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What Do We Know About Child Feeding? Review of Recommendations Related to Weaning

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Introduction

Before birth biological nutrition is arranged via the placenta of the mother and after birth generally through the mother's milk. Artificial substitutes for the biological nutrition during the foetal period are, in fact, impossible, and possible only under optimal conditions for the nursing period[1].

Any substitution of biological nutrition is proposed as weaning. The word "wean" is derived from the Anglo-Saxon wenian meaning "to accustom (as a child) to take food otherwise than by nursing"[2]. The problem of when to begin weaning and what foods are appropriate has been extensively examined, but while the literature is vast, the scientific data are less comprehensive[3]. The importance of the question is underscored when one considers the consequences of inappropriate weaning (Table 1)[4,5]. If the weaning starts when the biological nutrition is still sufficient, e. g. before 6-7 months of age, it may be termed as unphysiological weaning, when it starts after that it could be physiological weaning. In both cases, the food used as substitutes for the mother's milk must provide nutrients qualitatively and quantitatively comparable to breast milk. Too early initiation of weaning carries the risk both of increased morbidity due to diarrhoea and food allergies, as external challenges are introduced into the immature digestive tract, and of infant malnutrition due to the normal decrease in maternal milk production as the baby is withdrawn from the breast. Weaning too late can lead to faltering growth, decreased immune protection and, again, increased diarrheal disease and malnutrition

when exclusive breast-feeding becomes inadequate. Inappropriate choice of weaning foods can lead to protein-energy malnutrition and an array of micronutrient deficiencies[6].

The first year of life is characterized by rapid growth and changes in body composition: most healthy infants double their birth weight in six months and triple it in a year. The progression from breast milk to solid food is based not only on the infant's nutrient requirements, but also on developmental maturation and environmental influences[7]. Despite broad cultural diversity[45] published recommendations for weaning are remarkably consistent worldwide[8-18].

In the last 20years, much has been written on weaning and a number of recommendations have proposed on weaning foods and requirements during infancy and childhood. This paper summarizes the history of changing patterns and recommendations of infant feeding, and illustrates the complexity of the subject.

The primary scientific data on which these recommendations are based are summarized in Table 2. During the first four months of life, breast milk alone provides optimal nutrition for the rapidly growing young infant. [12,19-23]. As physical and developmental capacities mature, solid foods are introduced and the composition and consistency of the diet are advanced so that by approximately 12 months of age the infant is eating a variety of foods from a mixed diet (Table 3). Thus, infant feeding should be considered in three overlapping periods; (1) the exclusive breast-feeding period, (2) the weaning period, and (3) the period of a modified adult diet.[13,14,17,18,24,25]

Historical background and previous recommendations

Before 1920 solid foos were seldom given to infants. In 1923, however, Jundell[26] reported excellent results from experience of infants in an orphanage. The infants had been fed with a variety of solid foods from the age of 6 months. Further reports

noted that the early introduction of "Beikost" (all foods other than breast milk or formula in feeding of infants) was associated with weight gain, incresased resistance to infection, and lower incidence of anaemia[27]. Accordingly, Marriot, in his text book on infant feeding in 1935[28], advised that the solid foods should be introduced at the age of 6 months, and the Council of Foods of the American Medical Association in 1937[27] recommended the feeding of strained vegetables and fruits from the age of about 4-6 months. In 1943[29] Stewart reported the feeding of infants aged 4-6 weeks with sardines, tuna fish and shrimps, and in 1956, Sackett[30] described the introduction of Beikost within the first few days of life. Although the Committee on Nutrition of the American Academy of Paediatrics (AAP) in 1958[31] emphasized that there was no proof that feeding of solid foods before 4-6 months was either beneficial or harmful from the nutritional or phychological point of view, the practice of early introduction of Beikost continued to be advocated in many countries. Thus by the early 1970's market research in the USA showed that Beikost supplied about 30% of the energy intake at 3 months, 38% at 6 months and 58% at 9 months[32]. Later Wilkinson and Davis [33] in the UK reported that the mean age when breastifed infants received their first solid food was13.8 weeks, whilst for bottle fed infants it was 8.3 weeks.

During the 1970's concern arose about possible hazards from the early introduction of Beikost and this change of attitude was reflected in several authoritative statements. Thus the Protein Advisory Group of the United Nations[34] emphasized that breast milk is satisfactory as the sole source of food during the first 4-6 months, and that only after this age should foods from the family diet be gradually introduced. This group, however, recognized that in certain circumstances, and even in privileged societies, supplementation of breast-feeding with other foods might be necessary at an early age. An IPA seminar on nutritional problems in developing countries in 1975[35] recommended that the introduction of cereals and other solid foods to the diet of fully breastfed infants before the age of 4 months be strongly discouraged. In many European countries (eg. West Germany, France Finland, Sweden)

the recommendation was made that the introduction of Beikost be delayed until 3-4 months; in the USA the Committee on Nutrition of the AAP recommended that feeding of supplemental foods should start between 4-6 months of age[14]. In Britain food for the suckling began to change from 1974[36]. According to a report on Health and Social Subjects in 1974, breast-feeding before 4 months of age were strongly discouraged. The outlook has improved since then, as there has been a dramatic decline in the number of deaths due to gastroenteritis and few cases of hypernatraema showing that metabolic illnesses were were less severe[36].

Weaning period

Basically the weaning period is defined as the total period during which breast milk is being replaced by other foods, but still available to some extent. Ideally, weaning should not start earlier than about 6 months of life and be completed at 2-3 years. It would then cover the post weaning phase, which has become identical with the overwhelming problems of PEM and other deficiencies[1,8]. The exact time at which weaning needs to be initiated is determined by the lactation performance of the mother and the velocity of growth and maturation of the infant; it does not therefore depend strictly on age, but for most infants it is between the ages 4 and 6 months[37]; it is also necessary to begin not later than 6 months to ensure continued good nutrition. During latter part of infancy the feeding pattern has to be gradually changed to an adult type of diet. These Changes are dependent upon the development of physiological and psychomotor maturity, but it is important to emphasize that factors other than physiological ones also have to be taken into account[8]. The feeding of older infants is influenced by cultural, psycho-social and historical factors and cannot be isolated from the feeding habits and socio-cultural status of the whole population[8,38,-40].

The age at which complementary foods are introduced depends on many biological, cultural, social and economic factors[41,42]. In communities where breast-feeding for the first months

of a child's life is the rule, complementary foods may be introduced from as early as the first weeks of life. In others, the interval may be as long as one year. However, accumulated evidence suggests that in most cases the practice is begun when mothers themselves think the child is receiving insufficient milk from the breast[41]. In general, children who are not receiving complementary feeding after 6 months do not maintain adquate growth[42]. Late introduction of complementary foods seem to show a limited acceptance in children[43]. This anorexia has been resistant todietary intervention of any kind. Hence it has been suggested [4,44-46] that faltering of growth after 6 months in deprived environments is not only a consequence of insufficient provision of complementary food under unhygienic conditions, but perhaps of equal importance is the failure to stimulate the early acceptance of a varied eating pattern during the weaning process.

In conditions where undernutrition and social deprivation are common, the growth of exclusively breastfed children may begin to show signs of faltering before 4 months. However, early complementary feeding has definite hazards for the infant especially in poor and deprived environments where the risk of contamination is high. It poses a definite threat to gastroenteritis with all its consequences[41]. Early complementary feeding also has economic and social costs that may be critical to marginal families, limiting the choices of busy, poor, working women who need to provide adequate replacement foods for a missed breast-feeding[4,44].

When does weaning end?

The time which a child can be safely weaned completely, terminating breast-feeding, depends on the nature of the weaning diet, which usually also includes other animal foods. Complete weaning can be done early, before one year of age. On the other hand, if the child when completely weaned is going to be fed on a diet based on cereals or starchy roots or fruits, with very little or no

animal products, continued breast-feeding helps to maintain its health until the age, where its nutritional requirements can be more easily met with the foods usually consumed by the adult members of the family.

Weaning is thus a gradual process of adaptation, not only nutritionally, but also socially, the child being progressively less dependent on his mother[37]. The foods suitable for infants and young children vary from one place to another, depending on availability, cost, culture, food preferences and so on. A meal is usually made from several foods; each food supplies some energy and different nutrients, all of which combine together in a meal. It is important that the foods are in right proportion so that there is an adequate balance between the nutrients, and between energy and the nutrients[18].

Nutritional needs during the weaning period

Nutrient recommendations for the first six months of life are primarily derived from the average amount consumed by healthy infants, growing at an optimal rate, exclusively breast-fed by healthy, well-nourished mothers[47]. Energy and protein requirements have recently been revised by the World Health Organization (WHO)[48]. Energy and protein inadequacy and Deficiencies of iron, zinc, and vitamins D and A are the most common nutrient deficiencies observed during infancy, and weaning recommendations have focused on their prevention.

Energy

No specific time for the introduction of supplementary feeding has been universally shown to have positive short-or long-term effects on health[19-21]. Lack of clear evidence upon which to make recommendations raises the question of what constitutes optimal growth for the exclusively breast-fed infant. Currently, WHO recommends using the growth data of the U. S. National Center for Health Statistics as an international reference stand-

ard[49]. Various investigators have calculated that between 3-4 months of age exclusive breast feeding becomes inadequate to meet the theoretical energy needs of the normal infant[10,22,23]. Growth patterns and micronutrient intakes of infants exclusively breast-fed by well-nourished mothers indicate that subtle growth faltering, a possible precursor of more serious undernutrition, occurs at about six months[19,22]. When undernutrition and social deprivation are common, breast-fed children may show signs of faltering growth before they are four months old. Chronic or acute infection may be implicated here as well as dietary insufficiency; in any case, an infant who shows a significant falloff in growth will need supplementary feeding regardless of age.

In the developing world, long-term breast-feeding is often highly desirable, even if it covers only a fraction of the child's total requirement in the second year of life.[13-18]. Staple weaning foods of high caloric density are essential during this critical time.

Protein

In 1935 Cecily Williams[50] originally described the protein-deficiency syndrome she named "Kwashiorkor" and its association with prolonged breast-feeding and inappropriate weaning. The only supplemental food given to the infants Williams described was a high-calorie, low-protein maize preparation. The syndrome of edema, diarrheoa, irritability and skin lesions appeared at about 18 months of age, Williams was convinced the remedy should be dietetic and found that "in the absence of any accurate knowledge as to what the defect was, a full and varied diet, rich in accessory substances, was employed. "In developing countries protein deficiency rarely occurs as an isolated condition but exists in combination with deficiencies of energy, zinc, and potassium, which complicate the condition[51-53]. Although some researchers speculate that these nutrients may be primary factors in the development of kwashiorkor, other evidence suggests that an inadequate protein-to-energy ratio is the most likely cause[54].

As with the original description of kwashiorkor, cases from developed countries have been associated with markedly inadequate (high-carbohydrate, low-protein) weaning foods.

Mature human milk contains approximately 9 g protein per liter, of which approximately 70% is whey proteins. Protein quantity and quality affect both digestibility and the ability to support growth. The chemical properties of the casein in human milk promote the formation of a soft, flocculent curd, which is easier for human infants to digest than the casein in other animals' milk. Additional proteins in human milk, e.g., the immunologic factors secretory Immunoglobulin A (SIgA), lactoferrin, and lysozyme, do not contribute nutritionally available protein, although these proteins are active in the gastrointestinal tract. Their concentration has been estimated to be 3 g/l[55,56]. Thus, nutritionally available protein may approximate 7 g/l. This would provide the normal infant consuming 180 ml/kg in the first months of life with approximately 1.3 g protein per day, a figure that agrees with theoretical calculations of protein requirements during early infancy.[48]

Protein requirements are based on adequate energy intake and balance; both are major determinants of appropriate weaning foods. Food mixes (double-, triple-, or multimixes) containing the staple cereal of a country and additional ingredients that complement cereal proteins, such as nuts and seeds, have been used throughout the developing world to improve the protein quality of weaning foods.[13,18] Kitchri, a combination of rice, lentils, and oil, a common weaning food in India and Pakistan[13,18] and mungkiribath, a traditional Sri Lankan preparation are examples of such mixtures.

PHYSIOLOGIC MATURATION

Renal Developmnt

At birth the renal system performs all its normal functions, but with limited concentrating ability. Because of the infant's highly anabolic state, urinary urea excretion is low and retention of

electrolytes is relatively high. Immediately after birth, the concentration of antidiuretic hormone, reported to be 50 times normal basal values, helps the infant to conserve water in the early neonatal period before lactation is establishd[57]. However, the functional capacity of the kidneys increases rapidly, and by four months their abilîty to handle the increased solute load is adequate for the gradual addition of weaning foods. By 12 months kidney size has almost doubled and significant dietary variations are well tolerated[7].

A major question is whether breast-fed infants need additional water. Early introduction of water and herbal concoctions as supplements to breast milk is common around the world and may be recommended by health workers who are convinced that some infants need additional fluid to maintain their water balance, especially during the hot summer months. In countries where safe drinking water is available and environmental hygiene is good, the additional water may be appropriate. However, in developing countries where drinking water is often contaminated and environmental hygiene is poor, exclusive breast-feeding may significantly reduce the risk of diarrhea and respiratory infection[58, 60]. Theoretical calculations show that a five-month-old healthy baby weighing 7.0 kg, fed 110 kcal/kg per day from breast milk alone and gaining 4 g/kg per day will produce 756 ml urine with an osmolality of 130, well below the infant's renal concentrating ability of about 600 mmol/kg urine water[57]. Therefore, healthy, exclusively breast-fed infants should be able to maintain water balance without supplementary water. In addition, studies from Jamaica, Peru, and Argentina have documented the ability of exclusively breast-fed infants to maintain adequate hydration status seen in warm climates[61,63]. The 64 infants in the three studies ranged in age from less than one month to six months. The home temperatures varied from 23.5 C at night to 39 C during the day, with a relative humidity of 49-96%. The maximum urine osmolarity reported was 468 mmol/l. However, if the infant is stressed by diarrhea, vomiting, or fever that result in decreased urine output, the kidneys may fail to excrete even the osmotic load provided by human milk, and oral rehydration solutions may be required if dehydration is to be prevented.

Gastrointestinal Development

Between six weeks of gestation and birth the surface area of the intestine increases nearly 100,000 fold; the length of the small intestine at birth is approximately two and one-half times the length of the infant. Gastrointestinal motility increases with advancing fetal age and intestinal transit time at term averages four and one-half to seven hours[64]. Gastric capacity at term averages about 7 cc and increases rapidly during the first two weeks of postnatal life to over ten times that found at birth[65]. During the course of the first year of life, infants rapidly develop some rhythm in their feeding patterns. As gastric capacity increases, most infants progress from feeding approximately 180 ml/kg per day in two-to three-hour intervals to less frequent, higher volume and density feedings by the end of the first year[66]. Despite increased gastric capacity, however, infants often cannot consume enough of the traditional low fat, cereal based weaning food to meet their energy requirement. Because of their thick consistency even at high water content, these foods are bulky and of low energy density. This may explain the low energy intakes seen in many Asian children even when food availability is not a constraint.

Development of the Mucosal Barrier

Adaptation of the gastrointestinal tract to the extrauterine environment includes the development of a mucosal barrier against the penetration of harmful substances. Both breast-feeding and weaning have significant influences on this process. At birth many aspects of intestinal defense are passive or incompletely developed; weaning and the resultant exposure to pathogens and foreign proteins require active intestinal defense mechanisms[6]. Breast-feeding is the essential link in this process. Breast milk provides the stimulus necessary for development of these active mechanisms, as well as providing passive protection and limiting the infant's exposure to pathogens and foreign proteins.

Immunoglobulin A, the predominant immunoglobulin in breast milk that may transfer the mother's immunity to specific pathogens to the neonate, is produced by plasma cells in the intestine. Lack of stimulation by food and bacterial antigens has ben documented to decrease the number of immunglobulin-containing cells in such infants compared to infants fed normally, emphasizing again the importance of enteral feeding in normal gastrointestinal development[67]. During the immediate postpartum period, this complex defense system is incompletely developed; the newborn infant's gastrointestinal tract is particularly vulnerable to penetration by foreign proteins, thus increasing the risk of hypersensitivity reactions, including enteropathies causing bleeding and diarrhoea[68]. In many developing countries even though breast-feeding is the norm, it is often not initiated until the third day after birth, during which time a variety of prelactal feeds, including animal milk, are given[69-71]. This early exposure to animal-milk protein as well as to pathogens may in part explain the prevalence of diarrhoea in infants who thereafter may be exclusively breast-fed.

Human breast milk also contains trophic factors, including hormones, growth factors, peptidase, amino acids, and glycoprotein, which may play a role in the maturation of the small intestine[72]. Such compounds include epidermal growth factor, nerve growth factor, insulin like growth factor, insulin, thyroxine, cortisol, taurine, glutamine, and amino sugars. Feeding in most forms has indirect effects on the maturation of the gastrointestinal tract through the release or gastrointestinal hormones; those hormones that appear to affect the growth of the small intestine include enterogulcagon, gastrin, and motilin, which increase in neonatal animals in response to a feed[6].

While studies evaluating the relationship between weaning initiation and diarrhoea are generally limited by design and confounding factors, making interpretation difficult[20] in areas where the water used for mixing infant formula is unsafe and an adequate, affordable supply of premixed formula is uncertain, efforts should

focus on promotion of exclusive breast-feeding. Emphasis should be on sanitary practices that limit the infant's exposure to pathogens.

Developmental Feeding Issues

Infant feeding skills define the infant's developmental readiness to progress from nursing to new foods, textures, and feeding modes. Beginning at six months and continuing through the second year of life, characteristic patterns follow physiologic and neurologic maturation, with development of head, trunk, and gross and fine motor control[73-75]. Feeding milestones with a significant impact on weaning behaviors include taking food from a spoon, chewing foods, self-feeding with fingers, independent feeding from a cup, and using utensils[76].

The ability to swallow develops early in gestation and may help to regulate amniotic fluid volume in normal pregnancies[64]; the sucking reflex matures between 30 and 34 weeks of gestation[77]. By four months of age the tongue-extrusion reflex has disappeared; by five to seven months the infant can take food from a spoon. By about eight months increased tongue flexibility and the ability to sit without support allow greater manipulation of food before swallowing so that thicker boluses of food can be handled. By ten months the infant makes definite chewing movements, takes small bites of soft foods, develops a pincer grasp, and begins to experiment with self-feeding. By one year most infants are skilled at finger-feeding, can eat foods from all the food groups, and can drink from a cup using two hands. Manual dexterity continues to improve during the second year, and by the end of that year cognitive development usually enables the child to distinguish between food and nonfood items[78].

Much more is known about behavioral development during early infant feeding than during weaning[6]. However, it is clear that pleasurable sensations associated with teste and ingestion promote exploratory behavior and tolerance for the unfamiliar once the

weaning process has begun[6]. The original work of Clara Davis[79] documented the ability of newly weaned infants to self-select a nutritionally adequate diet when offered a wide variety of animal and vegetable foods that were thought to provide for all known nutrient needs. These infants, who at the start of the study had little experience with the foods offered, showed strong preferences, but selected a variety of foods offered, showed strong preferences, but selected a variety of foods rather than just the most preferred. This balancing of choices resulted in the consumption of nutritionally complete diets. Davis[79] concluded that young children should be offered a variety of foods of high nutritional value and that a healthy young child's energy requirements are controlled by appetite. This has been replicated by recent research evaluating more closely the energy intakes of 15 children, aged two to five years[80]. Food consumption patterns were highly variable from meal to meal, but daily energy intake was relatively constant because the children adjusted their caloric intake at successive meals.

Current weaning recommendations

The current universal weaning recommendations, based on present knowledge of the human infant's nutritional and developmental requirements, are outlined in Table 3.

In a deprived environment, however, weaning foods may be limited and monotonous. The sensory response to taste, appearance, smell, and texture decreases quickly following consumption, and early development of a varied eating pattern may ensure later acceptance of foods when it is critical to meet the child's nutrient needs[8].

Food selection is also influenced by cultural, sensory, environmental, economic, genetic, and family factors; the feeding relationship that develops between caretaker and child involves comples interactions[82]. Social and emotional learning is especially powerful with early feeding experiences, as documented by studies of nonorganic failure-to-thrive and eating disorders in affluent

societies. The lethargy and apathy seen in malnutrition can be partially a result of passive parenting and social deprivation and can accompany obesity as well as failure to thrive[82,83].

Recommendations for the composition of supplementary foods

Even in late 1960's protein was considered the most limiting factor of the diet and thus of special interest. The provision of adequate protein during weaning period was considered difficult and special attention was recommended to be given to the quality and quantity of protein in supplementary weaning foods. The PAG of the United Nations in October 1972[34], recommended that the level of protein in a supplementary food be at least 15% w/w, with a portion of nutritional quality equivalent to cow's milk (NPU=80). If the quality of protein was lower, i.e NPU less than 80, the quantity of protein had to be increased. In any case NPU and PER values should not be less than 60 and 2.1 preferably nearer 65 and about 2.3 respectively, according to the recommendations. The CODEX committee on foods for special dietary uses, at its 6th and 7th sessions on standards and regulations for special foods for infants and young children[84] in (1972), noted the recommendation regarding the minimum and maximum quantity of protein. It was agreed that a minimum quantity of 1.8 g of protein/100 kcal; and maximum quantity of 4 g/100 kcal for children beyond 6 months of age, if the protein nutritional quality was variable. The Joint FAO/WHO informal gathering of experts in 1971[85] suggested a composition of reference protein regarding the feeding of pre-school child. The committee estimated the amino acid requirements by using the intakes of cow's milk formulae on breast milk that supported satisfactory growth.

The current estimates of the requirements of essential amino acids for infants, assessed by determining the amounts needed for normal growth and nitrogen balance, in 1985[48], are different (somewhat higher) from those tabulated in the report of the 1971 Committee. for infants, the consultation concluded that the amino acid pattern of human milk should be accepted as the requirement. However, the 1985 recommendations do not stres much on the

amino acid requirement of children above one year and of school child and adult. Protein and diets with essential amino acid content and pattern that effectively meet the needs of infants and young children will also be adequate for older children, and adults, whereas the converse may not be true. Protein quality considerations are now believed to be much less significant forthe adult by FAO/WHO/UNU experts (1985)[48] than hitherto thought. However, the protein value of foods and mixtures for infant feeding remains of considerable importance in the recent estimates (WHO 1985)[48] as well, because of the higher protein needs of infants per unit body weight[86].

In the last decade many studies have emphasized that energy deficiency is more important than protein deficiency in the aetiology of malnutrition. The estimated energy requirement in 1985 from birth to 10 years from the observed intakes of healthy infants growing normally, as estimated before (1971), are 10-15% lower than those proposed by the 1971 committee[48]. Higher energy requirements have been reported in 1981 in the 2nd and 3rd years of pre-school period.

Interest in special weaning foods in developing countries was much more pronounced two decades ago-when the main emphasis was on high protein content[87]. The initiative has now declined for reasons such as high cost, the change in emphasis from protein to energy deficiency[88] and more recently the almost exclusive attention to aspects of breast-feeding and lactation in the approach to nutritional problems of infancy[36,37,89]. Concern over breast-feeding provides benefits unmatched by artificial feeding[88]. To ensure optimal growth and development, it has been reported that mother's milk is the ideal food for the infant, at least up to the age of 5or 6 months[90].

Home-made weaning foods

Various international agencies (WHO, FAO, UNICEF) involved in infant nutrition have shown considerable interest, in the last two decades, in home mixing of food components, for

infant feeding. Their efforts have been focussed mainly on the production of balanced weaning mixtures suited to the socio-economic and cultural environments of various regions. In addition to series of statements and guidelines relevant to food mixtures produced by the PAG, extensive reviews and critiques of the whole field have appeared[91-93] in latter part of the 1970's. A considerable body of information on appropriate mixtures has been prepared, and a comprehensive information on the preperation of home-made weaning foods, is available in the manual on feeding infants and young children[18], on the use of locally available staples more efficiently.

Weaning practices

Observation of weaning practices in traditional societies as well as new scientific knowledge indicated[37] that it is generally feasible to meet the nutritional requirement of older infants and young children with proper combinations of the foods regularly consumed by older children and adults. This is true even where milk products or other foods of animal origin are unavailable, culturally non acceptable, or too expensive. Advice may be needed about the proportions of the ingredients, the methods of preparing and the frequency of feeding. In many places traditional practices which are generally sound have been modified by the influence of foreign cultures, economic factors, or a combination of both[37]. Appropriate weaning with local foods is not only nutritionally acceptable, but also likely to have economic advantages for families, communities and countries since it eliminates the necessity of importing expensive weaning foods.

Feeding from the family diet

In the last decade use foods from the family pot has been reported[94,95], as the most practical approach to the prevention of malnutrition among pre-school children, even in impoverished families. The small shifts in food distribution within the family that are required with this approach are of negligible significance

of the other family members, but of critical importance of the young child. The practicability of this approach is naturally subjected tocultural variation in the suitability of foods being used by the other members of the family, e.g. high fibre content, strong seasoning or low nutrient density. Also the phrase "family pot" although may well apply to some cultures, in others there is no single pot, but rather a variety of foods some of which are always suitable for the young child[96]. It has also been stressed by Morley[96] that the family pot would provide ideal food for the child.

Frequency of feeds

The young child's stomach is small so that it is best to try less bulky foods, particularly compact sources of calories (mainly oils and fats)[89] and, at the same time, to offer at least five feeds daily, in the form of hot meals or cold snacks. This can be done by making a separate preparation for the young child, preferably served before the adult's meal[97].

In general the cheapest and most accessible weaning foods are those prepared in the home from supplies usually used and stocked in the household[95]. The appropriate complementation of breast milk at the age when the child's growth is most likely to falter requires such small quantities of the household diet as to have a minimum economic impact on the family. When improvement of the family foods used as weaning food and for children, addition of energy and /or protein rich household supplements could be done. If it is impossible to raise the quantity of food consumed, because of its inherent bulkiness, increasing the energy density with fats is the only way that the energy intake can be improved[95]. When, however, such supplements are not available or insufficient the remaining possibility which has been suggested[89] is try to modify the starch base of the food by reducing its bulk, as the dietary bulk is often mentioned as a possible or even probable factor in the aetiology of malnutrition[89]. Often bulk is determined by the amount of water necessary to produce the weaning-food of

suitable consistency for the child[98]. Considerable research on the use of germinated flour to reduce viscosity of starch based weaning foods has been carried out in Sweden, Tanzania[99] and India[100].

Compared to using centrally processed or donated foods, the home and village-weaning-food approach has been stated to have advantages of allowing for intervention at multiple points in the nutrition system and of being applicable to all segments of society to some degree[95]. However, effective communication of nutrition information will be necessary for families to combine and prepare household food supplies suitably for the child. It is generally agreed that nutrition supplement programmes must be based on foods that are cheap, locally available and culturally acceptable. However, advice given to mothers to cook special food items for pre-school children is generally not followed[94] because of the additional expense incurred in buying the materials and the extra work involved in cooking for the least demanding member of the family. The psychological and cultural factor of giving special food to one child and denying it to others also inhibits mothers.

Proposed strategies of the 80's and after

The three principal strategies proposed in 1984 by Mitzer et. al.[95] for directly improving the nutrition of the young child in the lower socio-economic populations of developing countries during the weaning period are: developing and promoting home and village prepared weaning foods, increasing the availability consumption of indigenous centrally processed weaning foods marketed through commercial chanels at the lowest pratical price, and distributing donated and locally produced weaning foods. It has also been suggested that the success of any of these strategies depends upon solving the problem not only of making a weaning food available and of educating the people to use it properly, but also of communicating the nutrition information necessary to promote and facilitate good weaning practices in general. This could be done through primary Health care Programme incorporating care of both mothers and children, and nutritional health-

education activates including promotion of appropriate weaning foods. The effectiveness of weaning strategies can also be increased[95] by subsidized weaning foods, weaning-food stamps or some other means of ensuring that the very poorest people have sufficient food for their young children.

As a country's sub populations live in varying locales and differs in their ability to produce or acquire food, in how much time and fuel they have and in their lifestyles, the national strategies have been proposed to be of multiple.

In Sri Lanka the steps that have been recommended recently by the Ministry of Health[101] to promote optimal growth and development of the young child are 1. Introduce semi solid or mashed foods to the infant between 4th and 6th months of age. 2. Prepare complementary food containing a variety of locally available cereals, yams, legumes, fruits and vegetables. 3. Use oil when preparing complementary foods to increase the energy content. 4. Gradually increase complementary foods in quantity and frequency. 5. Continue to breast feed up to 2 years of age as well as giving complementary foods. 6. Feeding infants and children from the family pot.

Are we making a progress?

The initiation of weaning has been identified as a critical event[102]. It also reports that no clear strategy that exists for substantially enhancing the breast milk output of demand feeding mothers in underprivileged communities. According to Michael[102] (1986) remarkably little progress has been made in our abilities to advise mothers, either on a collective or an individual basis, as to when they should supplement the diet of their breastfed offspring; one continuing problem being the failure to adopt appropriate growth standards for infants in the Asian situation. Furthermore, there has been little attempt to improve traditional weaning foods in terms of consistancy, shelf life and bioavailability of nutrients. It is also seen that insights into normal growth pattern of breastfed infants and knowledge of localized appropriate traditional food technology remain grossly under exploited.

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Table 1: Consequences of weaning onset

Too Early	*Ideal*
Increased diarrhoeal and allergic diseases, due to intestinal immaturity	Appropriately timed
Decreased breast-milk production, displaced by weaning foods	Starting at 4-6 months
Malnutrition due to diarrhoeal diseases	Nutritionally adequate Emphasizing calories,protein, iron, zinc, vitamin A, Vitamin D Culturally appropriate Available, and acceptable to the population

Too late

Growth failure
breast milk alone becomes calorically inadequate
Depressed immunity
due to inadequate energy and protein intake
Increased diarrhoeal disease
due to depressed immunity
Malnutrition
due to inadequate calories, diarrhoeal diseases
Micronutrient deficiencies
due to indequate dietary intake, increased needs with infection

Table 2: Basis of weaning recommendations

Nursing/Breast Milk	Weaning
Nutritional need Birth to 4 months Appropriate calorie/protein ratio in infancy High bioavailability (zinc, iron, vitamin A)	Four to 12 months Breast milk volume become inadequate (700-970) ml/day) at 3-6 months) Nutrients of public health concern to be emphasized in weaning foods are carbohydrate, fat (calories), protein, zinc, iron, vitamin D, vitamin, A)
Physiological maturation	
Renal function capacity Highly anabolic state, low renal solute load of breast milk Low concentrating and excretory capacity.	Increasedconcentraing and excretory capcity.
Gastrointestinal function Immune factors (SIgA, lactoferrin, lysozyme) Enzymes (breast milk amylase, lipase) Taurine Growth factors (peptides, IGF-1, cortisol, thyroxine,	Increased gastric capacity, higher volume, less frequent feeds Increased bile acid pool Increased pancreatic amylase
Developmental feeding issues Rooting Sucking Swallowing Extrusion reflex	Increased pepsin Bile-salt conjugation with glycine Matured microvillus membrane structure Diminished extrusion reflex (4months) Development of head, trunk, and gross and fine motor control (4-12 months) Develpment of exploratory behavior Manual dexterity (12-36 months)

Table 3: Current Weaning Recommendations

	Months 0	2	4	6	8	10	12	14	16...	24
Breast milk	----------	----------	----------	----------	----------	----------	----------	----------	xxxxxxxxxxxxx	
Staple weaning food and other grains			xxxxxxxx	----------	----------	----------	----------	----------	----------	
Soft fruits and Vegetables			xxxxxxxxxxxxxx	----------	----------	----------	----------	----------	----------	
Fish and egg			xxxxxxxxxxxxxxxx	----------	----------	----------	----------	----------	----------	
Meats				xxxxxxxxxxxxx	----------	----------	----------	----------	----------	

Transitional period xxxxxx

Given regularly ----------

1. Breast milk should be given exclusively for the first four to six months and encouraged throughout the first two years, even if it provides only a small part of total intake.

2. Beginning at four months and no later than six months, the infant is gradually introduced to weaning foods, The order of introduction is not precise and schedules will vary since each infant will progress at his/her own rate. A staple food that is calrically dense and adequate in protein is important and infant will progress at his/her own rate. A staple food that is calrically dense and adequate in protein is important and variety is essential in providing for complete nutritional needs. Iron, zinc, vitamin D, and vitamin A rich foods should be emphasized. Initially, complementary foods are given once a day, then gradually the frequency is increased so that the infant is eating two to four meals per day by about

six months of age. Infants over six months of age need to eat meals and snacks about four to six times a day in addition to breast-feeding.

3. To avoid bacterial contamination, only freshly cooked or freshly peeled or washed foods should be used. The hands of both the food provider and child should be washed before handling food.

4. Throughout the latter half of the first year of life, variety in taste and texture of diet is expanded. As the child approaches one year of age, he/she should be encouraged to feed himself, and by two years of age, he/she should be consuming a varied diet from the family diet with choices from each of the food groups.

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