

Colic, Crying, Fussing, and Feeding

Alan Lucas, MB, BChir, MA, MD, and Ian St James-Roberts, PhD

Points to Recall:

- **Three lines of evidence suggest colic or crying may relate to feeding practice:**
 1. differences between breastfed and formula-fed infants,
 2. influence of feeding-bottle type,
 3. increase in crying duration with increasing early growing rate.
- **Our data suggests that about 2 weeks of age is an important time for colic and crying in formula-fed infants; by 6 weeks, breastfed infants are at higher risk.**

In the 1970s, Illingworth¹ defined colic as a condition that:

“...commences in the early evening between 6pm and 10 pm. The pain may be mild, causing the baby to be restless, or severe, causing rhythmical screaming attacks, lasting a few minutes, alternating with quiet periods in which the baby almost goes to sleep. In the attacks borboynini can be heard and the child obtains some relief in the prone position or on passing flatus per rectum... It is possible that the pain is due to wind becoming locked up in a loop of bowel.”

More recently, almost every aspect of this lucid description has been debated.²⁻¹¹ Is colic really pain? Does it really involve the gastrointestinal tract? Does it occur only in the evening? Is it actually a disease process as opposed to a developmental one? Is drug treatment appropriate - or effective? Is it one entity, or two or more conditions, one of which fits the Illingworth picture?

From a pragmatic point of view, since the condition as perceived by parents is very common and clinical advice is often sought, it is important to identify those aspects of simple care that could have an impact on colic or crying behavior.

Attention has been focused on feeding and the gastrointestinal tract by several observers,^{1,3,12-14} but the significance of such factors in colic or crying is still debated. Since feeding practices can be manipulated, however, it is important that further and more specific evidence is acquired on the possible link between feeding and crying or colic. Today I will report on a study that explored three areas related to feeding in this context: breastfeeding versus bottle feeding, the design of the feeding bottle, and growth rate during the early weeks.

Subjects and Methods

One hundred forty-five healthy, full-term infants (78 males, 67 females) were studied at 2 and 6 weeks of age. The population comprised 45 infants breastfed exclusively for at least 6 weeks and 100 formula-fed infants randomly assigned to use one of two different feeding bottles and stratified by formula type. The randomized formula-fed groups did not differ in birth weight, sex ratio, Apgar scores, mothers' age, race, or education, or economic level of the family. As expected, however, the breastfed group,

compared with those fed formula, had older mothers, 29.3 (SE 0.6) vs 26.6 (0.6) years ($P < 0.01$), who were better educated ($P < 0.001$) and came from higher socioeconomic families ($P < 0.001$). These differences are adjusted for in some statistical analyses in this paper comparing breastfed and formula-fed infants.

The randomized formula-fed groups were studied to test the hypothesis that feeding-bottle design could influence colic or crying. When using a conventional bottle, an infant creates a vacuum in the bottle that might perturb the physiology of sucking. With breastfeeding, positive milk ejection would presumably counteract this phenomenon. A company in Great Britain has made a bottle that is designed to allow air to enter it as the baby sucks, avoiding a vacuum. Following anecdotal reports to the company that use of this bottle was associated with amelioration of colic, we elected to test this formally, since this would have implications for the etiology of the condition.

Extensive demographic, clinical, and anthropometric data were collected at birth and at 2 and 6 weeks. The anthropometric data were used to test the hypothesis that infant growth, a potential marker of early nutrition, was related to colic or crying.

Crying and Colic Outcomes

The two principal outcome tools were 1) maternal-kept 3-day diaries at 2 and 6 weeks and 2) a 24-hour audio recording of the infant's vocalizations at 6 weeks, using radiomicrophones and voice-activated tape recorders on one of the diary days.² Data from the latter procedure are not yet fully analyzed and not reported here. Diary data, the main focus in this paper, were based on Hunziker and Barr's method.^{2,7} Each diary day was divided into four 6-hour periods (6 AM to 12 N, 12 N to 6 PM, 6 PM to 12 MN, and 12 MN to 6 AM). Within each time of day, mothers shaded in 5-minute periods coded for sleeping, feeding, and awake content and for three crying/colic behaviors²: “fussing” (baby unsettled and irritable and may be vocalizing but not continuously crying); “crying” (periods of intense distressed vocalization); and “colic” (bouts of intense, unsoothable crying and other behavior, perhaps due to stomach or bowel pain). Diary data were not collected for all the infants, hence the slightly smaller numbers in tables than recruitment numbers.

Results

Breastfed Versus Formula-Fed Infants (conventional-bottle group only)

We hypothesized that formula-fed infants would have more colic and distressed vocalization than would those fed by breast. The Table shows diary data for 2 and 6 weeks: data from the 3 days were averaged to produce a mean 24-hour total of the behaviors in the four times of day (morning + afternoon + evening + night) studied.

Table. Daily Duration of Infant Behaviors Based on Parent-Kept Diaries at 2 and 6 Weeks. Data are mean in minutes (SE)

Behavior	2 Weeks		6 Weeks	
	Bottle n = 49	Breast n = 43	Bottle n = 41	Breast n = 37
Sleeping	809 (26)	788 (21)	817 (20)	733 (25)*
Feeding	209 (9)	269 (14) [†]	200 (12)	235 (15)*
Awake content	220 (13)	217 (14)	262 (14)	272 (19)
Fussing	75 (8)	74 (8)	65 (7)	83 (9)
Crying	43 (5)	43 (5)	34 (7)	49 (7)
Colic	22 (7)	4 (2)*	7 (2)	7 (2)
Total distressed vocalization	141 (12)	121 (10)	106 (8)	139 (9) [†]

* $P < 0.05$, [†] $P < 0.01$

Breastfed infants differed from formula-fed infants in spending significantly more time feeding at both 2 and 6 weeks. Between 2 and 6 weeks there was a significant drop in sleep time only in the breastfed group - from 788 (SE, 21) minutes to 733 (25) minutes ($P < 0.01$). Thus, by 6 weeks, breastfed infants slept significantly less than did those fed formula ($P < 0.05$).

At 2 weeks of age, distressed vocalization tended to be of longer duration in formula-fed versus breastfed infants. The total of all such vocalizations was 141 (SE, 12) minutes for the formula-fed group versus 121 (10) minutes in the breastfed group. This difference reached significance for one aspect of distressed vocalization: "colic" - 22 (SE, 7) minutes per day in the formula-fed group versus 4 (2) minutes in the breastfed group (Table). However, of considerable interest was the reversal of this pattern by 6 weeks. Indeed, between 2 and 6 weeks, the total of all distressed vocalization declined significantly in the formula-fed group, from 141 (12) to 106 (8) minutes ($P < 0.01$), and rose from 121 (10) to 139 (9) minutes in the breastfed group ($P = 0.1$). Thus, as the Table shows, by 6 weeks, total distressed vocalizations were significantly greater in breastfed than in formula-fed infants ($P < 0.01$).

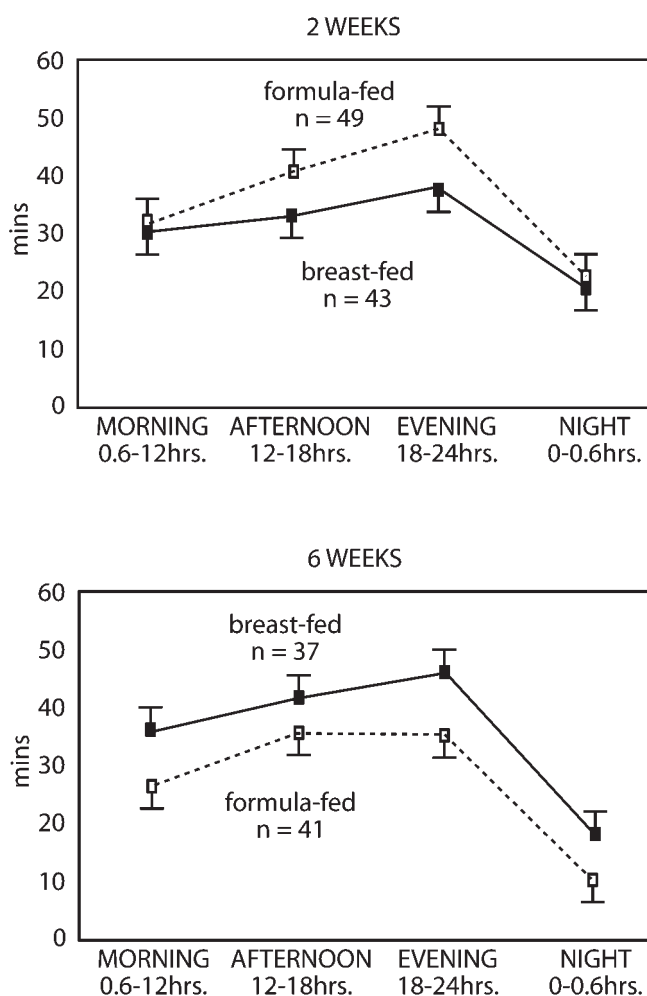
When those infants with total distressed vocalizations for over 3 hours were identified, 31% (15/49) of formula-fed infants fulfilled this criterion at 2 weeks, but only 12% (5/41) at 6 weeks - a significant fall ($P < 0.01$). In the breastfed group, there was a small rise from 19% (8/43) at 2 weeks to 24% (9/37) at 6 weeks (not significant). The population studied was also divided into those whose mothers recorded any colic in the diary or not. At 2 weeks, 43% (21/49) of formula-fed infants had colic at 2 weeks compared with 19% (8/43) of the breastfed group ($P < 0.05$). Again, by 6 weeks the incidence of recorded colic had fallen in the formula-fed group and risen in the breastfed group.

Fig 1 shows the diurnal pattern of distressed vocalization at 2 and 6 weeks. The reversal (formula worst at 2 weeks; breast worst at 6 weeks) is shown. An evening peak in crying duration was not dramatic, compared with crying durations in the morning and afternoon, but can be seen in both groups in the graphs.

All the identified differences between breastfed and formula-fed infants persisted after adjustment for potential confounding factors: maternal age, mother's education, and social class (determined by parental occupation).

In summary, our data indicate that the mode of feeding in healthy infants is strongly related to the duration of certain behaviors - sleeping, feeding, colic, and crying - even after adjustment for potentially confounding differences between breastfed and formula-fed infants. These data are surprising, in that they identify such an early period, 2 weeks, as an important one for distressed vocalization in formula-fed infants. Equally surprising was the significantly greater duration of total distressed vocalization in breastfed than in formula-fed infants at 6 weeks - a difference of 33 minutes per day and contrary to our starting hypothesis.

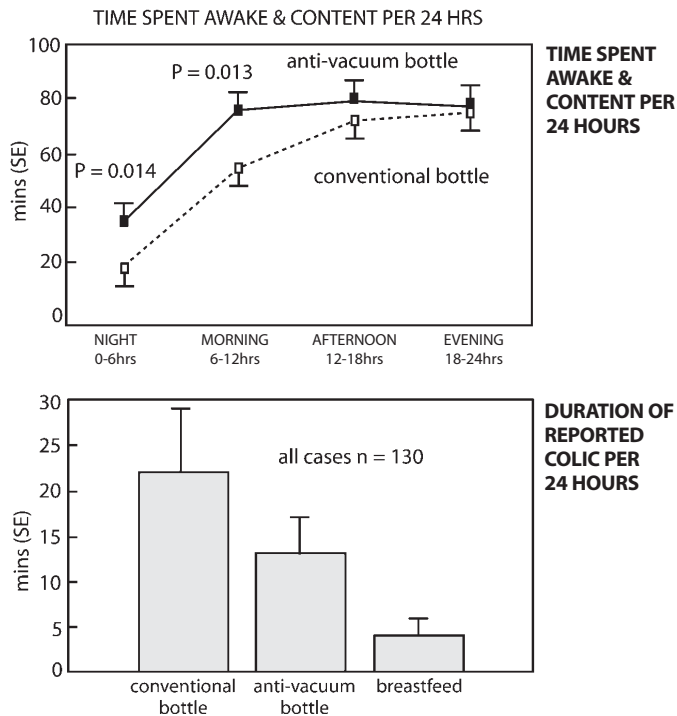
Fig 1. Duration of distressed vocalization throughout the day (summed for each 6-hour period) at 2 weeks and 6 weeks in formula-fed and breastfed infants.



Antivacuum Versus Conventional Bottle

At 2 weeks, a difference in the behavior pattern between randomized groups emerged. Infants fed with an antivacuum bottle spent significantly more time awake and content (total 265 [SE, 20] minutes) compared to those fed with conventional bottle: 220 (13) minutes ($P < 0.05$). This difference was marked at night and in the morning (Fig 2, top). There was also a trend to less recorded colic with the anti-vacuum bottle. Thus, for all infants (including those without colic), mean colic duration was 13 (4) minutes versus 22 (7) minutes on the conventional bottle; and for just those infants with colic, the mean duration was 31 (8) minutes with the antivacuum bottle versus 52 (15) with the conventional bottle. Those fed with the antivacuum bottle had a duration of colic closer to that seen in the breastfed infants (Fig 2, bottom). Indeed, analysis of the data in Fig 2, bottom, shows a significant decreasing linear trend in colic duration from conventional bottle to antivacuum bottle to breastfeeding ($P < 0.02$). At 6 weeks, no differences were found between bottle types.

Fig 2. Comparison of antivacuum and conventional feeding bottles at 2 weeks.



Colic, Crying, and Growth

Total duration of distressed vocalization in all infants (breastfed and formula-fed) at both 2 and 6 weeks was found to be significantly related to weight gain and length gain from birth to 6 weeks. These relationships were most marked in formula-fed infants and not significant in those who were breastfed. For instance, in Fig 3, weight gain from birth to 6 weeks has been divided into four categories (< 1 kg, 1-1.5kg, 1.5-2 kg, and > 2 kg) and related to the total of distressed vocalization at 2 weeks in formula-fed infants. The overall linear increase in vocalization with increasing weight gain was significant at $P = 0.009$ and was independent of birth weight. Fig 3 shows that infants who gained > 2 kg ($n = 10$) by 6 weeks had a mean period of vocalization (193 minutes) in excess of the value (3 hours) used by some to define more troublesome crying. Those who gained < 1 kg had little more than half the crying duration of those gaining > 2 kg.

Fig 3. Duration of total distressed vocalization at 2 weeks (minutes, SE) according to amount of weight gain (kg) from birth to 6 weeks.



Comments and Conclusions

Three lines of approach used in our study indicate that the mode of feeding may influence colic or crying. First, breastfeeding versus formula feeding appeared to have a major influence on sleeping and on crying and colic. It is possible that this could reflect confounding, since it is not possible to randomly assign these feeding groups and they are demographically quite different. However, two aspects of our data suggest a causal relationship between mode of feeding and distressed vocalization: 1) The relationship persisted after adjusting for major confounders, and 2) within each feeding group, there were changes in duration of colic and distressed vocalization that occurred over time (from 2 to 6 weeks), in opposite directions. It seems unlikely that demographic differences between groups could explain why formula-fed infants should apparently decrease and breastfed babies increase their crying behavior.

Few data have been collected on crying in the early neonatal period. It needs to be established whether the neonatal period indeed would be the best target period for feeding interventions designed to reduce colic in formula-fed infants. Interestingly, our randomized formula-bottle trial showed that effects on behavior and possibly colic duration were seen only at 2 weeks and not at 6 weeks.

The strong relationship between growth rate and distressed vocalization needs further investigation. One interpretation is that high levels of milk intake, which might explain the increase in growth, cause colic or crying. It was particularly interesting to note that half the infants who gained more than 2 kg in the first 6 weeks fulfilled a criterion for troublesome crying (periods of intense distressed vocalization) of more than 3 hours per day.

Collectively, the finding presented here provide three lines of evidence (breast milk versus formula, bottle design, and growth data) that add weight to the view that colic or distressed vocalization may relate at least in part to feeding. Since feeding policy can be manipulated, it may prove possible in the future to minimize distressed vocalization by modifying feeding practices.

Acknowledgements

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The Authors

Alan Lucas MB, Bchir, MA, MD, FRCP,
MRC Clinical Research Professor, Childhood Nutrition Centre,
Institute of Child Health, London, England.

Ian St James-Roberts, PhD.
Senior Lecturer in Child Development,
Thomas Coram Research Unit and Department of Child
Development and Primary Education, London University Institute
of Education, London, England.

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