RECENT DEVELOPMENTS IN BREASTFEEDING

DERRICK B. JELLIFFE

SUMMARY

Recent developments in breastfeeding are reviewed in relation to species-specific adaptive suckling and the level of maturity of the newborn. Scientific advantages and advances are noted concerning biochemistry, protective substances, emotional differences, child spacing and economics. The significance of unimpaired maternal reflexes and the need for information is stressed with regard to successful lactation and as common causes of inadequacy. The components needed in varying degrees, in breastfeeding programmes are mentioned briefly.

INTRODUCTION

Recent years have demonstrated ever more clearly the very great differences between human milk and the process of breastfeeding and bottle-feeding using cow's milk-based formulae.

ADAPTIVE SUCKLING

Research in different mammal species has clearly shown that their milks have become adapted and modified over millions of years to suit the precise needs of their particular offspring. For example, such sea mammals as whales and dolphins have a very high fat, calorie rich milk and a powerful milk ejection to permit the infant to receive large amounts of calories rapidly while feeding underwater.

Derrick B. Jelliffe, M.D.
Professor of Public Heath and Paediatrics
University of California, Los Angeles
School of Public Health, University of California
Los Angeles, California 90024, USA

The human infant has an intermediate level of maturity and at birth is essentially an "external foetus".[1,2] In fact, in the human the full foetal period may be envisaged as being eighteen months in duration, while the newborn is delivered at nine months in part because of difficulties in accommodating the large-sized head in the birth canal during delivery. This means, therefore, that biologically the human baby continues the close intra-uterine existence after birth with maternal body warmth and skin-to-skin contact, with the same auditory stimuli (especially the mother's heartbeat) and with the breasts acting as an external placenta. Also, the biochemical composition of human milk and the method of suckling indicates that the human can be classified as a "low solute, frequent suckling species".

SCIENTIFIC ADVANCES

In the last decade a flood of information has become available as the unique significance of human milk and breastfeeding have become increasingly apparent.[2,3] After a period of several decades of lack of interest or concern, many modern scientists have been employing new laboratory techniques to investigate this field. This has meant that a very large and continuing amount of new information has become available in recent years and continues to do so.

Biochemistry

The biochemical differences between human milk, cow's milk and infant formula have been absurdly over-simplified in paediatrics and other textbooks until recently. In fact, the only real similarities between the three are that they are whitish in colour and contain water and lactose. Even this comparison is not really valid as the normal light bluish color of human milk

Paper presented at the Pre-Congress Symposium on "Childhood Nutrition", 5th Asian Congress of Paediatrics, *4th August 1985, Kuala Lumpur, Malaysia.*

is not at all the same as the denser white of cow's milk, an unappreciated fact that can give rise to anxiety in mothers.

Recent biochemical studies have indicated that every other aspect of human milk shows a quite different structure from that of cow's milk or cow's milk-based formula. For example, the tyrosine content of cow's milk is very much higher than that in human milk. All the other biochemical constituents are also quite different and distinct. For example, detailed analysis indicates that the "casein-systems" are species-specific. The presence of enzymes, including fat-splitting lipase, in human milk is notable and indicates that the digestion of fat has commenced whilst in the infant's mouth and stomach.

There is, in fact, no way that cow's milk can be humanized any more than human milk can be bovinized.[4] This is particularly so when one considers that it is not only the composition of the actual ingredients, but their bioavailability. The absorption of nutrients from the intestinal canal, for example zinc,[5] is quite different. Also, there is a subtle interaction of nutrients with one another. It is over-simplistic to analyze for one nutrient only; each mammal's milk is, in fact, a complex, species-specific biological system.

Protective substances

Until quite recently, it was believed that the protective effect of human milk against some infections, notably diarrhoea, was related to the fact that it is clean and uncontaminated. This is quite true, but recent studies have shown that human milk contains large numbers of white cells and an increasingly recognized range of protective substances, including, for example, lysozyme, lactoferrin, secretory IgA, etc.[6] These are especially effective against enteral infections by bacteria, such as *E. coli* or *V. cholerae,* or viruses, such as the rotavirus, or some parasites, notably *Giardia lamblia.*[7]

In addition, it has been shown that the organisms that the mother comes in contact with are reflected by specific protective substances against these bacteria and viruses which appear in the milk. One way in which this is undertaken is *via* the so-called "gut-mammary axis". This means that the mother and baby have a dyadic interaction as regards bacterial flora as well as in many other ways, and that microorganisms entering the mother's alimentary canal lead to increases in specific antibodies in her milk.

The particular value of colostrum has also been under-emphasized until recently. It seems to have been the unstated view that this secretion was of little importance, merely filling a gap until the mature milk became available. This is far from true, and it is now recognized that colostrum is not only rich in protective substances, but also contains concentrated doses of certain nutrients, notably vitamins A and E, and zinc.

Emotional differences

In other mammals, there has long been a recognition that bonding between mother and baby occurred at a specific time resulting from, and leading to, specific mother-newborn behaviour. Recent investigations have also shown that a similar pattern of behaviour occurs in the human and that this can facilitate bonding, initiating the best chance of a harmonious relationship between mother and baby, as well as facilitating breastfeeding.[8] This bonding process is initiated most easily at the immediate postpartum period and is facilitated by close contact between mother and baby straight away after delivery. This is, of course, one reason for the modern move towards encouraging the baby to breastfeed as soon after birth as possible.

Child spacing

Until very recent years, scientific medicine believed the idea that breastfeeding had a child-spacing effect was an old wives tale. This was, perhaps, understandable as it is readily apparent that pregnancy occurs in women who are still breastfeeding. What recent endocrinological and epidemiological research has shown is that the child-spacing effect is "dose-dependent" — that is, the more the sucking, the more the prolactin produced and, therefore, the greater the anovulatory effect and the longer the period of lactation amenorrhoea.[9,10]

That this should occur is really unsurprising. All other mammals have appropriate methods of child spacing. In many, this is achieved by having periods of oestrus or mating seasons. In humans, mating is year-round and child spacing is achieved by the endocrinological effects of frequent sucking.

This child-spacing effect can be prolonged. For example, in some communities in Africa where breast-feeding is very frequent and other foods are not introduced early, the period between one pregnancy and the next can be up to four years.[10] Conversely, if the pattern of sucking is restricted with limited number of feedings during the day, with other foods given which reduce the appetite and deviate the baby's sucking vigour, then the effectiveness of this natural method of child spacing decreases markedly.

Economics

With the current world situation dominated by questions of economics and food supplies, the financial and agricultural wastage of bottle feeding needs emphasis. This can be viewed at a family level and, in many

developing countries, to be able to purchase sufficient formula needs up to 60–80% of a basic family's income.[1,11] Still more significant is the fact that breast milk represents a national resource, both economic and agronomic. If, for example, all women in Indonesia were to cease breastfeeding, then it has been calculated that an expenditure of approximately $52 million per annum would be needed to purchase adequate formula replacement, to pay for hospital care for children with diarrhoeal disease and to increase the family planning services.[12]

RISKS OF ARTIFICIAL FEEDING

In many more technically developed countries, including the USA,[13] Sweden,[14] UK,[15] and Australia,[16] breastfeeding has increased very considerably in the past ten years. By contrast, breastfeeding has declined markedly in many less technically developed countries, especially in urban and peri-urban areas. This has been due to a variety of different forces, the significance of which have varied from place to place and from country to country.[1] These have included the ill-effects of unsupportive and ill-educated health personnel and health services (especially prenatal clinics and maternity wards), problems with mothers going out to work outside the home, the adoption of urban life-styles, and the harmful effects of aggressive, unethical marketing, both advertising and promotion, by the infant food industry.

The ill-effects of artificial feeding with cow's milk-based formulas are universal. However, in poor circumstances in both industrialized countries and especially in developing countries, bottle feeding is extremely likely to result in diarrhoeal disease and marasmus often with fatal results. To be able to bottle feed adequately, three things are needed – adequate money to purchase enough formula, reasonable home hygiene (including water supply), and sufficient parental education to be able to prepare the formulas appropriately.

In addition, and very importantly, it has to be appreciated that the risks of artificial feeding with cow's milk-based formulas also need consideration with the well-to-do who can afford adequate money to purchase sufficient quantities. Among such groups, there are differences in relation to the number of episodes of infection in breastfed and bottlefed babies, as well as a higher incidence of infantile allergy to cow's milk protein, especially in families with an allergic history.

Also the bottlefed baby in any part of the world is receiving a different form of mother-to-baby interaction with a different form of emotional consequence. The baby who is bottlefed lovingly does **not** have the same experiences as does the breastfed. The stimuli are different for both mother and child, while the influence of maternal hormones is distinct in the breastfeeding mother and in the mother who is distant from the baby and feeding through a glass or plastic bottle and rubber nipple.

REFLEXES

Breastfeeding is not exclusively instinctive, but is a combination of learned behaviour and inherent reflexes. It is, in part, a meshing of neonatal reflexes – rooting, sucking and swallowing, and maternal reflexes – the prolactin reflex and the let-down reflex.

The practical significance of the maternal lactation reflexes is becoming ever more apparent as regards failure or success in breastfeeding. The **prolactin reflex** is principally a somatic arc in which stimulus of the nipple leads to nerve message being transmitted to the anterior pituitary leading to the production of prolactin. This hormone is polyvalent and passes in the blood-stream back to the breasts where it is responsible for milk secretion. At the same time, it acts on the ovaries leading to suppression of ovulation, on the kidneys leading to conservation of water as a result of its antidiuretic effect and also possibly on the brain ("motherliness" hormone). Its practical significance is that the amount of milk produced is related to the amount of sucking. Less than adequate sucking, as occurs with the early introduction of bottle feeds or semi-solids, leads to a diminished milk supply. Conversely, increased sucking as in twins or in the continuous lactation of the wet nurse for five to ten years or more leads to increased and/or prolonged secretion.

The **let-down reflex** has a somatic arc with, again, impulses passing from the breast to the posterior pituitary with the production of the hormone oxytocin which passes in the blood stream back to the breast, where it acts on the myoepithelial cells surrounding the alveoli and causing them to contract. This expels the milk from the alveoli to the lacteals. In other words, there is an **active** maternal component in the breastfeeding situation. However, the let-down reflex is also affected by maternal emotions. If anxiety is present, then the let-down reflex is inhibited, probably mainly due to the adrenaline secreted. Conversely, confidence enhances the reflex.

The commonest cause of inadequate lactation in most parts of the world is due to emotional interference with the let-down reflex – to so-called "anxiety-nursing failure syndrome". This has a double negative effect as the baby will receive only the milk available in the terminal lacteals and, in particular, will be deprived of calories, as the fat-rich hindmilk will remain in the alveoli.

LEARNED BEHAVIOUR

In traditional village circumstances, this is obtained by observation by girls watching their own mothers feed other siblings or seeing what is happening in the village with other women. It is not learned from a textbook, but subconsciously by observation. In addition, most traditional societies have *doulas* or female assistants who help during pregnancy, child birth and the puerperium. Part of this assistance is with traditional knowledge and with the physical and emotional support of the mothers during the initiation of lactation.

In planning maternity services, it is important to assess the methods currently employed traditionally in the community concerned and also in the health services. These then need to be reviewed in the light of their impact on the frequency of sucking and on the engendering of anxiety or confidence.

INADEQUATE LACTATION

This subject has been incorrectly presented in recent years. The proper approach is to investigate maternal statements concerning "insufficient milk" to see if inadequate milk production is actually occurring or not.

This is not as easy to do as is sometimes believed. Methods of measuring milk production (e.g., test weighing, milk expression, denterium,[17] flow-meter[18]) are all inaccurate, variable, and/or difficult to undertake in impoverished communities in real life. Likewise, assessment of the young infant's growth poses newly appreciated difficulties. For example, such assessment need to recognize that the majority of low birth weight babies in less technically developed countries are "small-for-dates" rather than pre-term. Such neonates show limited ability for subsequent catch-up growth, even when receiving all needed nutrients. Also, it is now recognized that the growth velocity in the second trimester is less than in the first three months of life. For example, second trimester weight-gains in predominantly breastfed Australian babies of well-fed mothers[19] approximated more to those commonly seen in developing countries.[20] In boys, comparable figures for the second three months of life were 1.70kg and 1.55kg, respectively, rather than 2.13kg derived from 1959 UK data.[20,21] It seems clear that the growth data often used as reference levels in early infancy have been based on bottlefed babies receiving high solute formulas and early semi-solids in Europe and the USA some decades back. Much so-called "faltering" in the second trimester is a part of a normal growth curve for some breastfed babies. It is, in fact, "pseudo-faltering".

When inadequate lactation actually exists, it needs to be investigated in relation to four influences which can be responsible, either singly or in combination (Fig. 1). These include maternal health, including nutritional status, and possible pharmacological effects, including oestrogen-containing contraceptives and nicotine from smoking.

However, as noted, the influence of lack of knowledge concerning practical management and the effectiveness of the maternal reflexes need priority attention. For example, it is common for mothers to complain that their milk is "too thin" or "too weak" or "too little", or "the baby didn't like the milk" or "baby refused the breast". Frequently, all of these can be understood and diagnosed if enquiry is made into the pattern of nursing and of other factors which may be interfering with sucking stimulation, such as the introduction of solid foods, or the restriction of breast feeds to the daytime only, together with enquiry into the factors which may be engendering confidence or anxiety. This diagnostic procedure must include examination

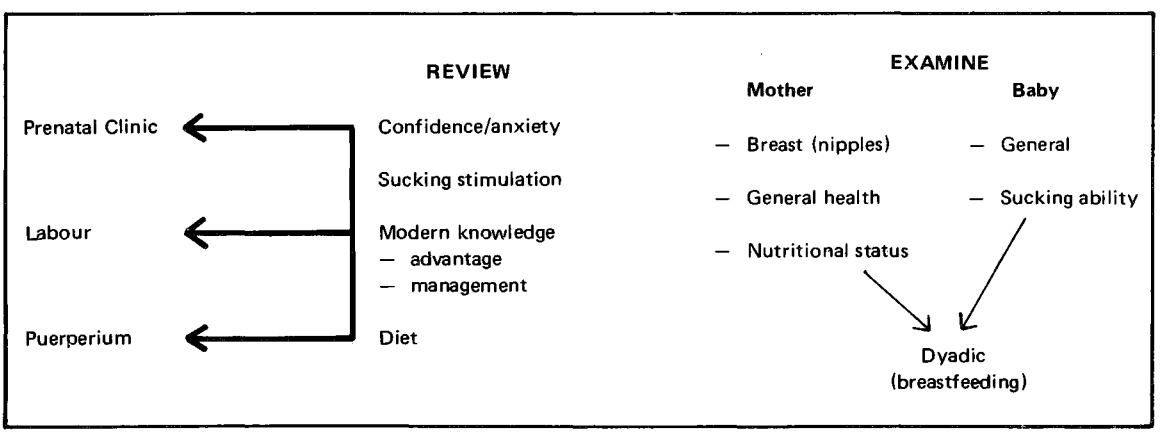

Fig. 1 Influences and adequacy of lactation: a diagnostic process.

of the mother and baby individually, together with observation while actually nursing. Curiously, this is rather uncommon, and yet it parallels exactly the type of approach undertaken in the diagnosis of abnormalities of function in other body systems.

CONCLUSION

Recent work demonstrates the main factors of significance in promoting breastfeeding, and successful programmes can be (and are being) developed to suit the needs of particular communites' **varying degrees of emphasis** with need to be given to information/education, modification of the health services, monitoring the infant food industry and the provision of services and support for working women who wish to breastfeed their babies. Epidemiologists can obviously play an important role in the detailed design of such programmes, but need to appreciate the psychophysiology of lactation and the definition of different types of breastfeeding.[21]

Essentially, infant feeding is much more than an exercise in nutritional mathematics, but needs to be viewed as a biological process with information to be gained from many sources and with a wide range of consequences that need to be considered.

REFERENCES

1 Bostock J. Evolutionary approaches to infant care. *Lancet* 1962; 1:1033–1035.

2 Jelliffe D B, Jelliffe E F P. *Human milk in the modern world.* Oxford: Oxford University Press, 1978.

3 Lawrence R.A. *Breastfeeding – a guide for the medical profession.* St. Louis: Mosby, 1980.

4 Jelliffe D B, Jelliffe E F P. The humanization of cow's milk: a non-starting concept. *J Mat Chld Hlth* 1977; 2:214–217.

5 Eckhert C. Isolation of a protein from human milk that enhances zinc absorption in humans. *Bioch Biophys Res Communic* 1985; 130:264–269.

6 Wilkinson A W (ed.) *The immunology of infant feeding.* New York: Plenum, 1981.

7 Gillin F D, *et al.* Human milk kills parasitic intestinal protozoa. *Science* 1983; 221: 1290–1292.

8 Klaus M H, Kennell J.H. *Parent-infant bonding.* St. Louis: Mosby, 1982.

9 Population Reports. *Breastfeeding, fertility and family planning.* Series J. (Nov.–Dec.), 1981.

10 Short R E. Breastfeeding. *Scientif Amer* 1985; 250:35–41.

11 Cameron M, Hofvander Y. *Manual on infant feeding* (scene edition). WHO: Geneva, 1985.

12 Rohde J E. Mother's milk and the Indonesian economy: a major national resource. *J Trop Pediat* 1982; 28:166–174.

13 Martinez G A, Nalezienski J P. 1980 up-date: the recent trend in breastfeeding. *Pediat* 1981; 67: 260–265.

14 Hofvander Y, Sjolin S. Breastfeeding trends and recent information actions in Sweden. *Acta Paed Scand* 1979; 275:122–130.

15 Wharton B. A quinquennium of infant feeding. *Arch Dis Childh* 1982; 57: 895–902.

16 Hartman P E, Kulski J.K, Rattigan S, Saint L. Lactation in Australian women. *Proc Neutr Soc Austral* 1980; 5:104–111.

17 Butte N F, *et al.* Evaluation of the denterium dilution technique against the test-weighing procedure for the determination of breast milk intake. *Amer J Cl Nutr* 1983; 37:996–1003.

18 Woolridge, *et al.* Effect of a new and a traditional nipple shield on sucking patterns and milk flow. *Early Hum Dev* 1980; 4:357–364.

19 Hitchcock N, Gracy M. Owles E N. Growth of healthy breast-fed babies in the first six months. *Lancet* 1981; ii:64–67.

20 Waterlow J C, Ashworth A, Griffiths M. Faltering infant growth in less developed countries. *Lancet* 1980; ii:1176–1179.

21 Baer E C, Winikoff B (eds.) Breastfeeding: Programs, policy and research issues. *Studies in Family Planning* 1981; 12:123–160.