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Report on Health and Social Subjects

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PRESENT-DAY PRACTICE IN INFANT FEEDING

Report of a Working Party of the Panel on Child Nutrition, Committee on Medical Aspects of Food Policy

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Committee on Medical Aspects of Food Policy

Panel on Child Nutrition: Working Party on Infant Feeding

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Preface

Most people accept that a mother's breast milk is the natural, convenient hygienic and nourishing food for her baby but, from time immemorial, there have been mothers who could not or who preferred not to feed their babies and the services of a "wet" nurse have been required. If such a person were not available other food for the infant had to be found and in spite of the dissimilarity between the young of the species and in the composition of the products of lactation, cows' milk has been the most used substitute food.

Over the past several decades the practice of artificial feeding has increased. At the same time modern technology has attempted to modify cows' milk in such a way that it resembles human milk more closely in composition. That so many babies are apparently successfully reared on these milks is a tribute to manufacturers. However dissimilarities of even modified cows' milk and human milk may present a hazard to the health and growth of some babies, and the large number of different infant milk products at present on the market make a bewildering choice to the physician, midwife and mother. Mistakes in the preparation of feeds seem to err on the side of over-feeding and this together with the practice of introducing solids at an ever-increasingly early age can and does result in obesity.

In June 1973 the Committee on Medical Aspects of Food Policy, through its Panel on Child Nutrition, set up a Working Party under the chairmanship of Professor T. E. Oppé, with the task of reviewing present-day practice in infant feeding. By March 1974 the working party had completed the review and the report had been accepted by the parent Committee. Professor Oppé and all members of the working party are to be congratulated for the speed with which they achieved a unanimous report.

The report stresses the importance of breast feeding, especially in the immediate post-natal period, but acknowledges that artificial milk feeds must be available. These should resemble breast milk in composition as closely as possible. The working party agree that up to the age of about four to six months normal growth and development occurs if the child is reared on milk alone; the introduction of solids before this age is not necessary and may in some circumstances be harmful.

The report will be of value not only to food technologists and manufacturers who are concerned in the production of infant foods, but also to professional bodies with responsibility for the training of doctors, dietitians, nurses, midwives and health visitors. The recommendations should be of use to all who formulate advice to mothers and will, we hope, ensure that this advice will be both practical and consistent whether it is supplied by the doctor or midwife or any other member of the team responsible for infant feeding.

Our thanks are due to members of the Committee on Medical Aspects of Food Policy, and especially to Professor Oppé and all members of the Working Party for the readiness with which they have given of their time and expert knowlege in a subject which is of especial importance. The children of today become the adults of the future. Their healthy growth and development is the responsibility of us all.

H. YELLOWLEES

Chairman,

Committee on Medical Aspects of Food Policy

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Contents

1. Introduction

1.1 Terms of Reference

To review the present practices in infant[1] feeding and to advise upon these practices.

1.2 Meetings

The working party has met five times and has had the benefit of discussion with a number of professional people and of representatives from some manufacturing firms (Acknowledgements p vii).

1.3 Form of the Report

The Report is confined to a review of the present-day practices of infant feeding, and of the effects such practices may have on the well-being of infants born at full-term. We have not included in our discussion the feeding of low birth weight babies, or the treatment of infants who have metabolic or other abnormalities which require special feeding.

[1]The term infant means in this context a child who has not attained the first birthday.

2. Present Practice in Infant Feeding

2.1 General

2.1.1 Present practices in infant feeding are the result of a number of different factors—nutritional, medical, social, psychological, cultural, economic and commercial—all of which exert an influence on the mother. Professional advice is probably less influential than is sometimes thought, and is often based as much upon authority and experience as upon knowledge and scientific investigation.

2.1.2 In spite of the view held by most members of the medical and nursing professions that breast feeding is for most babies superior to artificial feeding, there has been a progressive decline in the practice of breast feeding in Great Britain and in other industrialized countries from the beginning of this century onwards. At the same time there has been a continuous search for a milk which is both convenient to prepare and also as similar as possible to human milk in composition and nutritional value. The quest has not been entirely successful, partly because there is at present no method of manufacturing, at reasonable cost, a product which is in every way the equivalent of human milk so far as the known constituents are concerned, and also because the composition of breast milk varies from one mother to another and to some extent from day to day.

2.1.3 Many artificial feeds[1] are based on cows' milk and appear to be satisfactory for the great majority of infants, but these feeds make demands upon the physiological adaptability of the infant and, especially in the early weeks of life, these demands are greater than those made by human milk. In addition, the physiological stresses are increased when errors are made in the preparation of feeds. Nevertheless, because the chief problem associated with breast feeding is a failure of supply, satisfactory alternative feeds should be available at reasonable cost.

2.1.4 Failure of lactation is so often associated with under-feeding that gain in weight represents the most helpful criterion of satisfactory feeding. Nowadays, however, there is more concern about obesity—a condition which is difficult to treat and therefore desirable to prevent. Over-feeding in infancy may in some instances contribute to life-long obesity; thus steps should be taken early to avoid an excessive energy intake.

[1]Hereafter in this report, the term "artificial" milk feed is used to mean one that is made from cows' milk which has been modified in composition.

2.1.5 Until recently, the theory and practice of feeding infants formed a substantial part of the professional training of doctors, midwives and health visitors. But with the increased use of artificial milk feeds which are easily reconstituted, and more especially of the "ready-to-feed" liquid milks, professional interest in infant feeding has appreciably lessened. As a result, mothers rely to a greater extent than formerly on the printed instructions on the food pack and on manufacturers' booklets, which are given away free, and less on professional advice.

2.1.6. Nevertheless, most babies thrive. This in part reflects the responsiveness of the manufacturers of infant foods to advances in knowledge which have enabled them to overcome the earlier difficulties associated with the provision of satisfactory artificial feeds. But there still are problems, of which some present a grave threat to a small number of infants; others appear to be less acute but to have more widespread effects.

2.1.7 We have reviewed these problems, and have attempted to define their origins and to suggest measures which might be taken to avoid them or at least to minimize their effect. Our primary concern has been to scrutinize as far as is possible the factual evidence.

2.1.8. We have not explored in depth the psychological, sociological, economic or commercial aspects of the problems of infant feeding although we appreciate their importance.

2.2 Breast feeding

2.2.1 The United Kingdom is, in general, no longer a breast fed or breast feeding nation. Newson and Newson (1963) found that in 1959–60 83% of the babies of a sample of Nottingham mothers were breast fed for the first week of life, but that the percentage rapidly diminished to 54% by the end of the first month, 29% at three months and 13% at six months. Arneil (1967) found that 69% of babies from all areas in Scotland were not breast fed at all; 16% were breast fed for less than four weeks, 7% for 12 weeks and only 5% beyond four months of age. These figures are in accord with those obtained by surveys in England and Wales of several different groups of mothers and babies. For example Shukla, Forsyth, Anderson and Marwah (1972) found that 28% of babies in their survey were given breast milk as the first food but in most cases breast feeding had stopped by the end of the first month. Up to or beyond 12 weeks of age only 6% were having any breast milk and these babies were also having modified cows' milk and solids.

2.2.2 In one maternity hospital where there are about 150 deliveries per month, the percentage figures for breast feeding on discharge have increased from 45% in March 1970 to 64% in September 1973 (Creery, 1973b). This result should serve to encourage those who are in a position to promote the cause of natural feeding, although the figures apply to the initiation rather

than to the maintenance of breast feeding. A recent survey in the same area showed 41% of mothers to be breast feeding at 11 days, 22% at six weeks and 15% at three months (Seacombe 1973).

2.3 Bottle feeding

2.3.1 Thus the United Kingdom is largely an "artificially fed" or "bottle feeding" nation, in which cows' milk (rather than the milk of any other animal) is used as a food for infants instead of human milk.

2.3.2 When breast feeding is attempted and the supply of breast milk is insufficient for one reason or another, the feed may be *complemented* by a bottle feed. By this we mean an artificial feed derived from cows' milk which has been modified in composition, although we are aware that human breast milk may in certain circumstances be given by bottle. There is also a practice, especially among some working mothers, of breast feeding while at home and leaving the child to be given a *supplementary* bottle feed while the mother is at work.

2.3.3 Few mothers give their baby cows' milk as supplied by the dairyman ("doorstep" milk). Apart from the danger of the milk becoming infected once the bottle has been opened in the home, the nutrient content of cows' milk is so different from that of human milk that some modification in composition has been practised for many years. The oldest and simplest was to dilute previously boiled cows' milk with boiled water and to add sugar. In a short-term domestic emergency this would suffice. The next development was to fortify dried whole cows' milk with vitamins and iron, and liquid evaporated whole cows' milk with vitamin D. These products have been in popular use for many years. Manufacturers now produce "artificial" feeds from modified cows' milk which approximate more closely to the composition of average breast milk in respect of certain constituents—sodium, phosphate, calcium and protein. Filled milks are those which are still further modified by replacement of most of the butterfat by vegetable fats and oils. The composition of these various milks is to be found in Tables A1 and A2 (pp 34–35).

2.3.4 Modified cows' milk products are now available not only as powder or as concentrated liquids from both of which a diluted feed can be prepared, but also in liquid "ready-to-feed" form which, as the name suggests, can be given to the baby without further preparation. At present the "ready-to-feed" milks are used chiefly in hospital practice. The large number of different varieties of baby milks in common use may be confusing to mothers and to their advisers.

2.3.5 The majority of babies at home and in hospital are fed[1] the well established fortified dried whole milk powders suitably reconstituted by diluting the powder with water, which has been previously boiled and to

[1]The evidence for these statements is from marketing information supplied by manufacturers.

which, in some cases, sugar (sucrose) is added. Instructions about the preparation of feeds vary from one manufacturer to another and are not always easy to follow with accuracy. These powders are available as either half-cream or full-cream preparations which differ mainly in the relative amounts of butterfat. There are no clear indications as to when a feed should be changed from half- to full-cream, and in present-day practice the use of the half-cream milks has diminished.

2.3.6 A much smaller proportion[1] of babies are fed evaporated milks (unsweetened condensed milks) to which vitamin D has been added, which also require to be diluted with water and to have sugar added. Sweetened condensed milks, which do not require the addition of sugar and which are not fortified with vitamin D, are hardly ever used[1] in the feeding of babies in this country.

2.3.7 In some areas of the country the change from breast milk or modified cows' milk to ordinary fresh cows' milk is made at an early age. Arneil (1967) found that in some Scottish areas the proportion of infants feeding on "doorstep" milk within a month of birth was as high as 15%, and that infants born into large families and into social classes IV and V were more likely to start life on unmodified fresh cows' milk than those from small families and in social classes I and II.

2.4 The early introduction of solids

2.4.1 Present practice in the United Kingdom is to introduce solid food into the infant's diet before the age of three months. The solids most often used are cereal powders or rusks made from wheat flour. They are often sweetened and may be fortified with vitamins and minerals. A common practice in some areas is to put the cereal or rusk with the milk feed into the bottle. There is evidence (Table 2.1) that, in general, babies are offered solids when between three and four weeks of age, although it is not unusual to find babies being fed solids in the first fortnight of life. This table shows the age at which cereals and rusks have been reported to be added to the diet of infants in different parts of the country. In addition we have confirmatory evidence of the early introduction of cereal food from market research surveys (personal communication), although many advisory booklets which are supplied to mothers by manufacturers suggest that solids should be introduced at three months of age rather than earlier.

2.4.2 The reason for the early addition of solids is not entirely clear but appears to be related to a belief that the baby will be more contented rather than to nutritional necessity.

[1]The evidence for these statements is from marketing information supplied by manufacturers.

Table 2.1: *Summary of some recent reports about the addition of cereal (or rusk) to the diet of infants in the early months of life (expressed as the percentage of babies who were eating cereal at different ages)*

Reference		Survey sample		Age				
Author(s)	Year	Area	Number of children	One month	Six weeks	Two months	Three months	Four months
Arneil	1967	Scotland	1345	14	—	39	93	—
Hutchinson-Smith	1970	Chesterfield	200	19 (breast fed)	—	62 (breast fed)	—	90
				21 (bottle fed)	—	80 (bottle fed)	—	100
Taitz	1971	Sheffield	40	—	100	—	—	—
Tracey and Harper	1971	Northampton	223	—	—	—	80	—
Shukla, Forsyth, Anderson and Marwah	1972	Dudley, Worcs	300	40 (2 in first week) (6 in second week)	—	—	93	—
Oates	1973	London	100	18 (10 before 2 weeks)	—	—	—	—
Seacombe	1973	Glos	85	—	—	52	85	—

— signifies "not known".

2.5 The introduction of a mixed diet

2.5.1 The introduction of cereals is soon followed by that of other foods—eggs, fish, soup, cheese, meat, fruit and vegetables. In general, by three months most babies are taking a more varied diet than milk and cereals alone. Although most babies can tolerate a wide range of foodstuffs at an early age, there is no evidence of any advantage or benefit to health and development. On the contrary, there is some evidence that the practice may be harmful (paras 3.4.1.3 and 3.5.4).

3. Problems Associated with Bottle Feeding

3.1 General

3.1.1 Departure from the practice of breast feeding introduces certain hazards to the baby, and these are associated with (a) the difference in composition between human and cows' milk, (b) difficulties in the preparation of feeds, (c) the early introduction of solids and (d) problems of infection and immunity.

3.2 Problems associated with the difference in composition of human and cows' milk

3.2.1 *Neonatal tetany*

3.2.1.1 Cows' milk contains relatively large amounts of inorganic calcium and phosphorus compared with human breast milk (Table A1, p 34) and the calcium : phosphorus ratio is also different. As far back as 1937, Bakwin suggested that a high phosphate intake resulting from cows' milk feeds was an important factor in the aetiology of neonatal tetany, and Gittleman and Pincus (1951) reported that the condition occurred less often in breast fed babies than in those who were bottle fed.

3.2.1.2 Healthy full-term infants who were given feeds prepared from evaporated or dried cows' milk were found on average to have a higher concentration of phosphate and a lower concentration of calcium in their blood than breast fed babies (Oppé and Redstone 1968). This may be an important factor in the genesis of the common variety of neonatal tetany. However, by the tenth to fourteenth day, the baby adapts to the increased phosphorus load (Graham, Barness and György 1953) and the risk is diminished.

3.2.1.3 The concentration of magnesium in plasma, like that of calcium, is lower in babies who are fed on cows' milk than in those who are breast fed. Recent investigations by Cockburn, Brown, Belton and Forfar (1973) and by Snodgrass, Stimmler, Went, Abrams and Will (1973) show that neonatal convulsions may be associated with a disturbance of magnesium as well as of calcium and phosphorus metabolism. After the second week of life the hypomagnesaemia, which probably results from the high phosphate load of cows' milk, is corrected and the blood concentration of magnesium in the bottle fed infants returns to that found in breast fed babies.

3.2.1.4 Some of the milks now available for bottle feeding have a calcium, magnesium and phosphorus content which has been shown to reduce the risk of severe hypocalcaemia (Oppé and Redstone 1968; Barltrop and Hillier 1974).

3.2.1.5 In addition to the risk of neonatal tetany, hypoplasia of the dental enamel has been reported to be associated with postnatal hypocalcaemia in bottle fed infants (Stimmler, Snodgrass and Jaffe 1973). The authors did not observe the lesion in any child who had been totally breast fed for at least the first week of life (Stimmler, Jaffe, Osborne and Snodgrass 1973), and concluded that the risk of hypocalcaemia and enamel hypoplasia would be almost eliminated if mothers could be persuaded to breast feed for at least a week, and considerably reduced if a modified cows' milk with a lowered phosphate content were fed. Purvis, MacKay, Cockburn, Barrie, Wilkinson, Belton and Forfar (1973) have a different opinion about enamel hypoplasia in relation to neonatal tetany and think that the defective enamel indicates a prenatal disturbance in tooth development. They report the condition in association with neonatal tetany in breast fed and bottle fed babies when the mother has been deficient in vitamin D during her pregnancy.

3.2.1.6 Thus a number of factors are implicated in the causation of neonatal tetany (Lancet 1974), but the risk can be greatly reduced by breast feeding even for a period of only two weeks, or by the use of cows' milk which has been modified so that the calcium and phosphorus content and the calcium: phosphorus ratio are nearer that of human milk.

3.2.2 *Hyperosmolality (hypernatraemia)*

3.2.2.1 The concentrations of sodium and potassium are also higher in cows' milk than in human milk and contribute to the increased solute load presented to the kidney.

Table 3.1: *Average concentration of sodium and potassium in human and cows' milk (Macey and Kelly 1961)*

	Human milk meq/litre	Cows' milk meq/litre
Sodium	6·5	25·2
Potassium	14·1	35·6

3.2.2.2 The difference in sodium and water intake of a breast fed baby compared with that of a bottle fed baby can be seen in Tables 3.2 and 3.3. If, as often happens, the milk powder or evaporated milk is made up incorrectly to a concentration greater than that intended by the manufacturers (Section 3.3), the solute load is correspondingly increased. This may also occur at the introduction of mixed feeding when milk is replaced by solids (American Academy of Pediatrics 1974).

3.2.2.3 The excretion of excess potassium ions seems less difficult to a baby than the excretion of excess sodium ions (Tudvad, McNamara and Barnett 1954). Unlike adults, newborn infants cannot excrete a sudden excess of sodium ions. For about the first 10–14 days after birth the infant kidney, compared with the adult kidney, re-absorbs sodium ions from the glomerular filtrate more efficiently than it excretes water. Therefore an increase in the

Table 3.2: *Volumes of milk and quantities of water and sodium taken by a baby fed on breast milk*

Age	Milk[1] ml/kg/day (50th centile)	Water ml/kg/day	Sodium meq/kg/day
8 days[2]	145	126	2·90
3 weeks[3]	200	174	1·40
6 weeks[3]	190	165	1·35
11 weeks[3]	175	152	1·15
15 weeks[3]	160	139	1·05
19 weeks[3]	150	130	1·00

[1] From Fomon, S.J. 1967.
[2] Transitional milk.
[3] Mature milk.

Table 3.3: *Volumes of milk and quantities of water and sodium taken by a baby fed on full-cream unmodified dried milk powders made up according to instructions on the packet (to 70 kcal/100 ml) and providing the same number of kcal/kg/day as the breast milk in Table 3.2*

Age	Milk ml/kg/day	Water ml/kg/day	Sodium meq/kg/day
8 days	144	123	3·5
3 weeks	215	184	6·4
6 weeks	205	175	6·2
11 weeks	190	162	5·7
15 weeks	175	150	5·3
19 weeks	160	138	4·8

intake of sodium leads to a disproportionate fall in the volume of water which is excreted, and so to over-hydration and hypertonicity of the baby (McCance and Widdowson 1957). When, concomitant with the high blood osmolality which occurs in bottle fed babies in this country (Taitz and Byers 1972; Davies 1973), there is an increase in insensible water loss through the lungs and skin as in infection, or a decrease in the intake of water because feeds are too concentrated, hypertonic dehydration may result. Similarly if an increased fluid loss from the bowel is replaced by feeding cows' milk, hypertonic dehydration becomes the common complication of infantile diarrhoea (Harrison and Finberg 1964; Macaulay and Blackhall 1961; Ironside, Tuxford and Heyworth 1970). This condition can be fatal or can lead to permanent neurological sequelae in some of the survivors (Finberg and Harrison 1955; Macaulay and Watson 1967). If replacement of the fluid loss in diarrhoea is by water alone the resulting dehydration is hypotonic.

3.2.2.4 Although hypertonic and hypotonic dehydration can be explained on physiological principles, there is very little firm epidemiological evidence to establish a definite clinical relationship with salt intake. Several workers report instances of hypertonic dehydration in babies given large amounts of salt (Weil and Wallace 1956; Finberg and Harrison 1955; Colle, Ayoub and Raile 1958) but they made no estimates of salt intake in children with hypotonic or

isotonic dehydration. Macaulay and Blackhall (1961) found that in their series of children with hypertonic dehydration, dietary sodium had not played a significant rôle in determining the blood concentration of sodium. There is also evidence that the prevalence of hypernatraemia (a raised concentration of sodium in the blood) which occurs in well-nourished (and presumably breast fed) Jamaican children is similar to that in the technologically developed countries, while hypernatraemia rarely occurs in malnourished children (Ward 1964). There may therefore be some imperfectly understood mechanism concerning not only dietary intake but also overall nutritional status which is related to the tonicity of the body fluids.

3.2.2.5 A baby who is about three weeks old requires about 175 ml water/kg body weight/day and about 1.4 meq sodium/kg body weight/day. These quantities correspond to the amounts of water and sodium obtained from breast milk (Table 3.2). But a bottle fed baby of the same age would receive 184 ml water and 6·4 meq sodium per kg body weight per day (Table 3.3). These larger amounts can be excreted without obvious harm because at three weeks of age an infant can concentrate its urine as efficiently as can an adult, but to cause the kidneys this unnecessary work seems undesirable.

3.2.2.6 Since a relatively sudden change from breast to bottle feeding is often accompanied by a rapid gain in weight due to water retention (McCance and Widdowson 1957) because there is an increase in total body sodium content, the sodium concentration of the full cream unmodified dried milk powders for bottle feeding (even when feeds are reconstituted accurately according to the manufacturers' instructions) can be regarded as above the upper limit of safety for the feeding of infants. We think that the concentration of sodium in the reconstituted milk used for bottle feeding should ideally be that of mature breast milk, and in practice should be as near this concentration as is technologically possible.

3.2.2.7 We understand that at present it is not possible to achieve this ideal without the process of demineralization. Although demineralized cows' milk has been used for feeding babies, such milks are expensive and are not without a possible risk since in the process of demineralization, important, if as yet unidentified, nutrients may be removed. We are also advised that without demineralization the sodium concentration in reconstituted milk could be reduced so that it is a little less than midway between that of human and cows' milk, which would lessen considerably the solute load imposed upon the infant kidney. Accordingly we recommend that all milk products used in the feeding of babies should, when reconstituted, have a sodium concentration much closer than at present to that of average breast milk.

3.2.3 *Protein*

3.2.3.1 The relatively high concentration of protein in cows' milk (3·3 g/100 g) compared with human milk (1·2 g/100 g) has certain physiological disadvantages. The intake of protein is relatively unimportant to the internal osmolality of the body, but babies fed on cows' milk have a higher

concentration of blood urea than those who are given human milk (Davies and Saunders 1973). Reduction of protein intake allows a proportionate fall in the blood urea concentration (Creery 1973a).

3.2.3.2 There is also some, as yet inconclusive, evidence that a high concentration of amino acids in the blood may cause neurological sequelae in premature and in full-term low birth weight infants (Menkes, Welcher, Levi, Dallas and Gretsky 1972; Goldman, Goldman, Kaufman and Liebman 1973). Although infants of low birth weight are not within the terms of reference of this Report, such evidence suggests a need for caution in the amount of protein fed to young babies.

3.2.3.3 Tough casein curds which occur as a result of the high casein content of cows' milk have been known to cause intestinal obstruction (Cook and Rickham 1969). Creery (1973a) believes that casein curds occur much less frequently in breast fed infants and in those who are given modified cows' milk in which the protein content has been lowered. There is recently some evidence that intestinal obstruction may in some babies be associated with the formation of calcium soaps from butterfat.

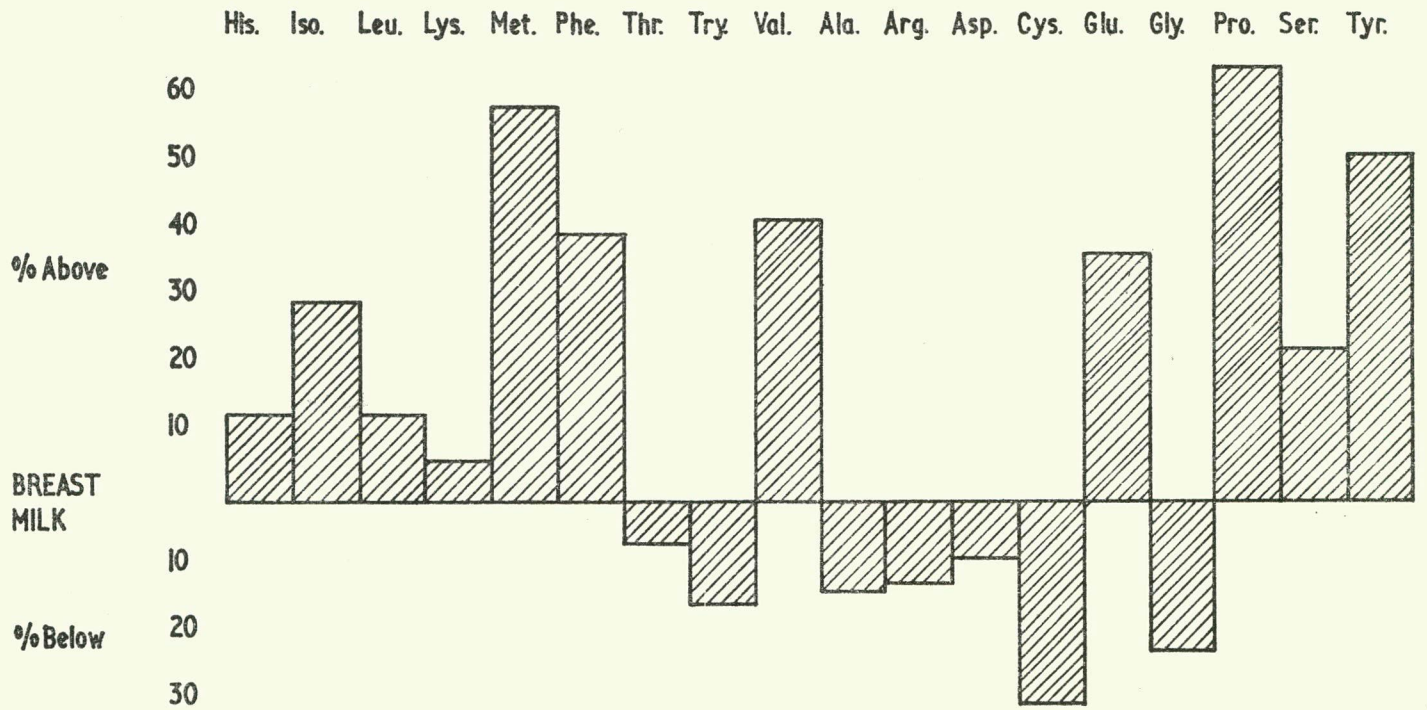
3.2.3.4 Not only are the amounts of protein different in human and cows' milk, but the amino acid patterns of the mixtures of proteins in the two milks are different (Figure 3.1). Thus although we are of the opinion that the concentration of protein should be lowered in any infant feed based on cows' milk, we are concerned that an adequate amount of all the essential amino acids is supplied. A decrease in protein content to about 2 g/100 ml milk feed would follow the suggested reduction in the sodium content of cows' milk (para 3.2.2.6). This would supply the essential amino acids in amounts at least equal to those in an equal volume of breast milk.

3.2.4 *Fat*

3.2.4.1 Unabsorbed fats are known to decrease the absorption of calcium (Widdowson 1965) and also represent a loss in energy intake. Butterfat is not well absorbed by human infants (Holt, Tidwell, Kirk, Cross and Neale 1935; Southgate, Widdowson, Smits, Cooke, Walker and Mathers 1969; Barltrop and Oppé 1973), and while this seems to be no great disadvantage to the majority of babies it was the main reason for the production for many years of "half-cream milks" for very young babies. In later infancy, "half-cream milk" was replaced by "full-cream milk". The use of half-cream milk appears to have decreased in recent years. Some manufacturers have replaced butterfat with other fats and oils which produce a mixture of fatty acids approximating more closely to that of breast milk (filled milks).

3.2.4.2 Table A3, p 36, shows that the fatty acid composition of the fat in human milk is different from that of butterfat. Breast milk is richer in polyunsatured fatty acids than cows' milk. This difference could be of importance in the growth of the developing brain (Crawford and Sinclair 1972).

Figure 3.1: *Comparison of the amino acid pattern[1] of human and cows' milk protein using human milk protein as the standard. (The values, expressed as mg amino acid per g nitrogen in cows' milk, have been calculated as a percentage of those for breast milk expressed on the same basis.)*



SOURCE: Food and Agriculture Organization of the United Nations, 1970.

[1] The information used is the most recent. The recovery of nitrogen as amino acids was nearly 100% for cows' milk but for human milk recovery was about 80% overall.

3.2.4.3 The linoleic acid content of human milk is, on average, 8·3 g/100 g milk fat (depending on the mother's diet) and that of cows' milk is 1·6 g/100 g milk fat. Linoleic acid usually provides approximately 1% of the energy value of cows' milk. Children in this country who are brought up on cows' milk preparations have not been reported to show any clinical evidence of linoleic acid deficiency. Only on diets in which linoleic acid accounts for less than 0·1% of the energy intake has "essential fatty acid deficiency" been reported in babies (Hansen, Stewart, Hughes and Söderhjelm 1962).

3.2.4.4 Serum cholesterol concentration is found to be higher in breast fed babies than in those fed on cows' milk (Darmady, Fosbrooke and Lloyd 1972). There is no evidence that these higher concentrations of cholesterol are harmful or that they are maintained in later childhood.

3.2.4.5 In the present state of knowledge we consider that the fat in breast milk is likely to be more suitable for young babies than either butterfat or the fats used in the manufacture of filled milks.

3.2.5 *Trace elements*

We have no evidence that normal feeding practice in the United Kingdom is associated with any clinical conditions attributable to either a deficiency or an excess of trace elements. Little is known of the metabolism of these nutrients, and we are content that these nutrients should be present in milk for infant feeding in approximately the same concentration as that found in breast milk.

3.2.6 *Iron*

The iron content of both mature human milk (0·15 mg/100 ml) and cows' milk (0·10 mg/100 ml) is relatively low, but normal infants are born with an amount of iron which depends partly on the transfer of blood from placenta to the child at birth. This is usually sufficient for the first few months of life. Some children, however, develop anaemia. Until there is evidence of harm, we see no reason to depart from present practice (para 2.3.3, and Table A1, p 34) and agree that baby milks may continue to be fortified with a non-toxic iron salt which is known to be easily absorbed.

3.2.7 *Vitamins*

3.2.7.1 At present the modified cows' milk dried powders and "ready-to-feed" products are fortified with vitamins A, C and D. A wide variety of proprietary vitamin preparations are also marketed. In addition, the Government, on the advice of experts in child nutrition, provide a vitamin supplement which is available at minimal cost for all babies, and is free to certain families who are entitled to this benefit. A single dose of the vitamin supplement contains the recommended daily intake of the three vitamins (Department of Health and Social Security 1969):

vitamin A	300 μg as retinol
vitamin C	30 mg
vitamin D	10 μg cholecalciferol

Instructions on the bottle state that breast fed babies should receive three drops daily from the first month increasing slowly to the full dose of seven drops daily at four months; and bottle fed babies should increase from 2 drops daily to 4 drops at four months. When breast or bottle feeding stops all children should receive seven drops daily. We agree with the present fortification of artificial feeds and we are of the opinion that vitamin supplements should be available to children during at least the first year of life. This is especially necessary where, for climatic or some other reason, exposure to sunlight may not be adequate for the synthesis of enough vitamin D to prevent deficiency and therefore rickets.

3.2.7.2 The members of the Working Party are concerned that the measurement of drops, the number per dose and any instructions on the bottle should be such that the supplement can be administered easily and accurately.

3.3 Difficulties in the preparation of feeds

3.3.1 The significance of the differences in electrolyte content of human and cows' milk in relation to hypernatraemia has already been discussed (paras 3.2.2.1 to 3.2.2.3). The difference may be accentuated by the known variation in the electrolyte content of cows' milk and by the addition of sodium during manufacturing processes (Shaw, Jones and Gunther 1973), and may be still greater if the preparation of feeds is such that the baby receives a more concentrated feed than the manufacturers intend.

3.3.2 Hytten and MacQueen (1954) noted that there were widespread inaccuracies in the making of feeds by mothers of differing competence, and more recently Taitz and Byers (1972) described gross mistakes in the preparation of feeds from dried milk powders all of which resulted in hypernatraemia. But it is not only mothers who make mistakes. Wilkinson, Noble, Gray and Spence (1973) made careful tests using the scoops supplied with several different brands of milk and found that nurses and midwives as well as mothers were inaccurate, and all erred usually on the side of over-concentration. Sizes of scoops and instructions for their use in preparation of feeds vary for different brands of milk. Confusion and inaccuracies would be considerably lessened if scoops and instructions for dilution could be standardized. The members of the Working Party appreciate that differences in particle size and in density make this difficult. They realize that other methods of packaging such as the use of sachets have been explored, but are of the opinion that further attention should be paid to this problem.

3.4 Problems associated with the early introduction of solids

3.4.1 *Coeliac disease (gluten enteropathy)*

3.4.1.1 Arneil (1967) showed that by 1965 the growing practice of early

introduction of gluten-containing cereals to the diet of children in Glasgow meant that 7·6% of the children in their study were on a diet which included some gluten before the age of one month, 23·6% by the age of two months and 90·8% by three months of age. In one large Scottish hospital where the same paediatricians (except for one) have remained over a number of years, there has been an increase in the number of diagnoses of coeliac disease (Arneil, Hutchison and Shanks 1973). The information (Table 3.4) was extracted from hospital index cards upon which were recorded admissions and discharges, and the age, sex and diagnosis of each child. From their results the Glasgow paediatricians conclude that the number of children in whom a diagnosis of coeliac disease was made increased during the two periods 1958–65 and 1966–73 compared with 1950–57. They also conclude that in the two later periods the diagnosis was made at an earlier age than in 1950–57. The later periods are the years during which the introduction of cereals into the diet of young babies occurred at an increasingly earlier age (para 2.4.1).

Table 3.4: *The numbers of children who were diagnosed as having coeliac disease in a Glasgow hospital over three eight-year periods from 1950–73 (Arneil, Hutchison and Shanks 1973)*

Period	Total number of children diagnosed as having coeliac disease	Number of coeliac babies aged less than six months per 100 cases of coeliac disease	Number of coeliac babies aged less than one year per 100 cases of coeliac disease
1950–57	123	0·8	5·6
1958–65	279	1·4	17·1
1966–73	286	3·1	16·7

3.4.1.2 An increased prevalence of coeliac disease has been reported over the past 11 years in the West of Ireland by Mylotte, Egan-Mitchell, McCarthy and McNicholl (1973), and these authors state that not more than 3% of the children were breast fed, and that cereals, predominantly wheat, were frequently given as early as two or three weeks of age. On the other hand in one large city in England the number of diagnoses of coeliac disease among children born in the city had not apparently increased during the past decade (Wharton, personal communication).

3.4.1.3 Although diagnostic precision has improved over the years, it seems probable that the early introduction of gluten into the diet of a child who is in any case sensitive to gluten may well cause that child to develop coeliac disease earlier in life. In a child who is not sensitive to gluten, the members of the Working Party are uncertain whether or not gluten sensitivity might be induced as a result of the introduction of dietary gluten at an early age. Recent research on nutrition and the developing brain (Dobbing 1968, 1973) suggests that malnutrition is especially undesirable during the first six months of post-natal life. The Working Party is of the opinion that the use of wheat cereal at an early age (before four to six months) is to be discouraged.

3.4.2 *High sodium intake*

Some of the baby foods (both strained and "junior" foods) which can be used as a first course for the infant's meal contain a concentration of sodium per 1000 kcal which is higher than that in either milk or cereals. For example, while breast milk contains on average 230 mg sodium/1000 kcal, and unmodified dried cows' milk powders contain 660–810 mg sodium/1000 kcal, some infant dinners may have as much as 3000 mg sodium/1000 kcal. Such a high concentration of sodium puts a stress upon the young kidney which we think should be best avoided. The members of the Working Party agree that salt should not be added to the infant's food to suit the taste of the parents.

3.5 Problems associated with infection and immunity

3.5.1 One of the great advantages of breast feeding is the avoidance of the risk of a microbial contamination which can occur both in the preparation and in the giving of bottle feeds. Gastro-enteritis is much more common among bottle fed babies (Mellander, Vahlquist and Mellbin 1959; Mata and Wyatt 1971). The hazard is much greater where amenities for cleanliness in the home are poor, as they were in years past in this country and are now in some countries, but intrinsic as well as extrinsic factors may play an important part in the protection offered by breast feeding against gastro-enteritis.

3.5.2 For instance there is some evidence (Bullen and Willis 1971) that the superior resistance of the breast-fed infant to gastro-enteritis may be associated with a higher acidity and a different bacterial flora of the large intestine compared with the low acidity of the stools of children fed on cows' milk. An important factor in the high acidity of the stools of breast fed babies may be the low buffering capacity of breast milk (Willis, Bullen, Williams, Fagg, Bourne and Vignon 1973). The greater buffering effect of cows' milk results in a low stool acidity which may favour the growth of certain pathogenic organisms (Bullen and Willis 1971). In addition the iron-binding protein lactoferrin, which is present in human but not in cows' milk, may be associated with specific antibody that can inhibit the growth of pathogenic organisms in the gut (Bullen, Rogers and Leigh 1972). More research is needed into the epidemiological significance of these *in vitro* investigations.

3.5.3 The breast fed baby benefits from antibodies which are derived from the mother and passed on to her child in her milk. For example, protection against the poliomyelitis virus is afforded in this way.

3.5.4 Breast feeding also ensures the avoidance of exposure to allergens which may be present in cows' milk feeds at a particularly vulnerable period of the child's life. The younger the baby the more likely is there to be some deficiency in immunological defence mechanisms, and there has been a suggestion that some chronic allergic illnesses may derive from exposure to allergens in cows' milk and other foods at a time when there is some degree of immuno-deficiency (Taylor, Norman, Orgel, Turner, Stokes and Soothill 1973).

4. Obesity

4.1 Most doctors and health visitors consider that there are now-a-days too many fat babies, and there is some evidence which incriminates obesity as a cause of ill-health in babies and toddlers. But, to date, there have been relatively few systematic studies of the epidemiology, aetiology, treatment or prevention of obesity in infancy and childhood.

4.2 Recent studies of the prevalence of obesity in infants (Hutchinson-Smith 1970, Taitz 1971, Shukla, Forsyth, Anderson and Marwah 1972) suggest that many babies are too fat in the first year of life. No differences in the prevalence of obesity have been reported between the sexes.

Table 4.1: *Summary of some obesity studies of infants in England*

Authors	Number of babies	Age	Findings
Hutchinson-Smith[1] 1970	200	under 1 year	35% were > 20% overweight
Taitz[1] 1971	240	six weeks	59·6% exceeded 90th centile for weight
Shukla *et al*[2] 1972	300	under 1 year	16·7% were > 20% overweight 27·7% in addition were > 10% < 20% overweight

[1] Used centile charts prepared by Tanner (1958).

[2] Used centile charts prepared by Tanner, Whitehouse and Takaishi (1966).

4.3 The direct cause of obesity must be an intake of energy which is in excess of output, and the storage of this excess energy as fat in the adipose tissue. Although genetic factors may be of importance, the reasons for both an excess intake of energy and storage of excessive amounts of fat are probably as complex in babies as they are in older children and adults. Several studies have shown that artificially fed infants gain weight at a faster rate than breast fed babies. As early as 1959, Mellander, Vahlquist and Mellbin in Sweden found that babies who were weaned from the breast by two weeks were heavier and longer than those who were breast fed for at least six months. By the age of 30 months there was no difference in length but the difference in weight persisted. Hutchinson-Smith (1970), Taitz (1971) and Shukla, Forsyth, Anderson and Marwah (1972) all found that more babies who were artificially fed were overweight than were those who were breast fed. The practices of putting cereals and rusks into the bottle at only a few weeks of age (para 2.4.1), of giving artificial feeds which are more concentrated than intended by the manufacturers (section 3.3), of adding sugar to the modified milk powder in greater quantity than advised, of giving sweetened fluids to

drink, of introducing a mixed diet in addition to milk feeds too early and of the mother making the baby's food sweet to her own taste, are all conducive to an energy intake in excess of requirements with the resulting deposition and excessive storage of fat.

4.4 Few studies have been made as yet, but there is some evidence that not all babies who become obese remain obese in early childhood. Two studies in England have shown that many overweight babies (presumably obese) are more likely to be obese children at the age of five to seven years (Asher 1966; Eid 1970). However, in a group of Swedish urban children aged seven years, Mellbin and Vuille (1973) reported that overnutrition in infancy was not an important cause of obesity. Lloyd, Wolff and Whelen (1961) found that 80% of obese children remain obese in adult life.

4.5 Obese babies have an increased risk of lower respiratory disorders (Hutchinson-Smith 1970; Tracey, De and Harper 1971) and obese adults are known to have a higher mortality from diabetes mellitus, hypertension and cardiovascular disease. Thus obesity in young children should be discouraged. Prevention lies in education and in early recognition of the condition.

4.6 The practices enumerated above (para 4.3) are to be deprecated. There may also be a relationship between obesity and the thirst which is induced by hyperosmolar feeds. When thirst is unrecognized and the baby is given milk rather than water, a vicious circle of over feeding is set up (Shaw, Jones and Gunther 1973).

4.7 In the past, frequent measurements of weight were made at child health clinics in order to check that babies were thriving. This procedure, which has recently been somewhat underemphasized, might well be renewed in order to ascertain the onset of obesity at an early stage. To do this, regular assessment of growth should be made by comparison with standard centile charts (Tanner, Whitehouse and Takaishi 1966; Tanner and Whitehouse 1973).

5. Discussion

5.1 Breast feeding

5.1.1 The members of the Working Party are unanimous in their opinion that the best food for babies is human breast milk. They are convinced that, when successfully managed, breast feeding of four to six months' duration offers many advantages to both mother and infant, and effectively safeguards the infant from the adverse conditions which are or may be associated with artificial feeding. Since the risks of ill-health (sections 3.2.1 and 3.2.2) are greater when the baby is very young, breast feeding for even as short a period as two weeks is an advantage. The members also agree that although for some mothers the establishment of successful breast feeding may require more professional help than for others, only rarely for either mother or child are there any contra-indications to breast feeding; and that for most infants normal growth and development can be maintained on a diet of milk without the addition of other foods for the first four to six months following birth. The introduction of other foods before this age confers no ascertainable benefit to the infant.

5.1.2 The causes for the unpopularity of, or of the incapacity for, breast feeding which have become characteristic of the industrialized countries in this century have not been identified with any precision. There has been a change in the cultural pattern of life with accompanying changes in the attitudes of both men and women to female sexuality, motherhood and family life, and to the feminine rôle in the home, society, industry and the professions. Other factors almost certainly include the provision and the promotion of artificial feeds.

5.1.3 To encourage breast feeding by any measure which would make artificial feeding less easy, less safe or more expensive is neither practicable nor desirable. To do so would imperil the health and growth of a large number of infants. The members of the Working Party do, however, deprecate the advertisement or promotion of infant milks in any way which suggests that a substitute milk is equivalent or superior to breast milk as a food for infants.

5.1.4 At present there are certain factors which militate against breast feeding and as many as possible of these difficulties should be removed. For example, breast feeding is in most cases incompatible with employment outside the home and the mother who wishes to breast feed may suffer a financial penalty. The present maternity allowance gives financial assistance to a woman in the last trimester of pregnancy,[1] but many healthy women are able and would like to work until nearer the time of parturition. The Working Party recommend that the period during which the maternity allowance is payable could be

[1]The maternity allowance is paid for a period of 18 weeks starting at the eleventh week before the week in which the baby is due.

adjustable so that, subject to medical advice, mothers who wish to do so may take advantage of the maternity allowance for a longer period after parturition than at present. Women who for medical reasons need to stop work well before their expected week of delivery would in any case be entitled to sickness benefit.

5.1.5 Evidence which was presented to the Working Party by experts (p vii) suggests that mothers may not be receiving from either the medical or the nursing professions all the help and advice about breast feeding which they need. At present the majority of births take place in hospital and, in consequence, the rôles of the general practitioner and domiciliary midwife in pre-natal and immediate post-natal care have diminished. The increasing use of pre-packed "ready-to-feed" liquid milks in hospital may, by the ease with which complementary feeds (para 2.3.2) can be given, play some part in lowering the interest in breast feeding, and in the acquisition of skills for helping the mothers to breast feed. The increasingly frequent discharge of a proportion of mothers from hospital within 48 to 72 hours after delivery (Ministry of Health and General Register Office 1961–68, Department of Health and Social Security and Office of Population Censuses and Surveys 1970–73) diminishes the "lying-in" period which heretofore has provided an opportunity for training doctors and midwives in the establishment and supervision of breast feeding.

5.1.6 Although in most hospitals there may be no lack of privacy, the members of the Working Party are aware of the very great importance to the young mother of the opportunity to discuss in comfort, and in a relaxed atmosphere, her plans and problems about feeding her baby. Members wish to emphasize the importance of accommodation, the number of visitors, staff attitudes and the organization of the patient's day to give time for relaxed breast feeding.

5.1.7 They are also of the opinion that in matters concerning infant feeding more continuity of care is needed during pregnancy and after delivery. At present any one expectant and nursing mother and her baby may receive medical and nursing care and inconsistent advice in many different places, from hospital doctors, general practitioners, clinic doctors, midwives and health visitors, no one of whom is alone personally responsible for the establishment of a good feeding relationship between the mother and her baby. It is hardly surprising that so many mothers decide to accept the apparent simplicity of bottle feeding. The Working Party are glad to note that some hospitals now employ an experienced doctor or midwife to undertake the personal supervision of infant feeding and hope that in the newly-integrated National Health Service all members of the professional team with responsibility for the care of mothers and babies will be so trained that they give more consistent advice about feeding practice.

5.1.8 Ignorance and prejudice are probably important factors which militate against breast feeding, but there is no firm evidence of the extent to which these factors may operate. Successful breast feeding does not depend upon the acquisition of a great deal of factual knowledge, although a recognition of the advantages might well increase the motivation of parents towards breast feeding. It is not within the Terms of Reference of the Working Party to do

more than state the opinion that education and discussion about breast feeding should be greatly encouraged in schools (to both boys and girls) and in parenthood classes. The Working Party also hope that in each National Health Service district there will be appointed somebody with suitable qualifications and experience to co-ordinate education in nutrition, including infant feeding.

5.1.9 Research should also be encouraged into the means by which breast feeding can be fostered.

5.2 Bottle feeding

5.2.1 Attempts to manufacture "artificial" milk feeds which, within the limits of scientific knowledge, are both chemically and physiologically equivalent to human milk, are governed by such factors as cost of production, problems of packing and storage, palatability, acceptance by mothers and by the fact that the composition of breast milk changes, especially during the early days of lactation. At the same time the advice which can be given by scientists to manufacturers is hampered by large areas of ignorance.

5.2.2 Nevertheless some changes could with advantage be made. For example, over the years, the number of different milk preparations has steadily increased as manufacturers have sought to keep pace with advances in scientific knowledge, with the result that both mothers and their professional advisers are confused. Once the immediate post-natal adaptation to feeding by mouth instead of via the placenta has been accomplished, there should be, for the majority of babies, a milk product which meets adequately the nutritional needs of the baby (as does breast milk) until the introduction of mixed feeding at the age of about four to six months.

5.2.3 Since it is most important during the first two weeks of life that artificial milk feeds should resemble human milk as closely as possible, the necessity was considered for a special milk for the very young baby in addition to a milk which would be less critically formulated but suitable until the time of weaning at four to six months.

5.2.4 In practice, cows' milk can be made to resemble human milk more closely either by the addition of a suitable carbohydrate so that the concentration of calcium, phosphate and other electrolytes is reduced, or by an ion exchange method of demineralization followed by addition of electrolytes to the required concentration. Either process results in a milk feed (Table A1, p 34) which has a sufficiently low phosphate concentration to overcome the hazard of neonatal tetany.

5.2.5 Only by demineralization and addition of electrolytes can a feed based on cows' milk be prepared which has a sodium ion concentration near to that of breast milk. But during this process all minerals are removed including, for example, known trace elements and perhaps others as yet unknown (para 3.2.2.7). When trace elements are replaced in the form of soluble inorganic salts, there is no certainty that they are then present in a physiologically ideal form. By the addition of carbohydrate the sodium ion concentration can be reduced only to about 15 meq/1000 ml which is rather

less than midway between the average concentration in human and cows' milk. In practice such milk feeds are successful in reducing the risk of hyperosmolality and this risk extends beyond the first two weeks of life.

5.2.6 By either manufacturing process, the protein concentration of the resulting milk feed is much nearer to that of breast milk, that is to say about 2·0 mg/100 ml (para 3.2.3.4).

5.2.7 On balance the members of the Working Party prefer to advocate a single type of cows' milk feed which will serve, as does human milk, from the earliest days of life up to the introduction of solids at four to six months of age.

5.2.8 Pre-packed, sterilized, liquid feeds for domestic use which do not require dilution present almost insuperable difficulties in cost, supply, distribution, storage and the disposal of containers. For these reasons, in all probability feeds will continue to be sold in a concentrated form which may be dried, evaporated or condensed. When the artificial milk feed is prepared, reconstitution should require only the addition of water. The addition of sugar or of any other substance should not be necessary.

5.2.9 The use of the liquid "ready-to-feed" milk has advantages in hospitals in view of the shortage of skilled staff and the cost of setting up and maintaining "milk kitchens", but the Working Party think it important to reiterate that the use of these feeds tends to discourage attempts to establish successful breast feeding (para 5.1.5). In addition those mothers who do not or cannot establish breast feeding may gain no experience in the preparation of bottle feeds and may therefore be ill prepared for the task on discharge from the maternity unit of the hospital.

5.2.10 At the same time the relatively new "ready-to-feed" milks are more acceptable in composition and concentration of nutrients, and if correctly handled present few microbiological hazards. In addition, they are not subject to any of the errors of dilution which have been recognized as characteristic of the concentrated milk feeds.

5.2.11 Most of the artificial feeds which are available to the mother on her return home do not have the advantage of the "ready-to-feed" milks. There is considerable risk of microbiological contamination in the reconstitution of evaporated milks or dried milk powders, and the risk is greater for the "less adequate mother". Only education and careful supervision can minimize this risk. The present confusion in dilution of the concentrated milks should be overcome, and the Working Party wish to emphasize that the degree of dilution should be standardized so that the size of scoops, or other measures used for dilution with water, are uniform.

5.2.12 The present instructions for the preparation of an artificial feed also seem to be unnecessarily complex. If the degree of dilution were standardized (para 5.2.11) this would enable instructions to be simplified so that the volume of feed to be prepared for children of different ages could be easily understood. Pictorial instructions would be helpful where there are language difficulties. The requirements of individual babies vary. Some babies will require more and

some less than the average volume of feed for a given age. This should be clearly stated.

5.3 Introduction of solids and a mixed diet

5.3.1. The members of the Working Party agree that the introduction of any food to the baby, other than milk, should be unnecessary, in general, before the age of four to six months.

5.3.2 They are also of the opinion that the practice whereby the mother adds either salt or sugar (sucrose), or both, to the infant's food in an amount to suit her own taste should be discouraged.

5.3.3 Caution should be exercised by manufacturers in the addition of sucrose and of salt to infant food products.

5.3.4 From the age when mixed feeding is established, there is little or no advantage in continuing for long to give cows' milk which has been meticulously modified in composition to resemble breast milk, and there could be an advantage in using milk which is relatively unsophisticated and which is a fairly rich source of nutrients. When "doorstep" milk is used together with a mixed diet, vitamin supplements should be given so that the child receives an adequate amount of vitamin D (para 3.2.7.1).

5.3.5 All persons who are responsible for the feeding of infants should remember that the amount of milk needed varies in different children, and diminishes as more solids are included in the diet.

5.4 Legislation

5.4.1 The present legislative position regarding infant foods, as set out in Appendix B, is such that existing regulations do not contain compositional standards specifically for infant foods, and certain labelling controls in the regulations apply only to products containing more than 70% dried milk. Most retail sales of full-cream dried milk in the United Kingdom are for infant feeding and fall within the scope of the regulations, but products which are exempted from these labelling controls under the 70% rule could include products sold specifically for infant feeding if the product contained, for example, more than 30% of added lactose or other carbohydrate. Therefore one effect of any recommendation made by the Working Party about the modification of cows' milk by the addition of carbohydrate could be to increase the number of products that escaped these labelling controls.

5.4.2 Regulations for condensed and dried milk powders were introduced in 1923 and have not altered substantially since then. At that time there were no milk-based infant foods containing less than 70% dried milk on the market.

5.4.3 The members of the Working Party recognize that controls which are too rigid can impede progress but they agree that legislation which refers to the composition and labelling of infant foods is out of date and should be reviewed.

6. Recommendations

6.1 General

6.1.1 Because we are convinced that satisfactory growth and development after birth is more certain when an infant is fed an adequate volume of breast milk, we recommend that all mothers be encouraged to breast feed their babies for a minimum of two weeks and preferably for the first four to six months of life (para 5.1.1).

6.1.2 We are concerned that women do not always receive adequate advice and encouragement to breast feed their babies and we recommend that steps be taken (paras 5.1.5 to 5.1.8) to remedy this situation.

6.1.3 We are aware that lactation will not always be successfully established and we therefore recommend that the provision of modified cows' milk feeds, at a reasonable cost, should be continued (para 2.1.3).

6.1.4 We recommend that young babies should be weighed regularly so that an assessment of growth by comparison with standard centile charts can be made (para 4.7), and that as much attention should be paid at an early stage to excessive as to inadequate weight gain.

6.2 Encouragement of breast feeding

6.2.1 We are of the opinion that breast feeding should be encouraged by education of (a) boys and girls in school and in the home; (b) parents in pre-natal clinics and classes, and (c) mothers in the maternity units of hospitals and at home (para 5.1.8).

6.2.2 We think that adequate instruction in the principles of nutrition, including infant feeding, should be given in the training of all professional personnel who are to be concerned with infant feeding—medical student, dietitian, midwife, health visitor and nurse (para 5.1.7).

6.2.3 We suggest that the principles and practice of infant feeding should be agreed by all concerned. We hope that in the newly integrated National Health Service there will be appointed in each district somebody with suitable qualifications and experience to co-ordinate education in nutrition, including infant feeding (para 5.1.8).

6.2.4 We are of the opinion that the period during which the maternity allowance is payable should be more adaptable to the requirement of the

mother and child—i.e. that those mothers who, with the approval of the doctor in charge of ante-natal care, wish to continue at work during the third trimester of pregnancy should be able to receive the allowance for a longer period after parturition than at present. Such an arrangement would encourage breast feeding without the likelihood of great financial loss to the mother (para 5.1.4).

6.2.5 We think that the mass media could with benefit be used in educating the public in the principles of infant feeding which we have stated in this Report, and we disapprove of their use and of the use of any advertisement to promulgate ideas about infant feeding which are contrary to those principles (para 5.1.3).

6.3 Artificial milk feeds

6.3.1 We recommend that the reconstituted artificial milk feed, with the exception of the amounts of vitamins A, C and D and of the iron compound with which such feeds are at present fortified, should approximate to the composition of breast milk as nearly as is practicable. Such milk feeds should contain a concentration of phosphate, sodium and protein which is lower than that of cows' milk and nearer to that of breast milk (paras 3.2.2.7, 3.2.3.4, 5.2.4, 5.2.5 and 5.2.6).

6.3.2 We agree that the reconstituted artificial milk feed should be fortified with vitamins A, C and D to the concentrations at present in use (para 3.2.7.1).

6.3.3 We agree that vitamin supplements should be available to children during at least the first year of life (para 3.2.7.1), and that the measurement of drops, the number of drops per dose and any instructions on the bottle should be such that the supplement can be administered easily and accurately (para 3.2.7.2).

6.3.4 In the absence of positive evidence of harm, we see no reason to depart from the present practice of the fortification of artificial milk feeds with a non-toxic iron salt which is known to be easily absorbed (para 3.2.6).

6.3.5 The composition of National Dried Milk (N.D.M.) should be modified in the light of these recommendations. We agree that a national dried milk which is equivalent in all respects to other infant milks, and which is cheap, should be available.

6.3.6 We recommend that artificial feeds should be so manufactured that they are either liquids which are "ready-to-feed", or liquids or powders that require the addition only of water and of no other substance (para 5.2.8).

6.3.7 We recommend that the present confusion in the reconstitution of an artificial milk feed should be overcome and that the degree of dilution should

be standardized so that the size of scoops or other measures used for dilution with water should be uniform (paras 3.3.2 and 5.2.11).

6.3.8 We recommend that artificial feeds should be so manufactured that the dilution required to reconstitute the milk should be independent of the age of the baby and thus instructions about dilution can apply to feeds for a baby from birth onwards (para 5.2.11).

6.3.9 We recommend that instructions, both about the reconstitution of an artificial feed and about the volume of feed to be prepared for children of different ages, should be simple to understand and if possible illustrated pictorially (para 5.2.12).

6.3.10 Instructions should also be accompanied by the information that some individual babies may require more and some less than the average volume (para 5.2.12).

6.4 Introduction of solids

6.4.1 We recommend that the early introduction of cereals or other solid foods to the diet of babies before about four months of age should be strongly discouraged; and that cereal foods in any form should not be added to the milk in the bottle feed (paras 3.4.1.3, 3.5.4 and 4.3).

6.4.2 We recommend that mothers be advised not to add sugar (sucrose) or salt (sodium chloride) to the solid foods in an infant's diet, and that caution should be exercised by manufacturers in the addition of sucrose and of sodium chloride to their infant food products (paras 3.4.2 and 4.3).

6.5 Research

We agree that further research into the principles and practice of infant feeding should be made.

6.6 Information

We think that the present methods of collecting statistics, for example, in the Hospital In-Patient Enquiry and in the General Household Survey, could be examined in order to evaluate the future use of these statistics in the provision of some means for a continuous review of patterns of infant feeding.

6.7 Legislation

We recommend that the legislation concerning the composition, labelling and advertising of milk-based infant foods be reviewed (paras 5.4.1–3 and Appendix B).

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Appendix A:
Tables A1, A2 and A3

Table A1: *Energy and nutrient content per 100 ml of infant feeds derived from cows' milk (made up according to manufacturers' instructions)*

Feeds	Dilution	Energy k cal	Protein g	Fat g	Carbohydrate g	Na mg	K mg	Cl mg	Ca mg	Mg mg	P mg	Fe mg	Cu µg	Zn mg	Na meq/l	K meq/l	Cl meq/l	Vitamin A µg	Vitamin A i.u.	Vit. C mg	Vitamin D µg	Vitamin D i.u.
1. Evaporated milks																						
Carnation	1→3	73[1]	2·7	2·9	9·2[1]	50	133	92	95	11·6	83	0·06	37·0	—	21·6	34·0	25·9	35	117	0·2	0·9	36
Cow & Gate	1→3	68[1]	2·7	3·1	7·5[1]	47	117	83	100	—	83	—	—	—	20·3	29·9	23·4	—	—	—	0·9	36
2. Dried milk powders unmodified																						
Cow & Gate Babymilk 2	1→8	72[1]	3·3	3·4	7·5[1]	56	138	—	106	11·6	88	0·50	14·6	0·2	24·4	35·3	—	100	330	3·5	1·1	44
Ostermilk Two	1→8	69[1]	3·3	3·3	6·7[1]	56	138	110	114	12·3	91	1·20	7·1	0·2	24·4	35·3	30·8	131	436	4·4	1·1	44
Golden Ostermilk	1→8	69[1]	3·3	3·3	6·7[1]	51	138	—	119	—	95	1·20	—	—	22·2	35·3	—	131	436	4·4	1·1	44
National Dried Milk	1→11	55[1]	2·5	2·4	5·9[1]	40	109	—	83	10·2	67	0·48	—	—	17·2	28·0	—	23	75	2·4	0·8	32
National Dried Milk (half-cream)	1→11	52[1]	3·0	1·4	6·3[1]	—	—	—	90	11·6	77	0·48	—	—	—	—	—	12	39	2·4	0·8	32
3. Dried milk powders modified by the addition of carbohydrate																						
Cow & Gate Babymilk 1	1→8	54	2·4	1·9	7·0	41	104	—	84	8·9	65	0·50	12·6	0·2	17·8	26·6	—	100	330	3·5	1·1	44
Cow & Gate Trufood	1→8	60	1·8	3·0	6·6	50	110	—	88	—	73	0·13	—	—	21·7	28·1	—	79	263	5·0	1·1	44
Cow & Gate Babymilk Plus	1→8	63	1·8	3·3	6·6	30	70	—	62	—	50	0·60	—	0·3	13·0	19·7	—	100	330	5·3	1·1	44
Ostermilk One	1→6·66	70	2·7	2·9	8·4	53	126	93	106	10·9	85	1·03	6·5	0·3	23·1	32·3	26·0	109	363	3·7	0·9	36
Ostermilk Complete Formula	1→6·66	71	1·8	3·0	9·3	45	83	68	60	6·2	50	1·00	—	—	19·6	21·2	19·0	105	350	7·0	1·0	40
4. Dried milk powders. Milk fat replaced with other fats																						
Cow & Gate V formula	1→8	62	1·8	3·0	7·0	33	82	—	63	5·4	50	0·75	36·3	0·3	14·4	21·0	—	79	263	5·3	1·1	44
SMA	1→8	65	1·5	3·5	7·0	26	75	48	53	5·6	43	1·24	43·8	0·3	11·3	19·2	13·5	80	266	5·3	1·1	44
SMA S26	1→8	67	1·5	3·6	7·2	15	55	41	42	4·0	33	0·80	40·0	0·3	6·5	14·1	11·5	80	266	5·3	1·1	44
5. Ready to feed																						
Cow & Gate full-cream		70	3·0	3·1	7·5	50	115	—	105	—	80	0·40	—	—	21·7	29·4	—	100	330	3·0	1·0	40
Cow & Gate half-cream		56	2·5	2·0	7·1	43	100	—	84	—	70	0·40	—	—	18·7	25·6	—	100	330	3·0	1·0	40
Cow & Gate Trufood		60	1·8	3·0	6·6	30	82	—	88	—	73	0·13	—	—	13·0	21·0	—	79	263	5·3	1·1	44
Cow & Gate V formula		62	1·8	3·0	7·0	33	82	—	63	5·4	50	0·75	36·3	0·3	14·4	21·0	—	79	263	5·3	1·1	44
Cow & Gate Babymilk plus		64	1·8	3·3	6·8	30	70	—	68	—	54	0·63	—	0·3	13·0	19·7	—	100	330	5·5	1·0	40
Ostermilk Golden		70	2·7	2·9	8·4	60	120	100	110	—	90	1·00	—	—	26·1	30·7	28·0	110	363	3·7	0·9	36
Ostermilk New (complete formula)		69	1·8	2·8	9·4	30	75	68	60	—	50	1·00	—	—	13·0	19·2	19·2	105	350	7·0	1·0	40
SMA		67	1·5	3·6	7·2	27	78	48	56	6·0	44	0·80	40·0	0·2	11·7	20·0	13·5	80	266	5·3	1·1	44
SMA S26		67	1·5	3·6	7·2	15	55	41	42	4·0	33	0·80	40·0	0·3	6·5	14·1	11·5	80	266	5·3	1·1	44
6. Human milk		67	1·2	3·8	7·0	15	55	43	33	4·0	15	0·15	40·0	0·5	6·5	14·1	12·1	58	191	4·3	0·01	0·4
Cows' milk		66	3·3	3·7	4·8	58	138	103	125	12·0	96	0·10	30·0	0·4	25·2	35·6	29·0	40	132	1·6	0·06	2·4

[1] Includes sugar added when making up the milk according to the manufacturers' instructions.

SOURCES: Widdowson, E. M. (personal communication).
Research departments of the various manufacturers of infant milks.
For human and cows' milk—Macy, I. G. and Kelly, H. J., 1961.

Values vary somewhat according to the different batches of milk since the composition depends on the breed of cow, season of the year and stage of lactation.

Table A2: *Nutrient content per 100 kcal of infant feeds derived from cows' milk (made up according to manufacturers' instructions)*

Feeds	Protein g	Fat g	Carbo-hydrate g	Na mg	K mg	Cl mg	Ca mg	Mg mg	P mg	Fe mg	Cu µg	Zu mg	Na meq/l	K meq/l	Cl meq/l	Vitamin A µg	Vitamin A i.u.	Vit. C mg	Vitamin D µg	Vitamin D i.u.
1. Evaporated milks																				
Carnation	3·7	4·0	12·6[1]	68	182	126	130	15·9	114	0·08	50·7	—	2·9	4·6	3·5	48	160	0·3	1·2	48
Cow & Gate	4·0	4·6	11·0[1]	69	172	122	147	—	122	—	—	—	3·0	4·4	3·4	—	—	—	1·3	52
2. Dried milk powders unmodified																				
Cow & Gate Babymilk 2	4·6	4·7	10·4[1]	78	192	—	147	16·1	122	0·69	20·3	0·3	3·4	4·9	—	139	458	4·9	1·5	60
Ostermilk Two	4·8	4·8	9·7[1]	81	200	159	165	17·8	132	1·74	10·3	0·3	3·5	5·1	4·5	190	635	6·4	1·6	64
Golden Ostermilk	4·8	4·8	9·7[1]	74	200	—	172	—	138	1·74	—	—	3·2	5·1	—	190	635	6·4	1·6	64
National Dried Milk	4·5	4·4	10·7[1]	73	198	—	151	18·5	122	0·87	—	—	3·1	5·1	—	42	136	4·4	1·5	58
National Dried Milk (half-cream)	5·8	2·6	12·1[1]	—	—	—	173	22·3	148	0·92	—	—	—	—	—	23	75	4·6	1·5	61
3. Dried milk powders modified by the addition of carbohydrate																				
Cow & Gate Babymilk 1	4·4	3·5	13·0	76	193	—	156	16·5	120	0·93	23·3	0·4	3·3	4·9	—	185	614	6·5	2·0	80
Cow & Gate Trufood	3·0	5·0	11·0	83	183	—	147	—	122	0·22	—	—	3·6	4·7	—	132	438	8·8	1·8	72
Cow & Gate Babymilk Plus	2·8	5·2	10·5	44	109	—	100	—	79	1·00	—	0·5	2·0	2·8	—	158	524	8·4	1·7	68
Ostermilk One	3·9	4·1	12·0	76	180	132	151	15·6	121	1·47	9·3	0·4	3·3	4·6	3·7	156	516	5·3	1·3	52
Ostermilk Complete Formula	2·5	4·2	13·1	63	116	96	85	8·7	70	1·40	—	—	2·8	3·0	2·7	148	493	9·9	1·4	56
4. Dried milk powders. Milk fat replaced with other fats																				
Cow & Gate V Formula	2·9	4·8	11·3	53	132	—	102	8·7	81	1·21	58·5	0·5	2·3	3·4	—	127	424	8·5	1·7	68
SMA	2·3	5·4	10·8	40	115	74	82	8·6	66	1·91	67·3	0·5	1·7	3·0	2·1	120	400	8·2	1·5	60
SMA S26	2·2	5·4	10·7	22	82	61	63	6·0	49	1·19	60·0	0·5	1·0	2·1	1·7	119	396	7·9	1·6	64
5. Ready to feed																				
Cow & Gate full-cream	4·3	4·4	10·7	71	161	—	150	—	114	0·57	—	—	3·1	4·2	—	143	472	4·3	1·4	56
Cow & Gate half-cream	4·5	3·6	12·7	76	177	—	150	—	125	0·71	—	—	3·3	4·5	—	179	590	5·4	1·8	72
Cow & Gate Trufood	3·0	5·0	11·0	50	136	—	147	—	122	0·22	—	—	2·2	3·5	—	132	438	8·8	1·8	72
Cow & Gate V Formula	2·9	4·8	11·3	53	132	—	102	8·7	81	1·21	58·5	0·5	2·3	3·4	—	127	424	8·5	1·8	72
Cow & Gate Babymilk Plus	2·8	5·2	10·6	47	109	—	106	—	84	0·98	—	0·5	2·0	2·8	—	156	516	8·6	1·6	64
Ostermilk Golden	3·9	4·1	12·0	86	171	143	157	—	129	1·43	—	—	3·7	4·4	4·0	157	519	5·3	1·3	52
Ostermilk New (complete formula)	2·6	4·1	13·6	44	109	99	87	—	72	1·44	—	—	1·9	2·8	2·8	152	507	10·1	1·4	56
SMA	2·2	5·4	10·7	40	116	72	84	9·0	66	1·19	60·0	0·3	1·7	3·0	2·0	119	396	7·9	1·6	64
SMA S26	2·2	5·4	10·7	22	82	61	63	6·0	49	1·19	60·0	0·5	1·0	2·1	1·7	119	396	7·9	1·6	64
6. Human milk	1·8	5·7	10·4	23	82	64	49	6·0	22	0·22	60·0	0·7	1·0	2·1	1·8	87	287	6·4	0·015	0·6
Cows' milk	5·0	5·6	7·3	88	209	156	189	18·2	145	0·15	45·0	0·6	3·8	8·1	4·4	61	201	2·4	0·09	3·6

[1] Includes sugar added when making up the milk according to the manufacturers' instructions.

SOURCES: Widdowson, E. M. (personal communication).
Research departments of the various manufacturers of infant milks.
For human and cows' milk—Macy, I. G. and Kelly, H. J., 1961.

Values vary somewhat according to the different batches of milk since the composition depends on the breed of cow, season of the year and stage of lactation.

Table A3: *Fatty acid composition of the fat in human and cows' milk, in infant feeds containing milk fat, and in infant feeds where the milk fat is replaced by other fats.*

Fatty acid	Human milk	Cows' milk[1]	Cow & Gate V formula	SMA and SMA S26
Saturated				
C10:0 Capric	1·7	2·6	0·6	1·4
C12:0 Lauric	5·8	2·2	6·7	14·5
C14:0 Myristic	8·6	10·5	3·3	6·0
C16:0 Palmitic	22·6	26·3	32·8	12·8
C18:0 Stearic	7·7	13·2	4·3	7·4
Unsaturated				
C16:1 Palmitoleic	2·9	3·1	Tr.	1·0
C18:1 Oleic	36·4	32·2	34·7	38·8
C18:2 Linoleic	8·3	1·6	16·3	13·1
C18:3 Linolenic	0·4	Tr.	Tr.	1·1
C20[2] Arachidonic and above	4·0	Tr.	NA	NA

SOURCE: Widdowson, E. M. (personal communication).

[1] Values apply to all infants feed based on modified cows' milk except Cow & Gate V formula and SMA.

[2] SOURCE: Fomon, S. J. (1967).

NA not available.

Tr. trace.

Appendix B: Present legislative position regarding infant foods

(1) There are no legislative compositional standards in the United Kingdom specifically for infant foods, but many milk products offered for sale as infant foods are subject to the Regulations made under the Food and Drugs Act 1955 controlling the composition and labelling of condensed and dried milk and of skimmed milk with non-milk fat. Particulars of these Regulations in force in England and Wales are set out below.

(2) *The Condensed Milk Regulations (1959)* and the *Dried Milk Regulations (1965)* control the composition and labelling of condensed and dried milk sold for direct consumption in England and Wales. Similar legislation operates in Scotland and Northern Ireland. The compositional standards are as follows:

	Minimum percentage of milk fat	*Minimum percentage of total milk solids including fat*
Condensed full cream milk, sweetened	9·0	31·0
Condensed full cream milk, unsweetened	9·0	31.0
Condensed partly skimmed milk, sweetened (half-cream)	4·5	26·5
Condensed partly skimmed milk, unsweetened (half-cream)	4·5	26·5
Condensed skimmed milk, sweetened	—	26·0
Condensed skimmed milk, unsweetened	—	20·0
Dried full-cream milk	26·0	Moisture content must not exceed 5·0%
Dried three-quarter-cream milk	17·0	
Dried half-cream milk	14·0	
Dried quarter-cream milk	8·0	
Dried partly skimmed milk	1·5	
Dried skimmed milk	1·5 (Maximum)	

(3) Condensed milk, unsweetened is normally sold under the description "evaporated milk", and condensed milk, sweetened under the description "condensed milk". The regulations require, however, that the statutory description of the product as specified in paragraph (2) together with a statement of the milk equivalence appear on the label in a prescribed form, for example:

CONDENSED FULL-CREAM MILK, UNSWEETENED
THIS TIN CONTAINS THE EQUIVALENT OF (X)
PINTS OF MILK

For skimmed milk products the declaration should also contain the statement "UNFIT FOR BABIES" or "NOT TO BE USED FOR BABIES"; and for all other products which are not full-cream products it should contain the statement "SHOULD NOT BE USED FOR BABIES EXCEPT UNDER MEDICAL ADVICE".

(4) *The Dried Milk Regulations (1965)* apply to dried milk to which no other substance has been added and to the dried milk contained in any powder or solid of which not less than 70% consists of dried milk. A product containing less than 70% dried milk is therefore exempt from the Regulations and is not subject to the labelling requirements in paragraph (3). The Labelling of Food Regulations (1970) would however require such products to be described in such a way as to indicate to an intending purchaser their true nature.

(5) *The Skimmed Milk with Non-Milk Fat Regulations (1960)* control the labelling in England and Wales of skimmed milk to which non-milk fat has been added. Similar legislation operates in Scotland and Northern Ireland. The product may be sold in liquid, concentrated, condensed and dried form. All forms of skimmed milk with non-milk fat, other than certain exempted products (see (6) below), must be labelled as "UNFIT FOR BABIES" or "NOT TO BE USED FOR BABIES" and carry a declaration in a prescribed form, for example:

DRIED SKIMMED MILK
WITH NON-MILK FAT
UNFIT FOR BABIES
[or NOT TO BE USED FOR BABIES]

(6) Certain products, whose composition is specified in the Second Schedule of the Regulations, are exempt from the requirement to be labelled as "UNFIT FOR BABIES". These are products which have been specially modified for infant feeding and are sold specifically for that purpose: their exemption from the labelling requirement "UNFIT FOR BABIES" is now only permitted on the advice of the Panel on Child Nutrition of the Committee on Medical Aspects of Food Policy (Nutrition) (formerly advice was given by the Panel on Milk Fat). The list of exempted products has been extended from time to time, i.e. by the Skimmed Milk with Non-Milk Fat (Amendment) Regulations 1966, the Skimmed Milk with Non-Milk Fat (Amendment) Regulations 1968 and the Skimmed Milk with Non-Milk Fat (Amendment) Regulations 1973.

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