

INFANT FEEDING**Breast- vs. Bottle-Feeding***A Study of Morbidity in Upper Middle Class Infants*

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This study compares the morbidity of two groups of healthy, full-term infants (25 in each group) who were exclusively either bottle-fed or breast-fed for 5 months. There were no statistically significant differences in morbidity between the two groups except for a borderline greater frequency of upper respiratory infections in the bottle-fed group.

Although the study groups are limited in size, the results suggest that, when appropriate hygienic measures are taken and statistical biases eliminated, differences in morbidity between bottle-fed and breast-fed babies are relatively minor.

The data also show that modern infant formulas seem to be nutritionally complete in that there was no difference in the rate of growth or in hematological parameters measured in the bottle-fed and breast-fed group.

THERE IS very little disagreement over the primacy of breast milk as the optimal infant feeding method in developing countries.¹ Controversy still exists, however, concerning the advantages of bottle- vs. breast-feeding in a sophisticated society such as the United States.²⁻⁶ Many studies comparing morbidity in breast- and bottle-fed infants have been impaired by lack of homogeneity in the study population.⁷ The increased morbidity observed in artificially fed infants in developing countries may be due mainly to environmental contamination rather than to nutritional deficiencies of infant formulas.⁸

The pediatric practice of one of the authors (Eiger) was eminently suited to eliminate some of the biases encountered in other studies for the following reasons: (1) it was a homogeneous, upper middle-class population of similar socioeconomic stature living in a large

urban area (New York City); (2) the parents were highly educated and all had made independent choices as to the method of feeding their infants; (3) the two groups of infants were closely comparable as regards family conditions (e.g., sibling members); and, (4) milk was the only source of nutrition in both groups.

Methods

The study was conducted in a predominantly upper middle-class population from a private practice in which approximately 70 percent of the mothers breast-fed their infants. The study subjects were all full-term, healthy newborns. Solid foods were not given during the 5 months of the study period, the only nutritional source being breast or formula milk. The formula used was a standard brand of modified cow's milk, iron-fortified at 12 mg per ready-to-feed quart. Formula-fed babies did not receive vitamin or iron supplementation other than that present in the formula. Breast-fed babies were given vitamins A, D, and C supplementation from the second week of life, but no iron supplementation. All study subjects were seen at routine monthly visits and for intercurrent illnesses.

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BREAST- VS. BOTTLE-FEEDING

TABLE 1. *Physical Characteristics, Mean (SE)**

Test Group	Length (cm)	Weight (kg)	Head Circumference (cm)	Chest Circumference (cm)
At Birth				
Breast	51.3 (0.2)	3.4 (0.1)	36.0 (0.4)	35.6 (0.4)
Bottle	50.5 (0.5)	3.2 (0.1)	36.4 (0.4)	35.4 (0.5)
p-value	0.03	NS†	NS	NS
After 5 Months				
Breast	65.2 (0.6)	7.2 (0.2)	42.8 (0.3)	43.1 (0.5)
Bottle	64.6 (0.6)	7.2 (0.2)	42.6 (0.4)	42.7 (0.4)
p-value	NS	NS	NS	NS

* SE—Standard error.

† NS—Not significant.

The number of phone calls was not recorded but there was no difference in the number of office visits. All infants were measured (length, head circumference, and chest circumference) and weighed by the same person at their monthly visits. Laboratory parameters were measured from heel stick blood samples at 1, 3, and 5 months of age by standard techniques. These included: red blood cell count (RBC), white blood cell count (WBC), differential white cell count including polymorphonuclear leukocyte percent (POLY) and lymphocyte percent (LYMPH), mean corpuscular volume (MCV), hemoglobin concentration (HGB), hematocrit percent (HCT), serum total bilirubin (TBIL), and serum direct bilirubin (DBIL). To prevent bias, data gathering, laboratory work, and data analysis were carried out by different investigators. The statistical analysis was performed without knowing which group was breast-fed and which was bottle-fed.

Results

Table 1 summarizes the physical characteristics of the breast-fed and bottle-fed groups at the beginning

and at the end of the study. There were no statistically significant differences. In addition, there was no statistically significant difference between the two groups in rate of growth as measured by a linear regression of the physical variables on age (weeks). The values were determined by an analysis of variants with repeated measurements adjusted for initial (birth) measurements.

Table 2 summarizes the laboratory values measured at 1 month of age and at the end of the study (5 months of age). There were no statistically significant differences in the parameters measured except for total and direct bilirubin at 1 month. The differences in total bilirubin and in direct bilirubin between the two groups at 1 month of age were due primarily to six infants (in the breast-fed group) having values higher than any of the other infants. Values for total bilirubin and direct bilirubin for these six infants returned to normal 2 months after birth.

Although the breast-fed group had no iron supplementation, the hematologic parameters measured were no different from the formula-fed infants who had been receiving the iron fortified formula (Table 2).

TABLE 2. *Hematological Data, Mean (Standard Error)*

	At 1 Month			After 5 Months		
	Breast-fed	Bottle-fed	p	Breast-fed	Bottle-fed	p
RBC* (mil)	4.1 (0.1)	3.8 (0.2)	0.08	4.4 (0.1)	4.4 (0.1)	NS
WBC (×10 ³)	10.1 (0.4)	10.5 (0.4)	NS†	10.1 (0.5)	10.6 (0.5)	NS
POLY (%)	22.0 (2)	20.0 (1)	NS	20.0 (2)	22.0 (1)	NS
LYMP (%)	67.0 (3)	69.0 (2)	NS	72.0 (3)	71.0 (2)	NS
MCV (cm)	9.7 (0.1)	10.0 (0.1)	0.09	8.2 (0.2)	8.0 (0.1)	NS
HGB (g/dl)	13.7 (0.4)	12.8 (0.5)	NS	12.5 (0.3)	12.3 (0.2)	NS
HCT (%)	39.3 (1.3)	37.9 (1.6)	NS	35.4 (0.7)	35.0 (0.6)	NS
TBIL (mg/dl)	2.3 (0.4)	0.8 (0.2)	0.001	0.9 (0.3)	1.1 (0.2)	NS
DBIL (mg/dl)	0.24 (0.04)	0.13 (0.01)	0.004	0.15 (0.02)	0.18 (0.01)	NS

* Abbreviations used in this column indicate the following laboratory values: RBC—Red blood cell count; WBC—White blood cell count; POLY—Polymorphonuclear leukocyte; LYMP—Lymphocyte; MCV—Mean corpuscular volume; HGB—Hemoglobin concentration; HCT—Hematocrit; TBIL—Serum total bilirubin; DBIL—Serum direct bilirubin.

† NS—Not significant.

Table 3 summarizes morbidity observed in the infants during the 5 months of the study. Criteria for morbidity was not established before the study was begun. Except for a borderline statistically significant increase in number of episodes of upper respiratory infection in bottle-fed infants, no difference in morbidity was observed between the breast- and the bottle-fed infants. Appropriate statistical analysis demonstrated that the differences in upper respiratory infection were not due to sibling effect; *i.e.*, infants in both groups had a similar distribution of the number of siblings.

Discussion

The question of whether bottle-fed infants in developed countries have a greater morbidity than breast-fed babies is undetermined. Although most data seem to show that breast-fed babies present with less illnesses than bottle-fed babies,¹⁻⁴ there is also evidence to the contrary.^{5,6}

Some statisticians have questioned the validity of studies showing less morbidity in breast-fed infants. It has been argued that the population of breast-feeding mothers is different from that of bottle-feeding mothers.⁷ For example, the breast-feeding mother population tends to be more educated,⁹⁻¹¹ of a higher socioeconomic stratum,^{12,13} less likely to work outside the home,¹⁴ and less likely to smoke¹⁵ than bottle-feeding mothers.

These differences between breast- and bottle-feeding mothers may influence the mother's access to medical care, her health, and her effectiveness as a health care provider for her infant.

Thus, the "Berkson fallacy"¹⁶ becomes evident; that is, a statistical vagary intrudes when the patients' selection is done in a way that does not represent the population as a whole in an even fashion,¹⁷ and the populations studied, when compared, are not "homogeneous."

The world literature contains an abundance of data which prove that breast-feeding does offer advantages to infants in underdeveloped countries where gastroenteritis is associated with an increased morbidity and mortality.^{1,18} These gastrointestinal diseases are due mainly to an unfavorable environment with lack of good hygiene and sanitary conditions.⁸ In industrialized countries, however, the problems of study design have precluded reaching definite conclusions because of the characteristics of the populations (breast and bottle) studied. There is a one-way flow of infants from the breast-fed group to the bottle-fed group and

TABLE 3. Morbidity

Category	Breast-fed	Bottle-fed	p-value
Upper respiratory infection	5 (20%)	12 (48%)	0.07
Lower respiratory infection	1 (4%)	1 (4%)	NS*
Acute otitis media	0 (0%)	1 (4%)	NS
Diarrhea and/or vomiting	3 (12%)	1 (4%)	NS
Dermatitis (diaper rash and/or eczema)	11 (44%)	12 (48%)	NS
Hypochromic anemia†	1 (4%)	2 (8%)	NS
Others	10 (40%)	8 (32%)	NS

* NS—Not significant.

† Anemia was defined as infants with less than 11 g of hemoglobin.

never the other way around. In other words, this phenomenon would work to place the "healthiest" group of infants in the breast-fed group and all "dropouts" in the bottle-fed group. There was then a justification for carrying out studies where the populations of breast-feeding *vs.* bottle-feeding mothers would be as "pure" and "homogeneous" as possible.

The breast-fed group had no iron supplementation. The hematologic parameters measured were no different from the formula-fed group that had been receiving the iron fortified formula. Under ordinary circumstances, lack of iron supplementation to solely breast-fed term infants is not associated with anemia at the end of 5 months of life.

Prolonged elevation of serum indirect reacting bilirubin in breast-fed infants in the first weeks of life has been well-documented.¹⁹⁻²¹ This phenomenon usually resolves by the end of the second month of life, although occasional persistence into the third month of life has been reported. Serum bilirubin levels rarely exceed 20 mg/dl and usually decrease markedly after a brief cessation (24-72 hours) of breast-feeding. The etiology of this phenomenon has not been determined fully. The breast-fed infants had higher total and direct bilirubin tests in this study. The lack of clinical significance of this finding is shown by its disappearance by 2 months of age without any differences between groups at any time in other hematological values.

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CLINICAL CORRESPONDENCE

Infant Feeding in Bygone Days

To the Editor:

Organized rebellion by various "health providers" in the form of a strike is not a frequent phenomenon in this day and age, but the following news item in the London *Lancet* of May 19, 1894, (page 1261) casts some flickering light on past and present problems of pediatric nutrition.

A Strike of Wet-Nurses

It is reported that Austria is threatened with famine, and that of a kind which is probably unprecedented in history. Like some others in recent times, it is not traceable to any adverse disposition of nature, but to economic discontent. Fortunately it cannot affect the entire population. The wet-nurses of the dual monarchy have rebelled against the conditions of their occupation, and the infant reinforcements of the nation are in danger of losing an important source of food-supply. The demands of the nurses are neither few nor small. They include an eight hour day, a vacation or close time, Sundays off duty, 30s. a week, and, above all, the abolition of a syndicate, which is their middleman. This latter arrangement surely ought to be, if it is not, a superfluous convenience. Its existence, however, only proves

to what dimensions the system of wet-nursing has grown in the country. This fact is in itself suggestive. So many mothers, yet so little milk that a stranger must be entrusted, and that as an everyday occurrence, with the performance of the most elementary duties of maternity—we have here no happy augury for the future of the race. The above proposals, moreover, very strongly tempt us to inquire what constitutes the essential character of a wet-nurse if her duties can be so readily performed, as they must be during her seasons of recreation, by the simple expedient of employing a feeding-bottle. It is perhaps surprising that their profits and their utility have not already been more seriously encroached upon than they have by their artificial rival. The proposed strike will not, we imagine, procure for nursing women that leisure or personal comfort which they, like many others who live to maintain the world's health and energies, vainly desire; it will, however, have done much if its effects should be the diminution of their own excessive numbers, and a more righteous recognition of the duties of Austrian motherhood.

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