Infant-feeding Practices

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Summary

A survey of mothers attending infant welfare clinics showed that 26% changed their infant's milk in the first two weeks after birth and that multiple changes were common. Twenty-two per cent. were preparing a milk formula more concentrated than the recommended strength by using either heaped or packed scoops instead of level scoops of powder or by giving extra scoops. The commonest age for starting solid feeding was between 3 and 4 weeks and the practice of adding rusk or cereal to the bottle was common. There are obvious dangers of hypernatraemia from taking concentrated milk feeds and problems of obesity which may follow the early introduction of cereals.

Introduction

Advice to new mothers about infant feeding comes from varying sources, including maternity units and health visitors, general practitioners and paediatricians, relatives and friends, child-care books, and manufacturers of infant foods. The advice is based partly on sound medical practice and partly on folk-lore and habit. Not surprisingly the advice sometimes conflicts, but despite this most mothers appear to feed their babies satisfactorily.

Recent reports have suggested that incorrect methods of preparing infant feeds can have serious consequences resulting in hypertonic dehydration.^{1,2} Overfeeding may cause obesity which can be correlated with excessive weight in later childhood³ and increased susceptibility to respiratory infections in infancy.⁴ When taking a feeding history from a mother it is often surprising to hear how often and for what reasons her baby's milk has been changed in favour of a different preparation. It is sometimes disconcerting to hear the answers to more detailed inquiries about exactly how the dried milk is reconstituted. For these reasons a study was undertaken to learn the pattern of infant feeding in the first six months of life, with particular reference to methods of reconstitution of powdered-milk formulae.

Method and Results

One hundred mothers of infants under 6 months of age were interviewed when they attended infant welfare clinics for a routine check. The mothers were told that the interviewer wished to learn their own particular feeding technique and all mothers were asked a standard set of questions. The mothers were interviewed before seeing the health visitor to lessen the chance of repeating her advice about feeding methods in preference to their own methods, although most of the mothers had visited the clinics previously.

The population studied was multiracial (table I). The age when the milk was changed to a different preparation is shown in fig. 1. The commonest age for changing was in the

TABLE I—Country of Origin of the 100 Mothers interviewed about Infant-feeding Techniques

British	Irish	Other European	West Indian	Asian	African
52	10	17	14	4	3

FIG. 1—Age at which infant's milk was first changed to different preparation.

first two weeks of life, soon after the baby had left hospital. Of the 26 mothers who changed the milk in the first two weeks 8 changed for no definite reason, 3 because of previous experience with other milks, 3 because the child "did not like the milk," 3 on the advice of the midwife or doctor, and 3 because of feeding problems or poor weight gain. Other reasons were loose stools (2 cases), difficulty in mixing the powder (2), advice from the local chemist (1), and cost (1). Multiple changes were noted in nine infants, five being on their third milk formula by 8 weeks of age. Four of these had feeding problems and one who had a skin rash was changed on medical advice.

Ninety mothers were using dried-milk formulae. Sixty-two of these mothers were preparing the milk in the correct strength according to the manufacturer's instructions, but 20 were preparing a formula which was concentrated and eight were making a dilute formula. Concentrated milk was prepared by using either heaped instead of level scoops of powder, packing the scoop tightly full, or using more than the recommended number of scoops (table II). One mother had misunderstood the instructions completely and was giving her baby one scoop of milk powder to one scoop of water instead of 1 fl oz (28.4 ml) of water. This would produce a milk concentrated by a factor of about five. Fifty-two mothers poured boiling water on to the milk powder, and the remaining 38 added hot water which had previously

TABLE II—Causes of Milk being prepared in Incorrect Strength

Concentrated Milk Feeds (n = 20)		Dilute Milk Feeds (n = 8)	
Method of Preparation	No.	Strength of Milk	No.
Packed scoop	5	Diluted by 25% or more ..	4
Heaped scoop	6		
Extra scoops increasing concentration by 25% or more ..	4	Diluted by less than 25% ..	4
Extra scoops increasing concentration by less than 25% ..	2		
Extra scoops at night only ..	3		

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been boiled as recommended in the manufacturer's instructions. Of the 90 babies receiving dried-milk formulae 37 (41%) were receiving milk prepared in accordance with instructions for both strength and water temperature, while 53 (59%) were receiving a preparation where one or both of these instructions had not been followed.

Forty-six of the mothers using dried milk gave extra vitamins in the form of drops containing vitamins A, C, and D, and 51 gave extra vitamin C supplements, usually as orange juice.

The commonest age for starting solids was between 3 and 4 weeks (fig. 2), the earliest age being 2 days. Adding extra carbohydrate, apart from sugar, to the milk was common; 33 (37%) babies received either rusk (15%) or cereal (22%) added to their bottle.

FIG. 2—Age at which feeding of solids was begun.

Out of 96 mothers who were bottle-feeding 74 (77%) prepared each bottle separately just before a feed was due. The usual reason given for preparing bottles singly was lack of a refrigerator. The most popular method of sterilizing bottles was the hypochlorite method, which was used in 90% of cases.

Forty-two per cent. of the mothers interviewed were attending the clinic with their first baby and 36% had one other child, perhaps suggesting that more experienced mothers do not feel the need to attend infant welfare clinics as often. The first source of advice the mother would turn to if her baby had a feeding problem is shown in table III. Not surprisingly, in a population attending an infant welfare clinic the health visitor is the most popular choice. The immediate family was a commoner first choice than the general practitioner, perhaps because it was felt that this was not a problem serious enough to warrant troubling the family doctor.

TABLE III—First Choice for Advice about Infant-feeding Problems (100 Mothers)

Health Visitor	Immediate Family	Family Doctor	Maternity Unit	Books	Friends
51	20	12	8	5	4

Discussion

Although manufacturers of infant milk preparations feel that it is important to introduce mothers to their products in the maternity ward, this survey showed that over a quarter of the mothers questioned had changed to a different milk preparation in the first two weeks of their baby's life. The reasons for changing were usually vague or suggested a feeding difficulty. Feeding difficulties are often due to faulty technique, and many paediatricians would agree with Illingworth⁵ that it is not necessary to change from one dried milk to another to find one suitable for the baby except for rare

conditions such as some inborn errors of metabolism. Perhaps more effort should be made to ensure that this concept filters through the infant welfare clinics and maternity units to reach the mothers.

The most worrying feature of this survey was the large proportion of babies who were receiving feeds of incorrect strength. The danger of hypernatraemia where salt rather than sugar has been accidentally added to the milk is well recognized,^{6,8} and considerable errors in infant formula preparations are known to cause hypernatraemia.^{9,11} The danger of cerebral damage from hypernatraemia in infancy is well known and may occur in 30% of cases.¹² Concentrated feedings have also been implicated as a cause of transient diabetes of the newborn.¹¹ Dugan and Holliday¹³ reported water intoxication related to overdilution of milk formula but felt that hyperosmolality was a more common problem.¹⁴ Less marked errors in formula preparation produced by giving heaped or extra scoops may also lead to hypernatraemia, and the results of this survey agree with the findings of Taitz and Byers³ that the tendency to use excessive amounts of milk powder in feeds is widespread.

Although the healthy infant's kidney can deal with a high solute load by increasing the concentration of the urine,¹⁵ very high solute loads in the presence of water-depleting conditions such as gastroenteritis will lead to an inability of the kidney to cope with the increased osmolar load and hypertonic dehydration will develop. Colle *et al.*¹⁶ showed that babies taking formulae containing increased amounts of sodium were at increased risk of developing hypertonic dehydration. The present study suggests that the number of children at risk may be considerable.

The baby with a high serum osmolality will be thirsty, will cry for a bottle, and most likely will be given more milk prepared in the same incorrect strength. This will temporarily relieve his thirst but will do little to relieve the hypertonicity, while the extra caloric intake is likely to lead to obesity. As there is now evidence that the total number of adipose cells becomes fixed in childhood and that overnutrition in the first year affects the rate of fat-cell multiplication¹⁷ it seems that adult obesity starts and can be prevented in the first year of life. This is further supported by the work of Eid,³ who showed that rapid weight gain in infancy is associated with obesity in later childhood, and by Salans *et al.*¹⁸ who showed that obese adults cannot reduce their total number of fat cells by dieting. Despite this knowledge there seems to be a widespread tendency to early feeding with cereals and mixed infant foods, resulting in excessive weight gain in infancy.¹⁹ Harris and Chan²⁰ found that 80% of well babies attending the Mayo Clinic were receiving cereal at 1 month or earlier. This study suggests a similar trend to early feeding of cereals, with the habit of adding rusk or cereal to the bottle to be quite common.

Although most commonly used dried milk preparations, with the exception of National Dried Milk, contain added vitamin C, this heat-labile substance was likely to be destroyed in over half of the cases where boiling water was added to the powder. Many of the mothers questioned did not distinguish between hot, previously boiled water and boiling water, although the instructions on the Ostermilk and S.M.A. packets state that the water should not be boiling.

Most mothers sterilized the bottles by the hypochlorite method, which is superior to boiling in the home,²¹ although one wonders how effective this sterilization was, as Gatherer and Wood²² showed that the number of mothers who knew how to sterilize bottles and teats was far in excess of the number who were actually doing it correctly.

It should be cause for concern that there is such a high proportion of concentrated feeds prepared by a group which has been given correct feeding instructions. This suggests that the incidence of errors made by mothers who do not receive instruction at infant welfare clinics may be even

higher and that a large number of babies are at increased risk of developing hypernatraemia.

Clearly the problem is one of education of mothers beginning in the maternity unit and continuing through the advice of health visitors and family doctors. The use of written, illustrated instructions and practical lessons in the maternity unit and clinics where mothers can be shown and then practise how to reconstitute dried milk should be more widespread. Manufacturers of dried milk could improve the mixing instructions by illustrating the procedure step by step on the packet, as is done by one major manufacturer. The information on some packets that 1 fl. oz. (28.4 ml) equals two tablespoons could probably best be discarded and replaced by a statement that quantities must be measured accurately in a measuring jug. The volumes of tablespoons are variable and the strength of the milk will vary accordingly. As infant-feeding practices are largely influenced by tradition, folk-lore, and advertising pressures considerable educational effort may be needed to avert the trend to obesity and the dangers of hypernatraemia to which many infants seem to be exposed.

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Occasional Survey

Infective Endocarditis: A Changing Disease*—II

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The structure of the vegetations is of considerable importance in relation to treatment and complications. The vegetation itself is composed of fibrin and platelets. Leucocytes are absent and the organisms are centrally placed. In the valve beneath the vegetation there is what appears to be an attempt at healing, with fibrosis and areas of calcification.¹ It seems paradoxical that bacteriostatic drugs are ineffective, and yet drugs which are bactericidal in the test-tube and effective clinically probably act as bacteriostatic drugs in the body. We are accustomed to thinking that the organisms are protected by the thick fibrin-platelet layer, but in the laboratory this is easily penetrated by the concentration of antibiotics available clinically, so that the organisms should be killed in a few days, whereas we know that short courses of five to seven days' treatment are always ineffective.² The first essential feature of healing is inhibition of growth of bacteria to diminish the stimulus to deposition of fibrin and platelets and allow the vegetation to be covered by endo-

thelium, and it is of interest that healing can occur even if the organisms are not killed, as shown by the demonstration of viable organisms in vegetations several months after clinical cure. Removal of turbulent flow also encourages healing. Occasionally in patients with rickettsial, fungal, or other resistant infections not responding to treatment valve replacement has been carried out in the presence of uncontrolled infection. It is not always possible to remove all infected material at the time of operation, and yet post-operatively the infection will respond. The second phase of healing is invasion at the base from the periphery with phagocytes and fibroblasts, which will transform the vegetations into fibrous tissue, often calcified, and this may well cause increased valvular incompetence.

Principles in Treatment

There are certain important general principles in treatment.

(1) In addition to recovering the organism the laboratory should determine which antibiotics singly or in combination will kill it and what concentrations are needed. This is time-consuming, often apparently unnecessary with a sensitive organism such *Streptococcus viridans*, but can be life-saving. It has been our practice for several years to ensure that bactericidal levels of antibiotics are present in the blood by back-titrating the serum against the patient's own organism and adjusting the dose so that a dilution of 1 in 4 is bactericidal.

*Croonian lecture delivered at the Royal College of Physicians of London on 18 May 1972.