2.1	14.6	1.9	.79
Maternal Goal (wk)	26.7	20.4	22.8	18.0	.13
First successful latch and feeding (minutes of age)	233.3	536.1	225.6	419.6	.91

TABLE 2. Characteristics of Study Participants by Pacifier Introduction

Characteristic	Pacifier Introduction After 6 Weeks/Never (<i>n</i> = 84)	Pacifier Introduction by 6 Weeks (<i>n</i> = 181)	<i>P</i> Value
	Proportion (%)	Proportion (%)	
White	98.8	96.7	.44*
Married	90.5	89.5	.81
Plans to return to work	54.8	61.9	.27
Primiparous	38.1	48.6	.11
Delivery by c-section	15.5	21.0	.29
Breastfed an infant previously (all mothers in study)	51.2	50.6	.92
Paternal preference breastfeeding	65.5	63.0	.69
Family preference breastfeeding	28.6	30.9	.70
Feeding decision <3rd trimester	71.4	65.2	.32
Problems pregnancy/delivery	70.2	70.2	.99
Most friends have breastfed	39.3	37.6	.79
Apgar score at 5 minutes			.50
5	0.0	1.1	
8	3.6	5.5	
9	86.9	87.9	
10	9.5	5.5	
Randomization**	48.8	51.4	.70

* Fisher's exact test.

** Randomization to commercial materials in randomized clinical trial of infant feeding choices.¹⁶

problems with pregnancy/labor/delivery, breastfeeding goal (weeks), family preference for breastfeeding, paternal preference for breastfeeding, having friends who breastfed, randomization group,¹⁶ plans to return to work, infant's 5-minute Apgar score, and infant's age in minutes when first breastfed (first successful latch and feeding). Predictive factors with a *P* value $\leq .10$ were retained in the model. A continuous variable for pacifier use instituted by 6 weeks was then forced into each of the selected models to evaluate any associated risk for shortened breastfeeding duration. Finally, to evaluate any modification of pacifier effects attributable to potential confounding factors of specific interest (eg, bottle introduction, study group assignment), both the pacifier variable and the variable in question were added to the selected "best" models.

Initial models used continuous data for mothers' breastfeeding goal and maternal age. To facilitate presentation of the final model, dichotomous variables were constructed for these factors (ie, goal ≤ 26 weeks or > 26 weeks and maternal age ≤ 30 years or > 30 years). The use of dichotomous variables did not alter significantly the strength or direction of the associated predictors.

The timing of pacifier introduction on breastfeeding was evaluated by using logistic regression modeling to predict breastfeeding duration to 2 and 3 months' postpartum. Models were constructed using the same 19 predictors of breastfeeding duration. Factors with *P* $< .10$ were retained in the model. A dichotomized pacifier introduction variable then was forced into the model. Separate models were used to evaluate the effect of pacifier introduction 1) before 2 weeks, and 2) before 6 weeks' postpartum on breastfeeding continuation to 2 and 3 months.

RESULTS

Pacifier use was common among subjects in this study. By the time infants were 6 months of age, 74% of mothers had initiated pacifier use: 15% began use before hospital discharge, another 36% began use by 2 weeks' postpartum, another 17% began by 6 weeks' postpartum, and 6% began use between 6 and 24 weeks' postpartum.

Demographic and social characteristics for the 265 women according to pacifier introduction are presented in Tables 1 and 2. Women who introduced pacifiers to their infants compared with those who did not tended to be primiparous (*P* = .11), to have shorter goals for breastfeeding (*P* = .13), and to be somewhat younger (*P* = .06). Women who chose to introduce pacifiers were otherwise similar to women

who chose not to introduce pacifiers on a variety of demographic and support factors. Pacifier use was not associated with either study group assignment (educational packet received at first prenatal visit) or the obstetric practice where the women were recruited (*P* $> .7$).

Unadjusted survival analyses (Kaplan-Meier) of overall breastfeeding duration according to pacifier use are presented in Fig 1. There is a trend toward shorter duration in women who introduced a pacifier by 6 weeks (168.5 days [SE 9.7]) compared with those who introduced pacifiers after 6 weeks/never (196.0 days [SE 18.4]). These results, however, were not statistically different (*P* = .10). Additionally, although the data displayed in Fig 1 are unadjusted, detrimental effects attributable to pacifiers are evident only after the first several months of lactation.

To evaluate the effect of pacifier introduction on breastfeeding duration while adjusting for other known predictors of duration, Cox proportional hazard models were developed. Pacifier introduction by 6 weeks was associated with a significant increased risk for shortened duration of full breastfeeding (hazard ratio [HR], 1.53; 95% confidence interval [CI]: 1.15,2.05; *P* = .004) and overall breastfeeding (HR 1.61; 95% CI: 1.19,2.19; *P* = .002). The model for overall breastfeeding duration is presented in Table 3. Randomization group for the primary study¹⁶ and bottle introduction, when added to the final models, did not significantly alter risks associated with pacifier use.

The effect of pacifier introduction on breastfeeding frequency was investigated. Breastfeeding frequency was significantly decreased at 2 weeks' postpartum in women who had instituted pacifier use by 2 weeks (8.1 ± 2.6 vs 9.0 ± 2.3 ; *P* = .003) and at 12 weeks' postpartum in women who had introduced pacifier use by 6 weeks (6.3 ± 2.0 vs 7.4 ± 1.6 ; *P* $< .001$). Although there was a trend toward decreased frequency among pacifier users, differences were not

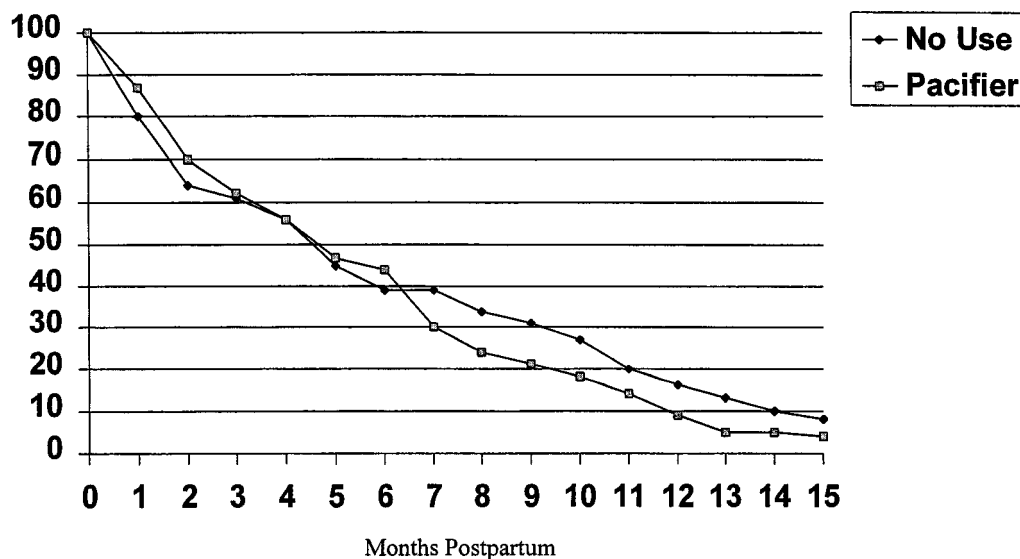


Fig 1. Percent of infants still breastfeeding according to pacifier exposure (pacifier introduction at ≤ 6 weeks vs never/ > 6 weeks).

TABLE 3. Predictors of Reduced Overall Breastfeeding Duration (Cox Proportional Hazards Analysis)

Predictors of Overall Duration	HR	95% CI	Significance
Pacifier use ≤ 6 wk	1.61	1.19, 2.19	.002
Maternal age ≤ 30 y	1.32	1.02, 1.71	.03
Father not in favor of breastfeeding	1.30	0.99, 1.70	.06
Plans to return to work	1.42	1.09, 1.85	.01
C-section	1.30	0.95, 1.79	.10
Pregnancy/labor/delivery problems	1.31	0.98, 1.73	.06
Breastfeeding goal ≤ 26 wk	2.12	1.57, 2.87	<.0001

significant at 6 (7.4 ± 2.5 vs 7.8 ± 2.0 ; $P = .23$) and 24 weeks' postpartum (5.1 ± 2.2 vs 5.4 ± 1.9 ; $P = .57$).

Extensive information was gathered at each postpartum contact regarding breastfeeding problems. We evaluated the effect of pacifier introduction on the likelihood of mothers reporting breastfeeding problems at 6 and 12 weeks' postpartum. The only significant differences in incidence of breastfeeding problems occurred at 12 weeks' postpartum; mothers who had introduced a pacifier by 6 weeks were more likely to report that breastfeeding was inconvenient ($P = .05$) and that they had experienced problems with not producing enough breast milk ($P = .05$).

Timing of pacifier introduction up to 6 weeks' postpartum was not significantly associated with breastfeeding duration to either 2 or 3 months. Independent predictors of breastfeeding at 2 months included maternal breastfeeding goal, education, age, history of problems during pregnancy/labor/delivery, and plans to return to work. Infant-related predictors included the minutes to first breastfeeding and the infant's Apgar score at 5 minutes. The 3-month model contained one additional predictor, the time at which the feeding decision was made (before 3rd trimester). Pacifier introduction at ≤ 2 weeks' postpartum was not significantly associated with breastfeeding duration to either 2 or 3 months. Similarly, pacifier introduction up to 6 weeks' postpartum was not significantly associated with breastfeeding duration at 2 or 3 months. Rates of breast-

feeding at 2 and 3 months' postpartum according to pacifier introduction are presented in Table 4.

DISCUSSION

Breastfeeding results in many health benefits for both mothers and infants and is widely acknowledged as the optimal way to nourish an infant.^{6,23-28} Scientific investigation of the effect of early artificial sucking experiences on the ability of newborns to breastfeed successfully is of profound relevance and importance to maternal and child health in the United States. Moreover, because nonnutritive sucking is associated with beneficial effects including enhanced growth in premature infants, possible prevention of SIDS, and coping with adverse stimuli,²⁹⁻³⁴ as well as with detrimental effects including increased rates of otitis media and malocclusion,³⁵⁻³⁷ it is even more important to determine whether pacifier use is detrimental to breastfeeding.

Despite some limitations, this study documents important associations between pacifier use and a variety of breastfeeding outcomes. Pacifier use in the first 6 weeks' was independently associated with shortened full and overall breastfeeding duration. Confirming findings from studies conducted outside the United States, this study demonstrated an approximate 1.5-fold increase in the risk of shortened breastfeeding duration in the pacifier group. This effect, however, is of a smaller magnitude than that documented in the Brazilian studies, where risks for shortened duration were two- to threefold higher among pacifier-exposed infants.^{9,11,12} Additionally,

TABLE 4. Percent of Women Still Breastfeeding at 2 and 3 Months According to Pacifier Introduction

Pacifier Introduction	2 Months (%)	3 Months (%)
Introduction ≤ 2 wk	68	60
Introduction > 2 wk	69	64
Introduction ≤ 6 wk	70	63
Introduction > 6 wk	63	60

pacifier use in this study was associated primarily with long-term breastfeeding duration and did not affect short-term outcomes; there was no significant association with breastfeeding duration up to 3 months' postpartum. Although concerning, these findings fail to support breastfeeding attachment problems or nipple confusion as the biologic mechanism whereby pacifier use affects breastfeeding duration.

In our evaluation of breastfeeding problems, we also found minimal evidence of any problems attributable to suckling technique. At 12 weeks, there were reports that breastfeeding was inconvenient and that pacifier users experienced more problems with insufficient milk supplies. It is difficult to reconcile the proposed biologic mechanism of nipple confusion, interference with an infant learning proper latch and suckling mechanics, with maternal perceptions that breastfeeding is inconvenient in the absence of other problems like nipple trauma or breast refusal. Reported problems also were isolated and reported inconsistently across contact times. The timing of reports, at 12 weeks' postpartum, was additionally relatively late according to the proposed biologic mechanism of nipple confusion. Mothers who introduced pacifiers in this study tended to breastfeed less frequently than those who avoided use. It is plausible that women who used pacifiers tended to offer the pacifier in an effort to extend the time between feedings. Certainly, those who considered breastfeeding inconvenient might tend to delay feedings through the use of a pacifier, and infrequent feedings are a known cause of insufficient milk supply.

One possible explanation of these findings is that our results are confounded by differences between mothers who use or avoid pacifiers. Perhaps women who used pacifiers breastfed less frequently and were more likely to wean their infants earlier than mothers who avoided pacifier use for reasons unrelated to breastfeeding difficulties, but deriving from infant feeding beliefs and/or parenting styles. In support of this premise are the lack of an association between pacifier use and breastfeeding duration up to 3 months and a relative absence of significant breastfeeding problems in the pacifier group. The most recent study from the Brazilian group demonstrated that many mothers used pacifiers to wean their infants and that mothers who introduced pacifiers breastfed less frequently and were more likely to have rigid breastfeeding styles.¹² Unfortunately, the kind of ethnographic data that made those conclusions possible are not available from this study.

Although this study provides prospectively collected data, it is observational by design and is limited in its ability to provide evidence of a causal association between pacifier use and breastfeeding success. Despite efforts to adjust for potentially confounding factors, there may remain unmeasured differences between mothers who choose to introduce a pacifier or infants who engender their use that account for the observed results. Findings from observational studies also are vulnerable to reverse cau-

sality. For example, an association between pacifier use and shortened duration might result not from the effect of pacifiers on breastfeeding success but from the use of pacifiers to facilitate the weaning process. Finally, we conducted a number of analyses in this study, particularly with regard to the occurrence of breastfeeding problems, and the possibility of spurious positive findings attributable to multiple comparisons must be acknowledged.

Findings from this study also may not be generalizable to other sociodemographic groups or populations with less social and educational support for breastfeeding. This study followed a population of women that were primarily privately insured, well educated, white, and married, who might be expected to experience social and familial support for breastfeeding. Most participants had regular postpartum contact with their infant's physician, and all had contact with study nurses who offered help with breastfeeding at each follow-up contact. In combination, these factors could lessen detrimental effects of pacifier use on breastfeeding.

In summary, findings from this study suggest that pacifier use, through an association with infrequent breastfeeding, mediates the declines observed in breastfeeding duration. Given the infrequency of breastfeeding problems among pacifier users and the lack of an association with breastfeeding duration to 3 months, these data otherwise fail to support the development of nipple confusion in pacifier-exposed infants. Despite the limitations of this study, the finding that shortened breastfeeding duration is associated with pacifier use in a cohort of US women is important. Full and overall breastfeeding duration are clinically important health measures.²⁷ Many infant health benefits attributable to breastfeeding are known to depend on the duration of full breastfeeding, and overall duration is associated with such important benefits as concurrent maternal fertility reduction and lessened risks of breast and ovarian cancers.^{1,24,26,38-40}

To clarify the current evidence, additional research using the rigorous scientific methodology of the randomized clinical trial will be necessary. Such trials should be conducted in varied populations and settings and include longer periods of restricted exposure to pacifiers than have been examined thus far.¹³ Until such studies can be completed, it is important that breastfeeding support and education be incorporated into prenatal obstetric and early pediatric patient encounters. Parents wishing to use a pacifier may benefit from education about alternative methods to comfort infants, the importance of frequent suckling in establishing and maintaining milk supplies, and the benefits of full breastfeeding during the first 6 months of life and thereafter with the appropriate addition of solid foods for at least 12 months. Although pacifier use ultimately may be determined to be only a marker of women at risk for shortened breastfeeding duration, education and support of these women and their efforts to breastfeed is vital.

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Cynthia R. Howard, Fred M. Howard, Bruce Lanphear, Elisabeth A. deBlieck, Shirley Eberly and Ruth A. Lawrence

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