

BREASTFEEDING AND THE PREVENTION OF MALNUTRITION

E. F. PATRICE JELLIFFE

SUMMARY

The role of breastfeeding in preventing malnutrition is considered in relation to the Bostock classification of early human development, its relevance to different forms of malnutrition and to general ecological considerations, including economics and the management and prevention of diarrhoea.

INTRODUCTION

The role of breastfeeding in preventing malnutrition can be most logically considered in relation to sequential analysis of early human development using the Bostock classification¹ — the foetus, the "external (or extero-gestate) foetus" (from birth to six months or so) and the subsequent "transitional" or weanling (Fig. 1)

The concept of the external foetus is important. Human babies are obviously extremely helpless and dependent. They cannot walk and are dependent in large measure on milk from the mother's breasts, which can be considered as an external placenta. Following this helpless phase, the transitional child moves from dependence on the breast milk towards other foods.

In many communities, the extero-gestate foetus is carried (or "marsupialized") on the mother's back. During this time, the child is having skin-to-skin contact with his mother, he is listening to her heartbeat to which he has been accustomed during the nine months *in utero*. In addition, the child is obtaining an early socialization

E. F. Patrice Jelliffe
Lecturer, Population and Family, Health Division,
School of Public Health, University of California
Los Angeles, California 90024, USA

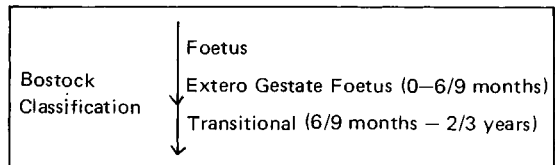


Fig. 1 Bostock classification of early human development.¹

with the community. Instead of sitting in a cot in the house, he is able to look around and get used to other people and other sounds.

Reviewing the nurturing process at these three states of development, the foetus receives nutrients transplacentally, and possibly also while ingesting about a litre of amniotic fluid. This may be a source of amino acids, pantothenic acids and other nutrients.

Secondly, the external foetus obtains nutrients from stores, from breast milk, from sunlight (vitamin D) and *via* the placental transfusion (Table I).

Breast milk, including colostrum, is the most important source of nutrients for the extero-gestate foetus. As is increasingly appreciated, colostrum provides a bonus of some important nutrients, including zinc and vitamin A, etc. Also, ultraviolet light from sunshine is the main source of vitamin D, which is not really a vitamin, but a hormone secreted by the skin.

With regard to the transitional, then the weaning diet, made up of multimixes or mixtures of foods which complement each other nutritionally, become progressively dominant nutritionally. In fact in the second year of life, breast milk becomes a supplement and, after six months of life, it is no longer the main food

Paper presented at the 5th Asian Congress of Paediatrics on "Better Child Health in Developing Countries" 5-9th August 1985, Kuala Lumpur.

TABLE I

RELATIVE ROLE OF BREASTFEEDING IN THE PREVENTION OF COMMON TYPES OF MALNUTRITION IN EARLY CHILDHOOD COMPARED WITH SIGNIFICANCE OF FOETAL STORES, SEMI-SOLID WEANING FOODS, ETC.

Major Vitamin / Mineral Deficiencies			
General	Vitamin A (Xerophthalmia)	Vitamin D (Rickets)	Fe (Iron) (Iron deficiency anaemia)
Sources of nutrients:			
Foetal stores	significant (+)	significant (+)	significant (+)
Breast milk	significant (+) (colostrum)	insignificant (\pm)	significant (+) (bioavailability)
Weaning foods semi-solids	very highly significant (+++)	insignificant	very significant (+)
Special			
Placental transfusion	not significant	not significant	significant (+)
U.V.L.	not significant	very highly significant (+++)	insignificant

However, as described from Indonesia, in the second year of life the mother can provide the equivalent of about a glass of breast milk a day.² This is an important nutritional supplement as regards protein and other nutrients. During the transitional period, the infant may still be using some foetal stores and he should be obtaining vitamin D from the ultraviolet light in sunshine.

WIDER PERSPECTIVES

General Considerations

Breastfeeding has a wide role in the prevention of malnutrition in early childhood. Firstly, there is the obvious direct dietary function of breast milk in supplying nutrients for rapid growth. Secondly, the anti-infective properties of breast milk have a nutritional significance in protecting the infant from infections which contribute to the development of malnutrition ("conditioning infections"). Thirdly, the partial effect of breastfeeding is important with regard to child spacing, family planning and to population size. This is obviously highly important in a world striving to provide enough food and other services for its rapidly expanding population.

Fourthly, the economic significance of breastfeeding has to be considered in terms of the cost of alternative feeding at the family level, and also as regards the important loss of resources at a national level, especially in terms of self-sufficiency of basic food supplies. As an example, it may be noted that a calculation made in

Brazil some years ago showed that about 3.6 billion *cruzeiros* would need to be spent annually for replacements if breastfeeding were to cease completely.

Protein-Energy Malnutrition

Breastfeeding has its most significant preventive role against Protein-Energy Malnutrition (PEM) (Table I). This is especially the case in infantile marasmus, because the alternative in Third World circumstances is bottle feeding with dilute, contaminated formula. Rarely, infantile marasmus can also occur if the mother's milk supply is very limited. This can take place, for example, in famines, such as in Ethiopia and Somalia recently. Also, inadequate milk can occur with mothers living in highly deprived communities, where there is little money, poor housing and sanitation, and great social stresses, which affect the maternal let-down reflex. Lastly, women who are taking high doses of oestrogen contraceptives can have a significantly decreased volume of breast milk.

Breast milk also plays a significant role in the prevention of kwashiorkor. The relation of small amounts of milk ingested in the second year of lactation can assist nutritionally, especially in increasing the protein intake, which is low in kwashiorkor. Semi-solid weaning food multimixes play no role in the prevention of infantile marasmus, but become increasingly significant in the child who is being weaned, often starting between the ages of four and six months.

Community Case Study:¹ Infantile Kwashiorkor

The protective effect of breast milk was illustrated by a retrospective study undertaken some years ago looking at children admitted to San Fernando Hospital, Southern Trinidad.² In this study, the records of children who were admitted with severe PEM were analysed. 80% were below one year of age, and 14% were between the ages of one and three years.

On analysing the children with kwashiorkor, 15 (83%) were under one year of age, and 9(50%) were aged two to four months. This is, of course, a very unusual age range for kwashiorkor, and nowadays in Trinidad, infantile kwashiorkor has practically disappeared because of improved economics, and nutrition.

Examination of the feeding patterns of affected children was undertaken. The mothers of these children showed no evidence of malnutrition. However, breast-feeding was very inadequate in 99% of affected children. That is, it was either not initiated, or only given two or three times a day and then complemented with milk, or it was discontinued two months before the child was admitted to hospital. The bottle feeding comprised either very dilute cow's milk, or formula, or sweetened condensed milk. Also, the babies with infantile kwashiorkor were also being fed with a gruel made from arrowroot. Now, arrowroot is a root which is grown mainly in St. Vincent and other islands. It was at this time very popular in the Caribbean for infant feeding. Unfortunately, it contains almost no protein, but has quite a substantial amount of calories.

Babies with infantile kwashiorkor presented oedema (Fig. 2) and a low serum albumen. Also, at post-mortem, they were found to have large, fatty livers.

In other words, failure of breastfeeding together with a low protein, high calorie diet in the early months of life led to the development of infantile kwashiorkor.

Community Case Study:³ National Nutritional Survey

Another investigation indicating the preventive role

TABLE II
INFANTILE KWASHIORKOR: AGE DISTRIBUTION
OF YOUNG CHILDREN ADMITTED TO HOSPITAL
(SOUTHERN TRINIDAD, 1960)³

<p>TOTAL KWASHIORKOR: 18 < 1 yr : 15 (83%) 2-4 months : 9 (50%)</p>



Fig. 2 Infantile kwashiorkor: showing bilateral pitting oedema, moonface and very large liver.³

of breastfeeding was a national survey for malnutrition in early childhood on the island of Haiti.⁴ This included 22 rural villages in representative areas of the country, and one slum area in Port Au Prince. Results showed that, using the Gomez weight classification, no severe PEM was seen in babies in the first six months of life (Table II). This was because they were totally or predominantly breastfed.

In the same survey, 7% of one to three-year olds were found with kwashiorkor in the community — a very high rate indeed.

Other Community Data

Results from Iran reported by Sadre⁵ contrasted the incidence of severe PEM in children in urban and rural areas. Differences were marked. In urban areas, where bottle feeding was widespread, 26% of infants in the first six months of life were under 60% of the Harvard standard weight for age. By contrast, in rural areas where

TABLE III
DEGREE OF MALNUTRITION BY WEIGHT DEVIATION IN FIRST AND SECOND HALVES OF FIRST YEAR OF LIFE: 22 RURAL VILLAGES, 1 SLUM (HAITI)⁴

Age group (months)	Weight			
	Normal (%)	Degree of malnutrition		
		1st (%)	2nd (%)	3rd (%)
0-6	86	12	2	0
6-12	60	20	17	3

breastfeeding was the norm, no children were reported with severe PEM in this age group.

Again, a study some years ago in Thailand showed a completely contrasting picture in rural areas and slums with regard to severe malnutrition under six months of age.⁶ In four villages, there was very little severe PEM compared with Bangkok slum babies of the same age-range. A basic difference was the fact that breastfeeding is low in the urban areas in contrast to the rural areas.

Vitamins and Minerals

Breastfeeding needs consideration in the prevention of major vitamin and mineral deficiencies which are of public health importance in some Third World countries, i.e., vitamin A (xerophthalmia), vitamin D (rickets), and iron deficiency (anaemia) in young children and iron deficiency in women.

These need reviewing in relation to the significance of foetal stores, breast milk, weaning multimixes and other sources of nutrients.

Foetal stores are important initially in relation to vitamin A, iron and vitamin D. Breast milk, particularly colostrum, is one significant component in the prevention of avitaminosis A.

By contrast, breast milk is not very significant as a source of vitamin D. However, in terms of iron, its value has been under-valued. This is because of the high bio-availability of iron in human milk.

With regard to weaning foods, they are very highly significant in terms of prevention of vitamin A deficiency. In most Third World countries, there are many sources of carotene-rich yellow and green vegetables, and other food items containing iron.

With regard to rickets, the weaning diet in most circumstances plays no part in prevention, which is related to the degree of exposure of the young child to sunlight. This may pose considerable cultural problems for both mothers and their infants. Difficulties may be due to the practice of women veiling themselves, or swaddling their babies and/or keeping them out of the sun because they would like the babies to have a light complexion.

Negative role

Under certain extreme circumstances, breastfeeding can have a negative role. For example, if mothers are receiving a diet which is very low in thiamine, breast-fed babies can develop infantile beri-beri with aphonia and with heart failure. This has been reported in recent years in refugee camp circumstances in Southeast Asia. Also, severe dietary restrictions of vitamin B₁₂ in mothers can produce a "syndrome of tremors" with pigmentation of extremities.

Less commonly considered, and more difficult to diagnose, is zinc deficiency. Again, bioavailability of this nutrient is high with breast milk. This has been shown to be due to a specific protein.⁷

Diarrhoea

Diarrhoea is one of the main contributory infections in malnutrition, and recent emphasis has been given to the role of breastfeeding in the management of diarrhoea. This is important for several reasons (Table III). Firstly, breastfeeding is a source of clean water. Secondly, it is vital to ensure the continuation of lactation during and after the diarrhoeal episode. Also, breast milk is a source of various substances which facilitate the absorption of sodium and water. These include the amino acids, alanine and glycine, and also glucose. Human milk continues to supply many anti-infective substances,

TABLE IV
ROLE OF BREASTFEEDING IN MANAGEMENT OF DIARRHOEA

Source of clean water.
Ensures continuation of lactation.
Source of substances facilitating absorption sodium and water (eg. alanine and glycine).
Supplies nutrients not usually traditionally available in weaning diets e.g. fat, vitamin A, iron and full range amino acids.
Anti-infective factors.

including factors which prevent or limit the adherence of *E. coli* fimbria to the intestinal epithelium.

In addition, the protective role of breastfeeding and infectious diarrhoea is well-emphasized in a study which was undertaken in Israel in 1972.⁸ This looked at the hospitalization of children in the first three months of life with severe gastroenteritis. Results showed a rate of 0.5% breastfed babies, compared with 24.8% in the bottle-fed. The significance of this is, of course, not related to the immediate risk of death from dehydration, but also the possible initiation of malnutrition.

CONCLUSION

It is obviously a priority to continue with efforts to protect and promote breastfeeding. This implies paediatric advocacy for politicians and administrators. There is a continuing need to educate them in the facts. This is not only for humanitarian reasons. Breast milk prevents or minimizes various forms of malnutrition and diarrhoea; it thus has a preventive benefit economically by limiting the need for certain types of health services, as well as reducing the expenditure of limited foreign currency on unnecessary imports — formulas.

REFERENCES

- ¹ Bostock J. Evolutionary approaches to infant. *Lancet* 1962; i:1033–1035.
- ² Rohde J E. Mother's milk and the Indonesian economy: a major national resource. *J Trop Pediat* 1982; 28:166–174.
- ³ Jelliffe D B, Symonds B E R, Jelliffe E F P. The pattern of malnutrition in Southern Trinidad. *J Pediat* 1960; 57:922–928.
- ⁴ Jelliffe D B, Jelliffe E F P. The nutritional status of Haitian children. *Acta Tropica* 1960; 18:1–40.
- ⁵ Sadre M, Emami E, Donoso G. The changing pattern of malnutrition. *Ecol Food Nutr* 1971; 1:55–58.
- ⁶ Khanjanasthiti P, Wray J. Early protein-calorie malnutrition in slum areas of Bangkok municipality, 1970–71. *J Med Ass Thailand* 1975; 57:468–472.
- ⁷ Eckhert C. Isolation of a protein from human milk that enhances zinc absorption in humans. *Bioch Biophys Res Commun* 1985; 130:264–249.
- ⁸ Kanaaneh H. The relationship of bottle feeding to malnutrition and gastroenteritis in a pre-industrial setting. *J Trop Pediat* 1972; 18:302–305.