AMERICAN ACADEMY OF PEDIATRICS

Committee on Nutrition

On the Feeding of Supplemental Foods to Infants

Recommendations and practices of feeding solid foods to infants are widely divergent in the United States and in other countries. Although few differences in health are noted from such divergent practices, the consequences may be subtle or may require long-term, careful observations.

The previous Committee on Nutrition statement[1] on this subject reviewed the history of the use of solid foods and showed that solid or supplemental foods were seldom offered to infants before 1 year of age until about 1920. Breast milk, for the most part, or modified cow's milk formulas supplied all or most of the nutritional needs of infants during the first year. The first supplements to the diet were cod liver oil to prevent rickets and orange juice to prevent scurvy.

Over the next 50 years recommendations were made that some cereals and strained vegetables and fruits be introduced at about 6 months of age to: (*a*) supply iron, vitamins, and possibly other factors; and (*b*) help prepare the infant for a more diversified diet. A much wider variety of infant foods became available, and these were introduced into the infant's diet earlier and earlier. Some of the reasons for earlier introduction of solid foods were the desire of mothers to see their infants gain weight rapidly, the ready availability of convenient forms of solid foods, and the mistaken assumption that added solid foods help the infant to sleep through the night.

INFANT FEEDING PERIODS

Infant feeding should be considered in three overlapping stages: the nursing period, during which breast milk or an appropriate formula is the source of nutrients; a transitional period, during which specially prepared foods are introduced in addition to breast milk or a formula; and a modified adult period, during which the majority of the nutrients come from the foods available on the family table. The rate at which an infant progresses through these stages should ideally be determined by the rate of maturation of the nervous system, intestinal tract, and kidneys.

During the nursing period the young infant is able to suck and swallow only liquids. At this time the intestinal tract has not yet developed the defense mechanisms for coping with foreign proteins[2,3] and is best equipped to digest the protein, fat, and carbohydrate in breast milk. The young infant's kidneys are not mature enough to handle large osmolar loads of protein and electrolytes.[4]

During the transitional period the infant is developing the neuromuscular mechanisms needed for recognizing a spoon, masticating and swallowing nonliquid foods, and appreciating variation in the taste and color of foods. At this time the intestine is developing immunologically with defense mechanisms to protect the infant from foreign proteins; the ability to digest and absorb other proteins, fats, and carbohydrates is increasing rapidly; and the kidneys are developing the ability to handle osmolar loads with less water.

With the onset of the modified adult period the physiologic mechanisms have all matured to near adult proficiency, and the infant is learning to feed himself. At this time family food requires only minimal alteration, such as cutting into small pieces, and taste ability and preferences are becoming established. The ability to digest and absorb a variety of foods also has matured.

Information about the development of the nervous system and the kidneys is more complete than knowledge concerning the maturation of intestinal function, particularly its immunologic mechanisms. Recommendations for the introduction of solid foods to infants must nevertheless be based on our current concepts of these developmental processes.

The nursing period lasts for at least four to six months and is followed by the transitional period. The timing of this dietary change is in part related to the neuromuscular development of the infant. By 4 to 5 months of age the extrusion reflex of early infancy has disappeared and the ability to swallow nonliquid foods has become established. By 5 to 6

months of age, the infant "will be able to indicate desire for food by opening the mouth and leaning forward, and to indicate disinterest or satiety by leaning back and turning away. Until the infant can express these feelings, feeding of beikost will probably represent a type of forced feeding."[5]

The onset of the modified adult period is more a matter of individual preference, but it generally begins after the age of 1 year.

Adequate intakes of human milk[6] or a prepared formula[7] meet all the known nutritional requirements of infants for the first 6 months of life, with the possible exception of vitamin D and fluoride in the case of breast-fed infants. Though vitamin D metabolites are present in human milk, rickets is rarely seen in breast-fed children. The reported cases[8] have occurred in those who, with their mothers, are exposed to little sunlight. When climatic and social conditions interfere with radiation of vitamin D precursors in the skin, breast-fed infants should be supplemented with 400 IU of vitamin D daily.

While all known essential nutrients are contained in presently available proprietary formulas based on cow's milk, it is possible that unrecognized deficits may be avoided by introducing supplemental foods at 4 to 6 months of age.

INTRODUCTION OF SOLID FOODS

When solid foods are introduced, single ingredient foods should be chosen and started one at a time at weekly intervals in order to allow for an opportunity to identify food intolerance.

Infant cereals, which provide additional energy and iron, are a good choice as one of the first supplemental foods to be presented to the infant. Single grain cereals, particularly rice, are usually well-tolerated. Three level tablespoons of dry infant cereal fortified with electrolytic iron and diluted with milk or formula provide about 7 mg of iron. Other solid foods include vegetables and fruits, and meats; the order of introduction is not critical. Most baby foods are high in carbohydrate, providing a balance to the high protein content of the diet when cow's milk is the major source of calories. Higher protein foods, e.g., meat or chicken, are appropriate choices in the breast-fed infant because of the lower protein content of breast milk.

Combination foods of cereal and fruit provide about 5 mg of iron per 4½-oz jar and may be introduced to older infants after the tolerance for individual components has been established. They are generally more expensive than single foods. Juices should be introduced when the child can drink from a cup. Juices provide carbohydrate and vitamin C. However, if juice in bottles is used as a pacifier it predisposes to nursing bottle caries.

A gradual introduction of a variety of foods contributes to a nutritionally balanced diet and helps promote good food habits. Strained foods prepared at home are nutritionally equivalent to those obtained commercially. Care must be taken to avoid spoilage of both home-prepared foods and commercial, strained foods once the jars have been opened. Spinach, beets, turnips, or collard greens are not good choices for early infancy because they may contain sufficient nitrate to cause methemoglobinemia.

Salt and sugar are not added to commercially prepared infant foods. Similarly, there is no need to add salt or sugar to fresh or frozen foods when they are used for home preparation of baby foods. Canned foods often contain large amounts of salt and sugar and are unsuitable for the home preparation of baby foods.

WATER

During the nursing period, the amount of water needed by infants to replace water loss from the skin and lungs, feces, and urine, and to provide for growth, is provided by breast milk or infant formula. Healthy infants usually require little or no supplemental water, except in hot weather.

When solid foods are introduced, additional water is often required because the renal osmolar load is high in foods with a higher protein or electrolyte content such as strained meats, egg yolk, and "high meat dinner." Fruit juices, fruits, puddings, vegetables, and desserts have a low renal solute load. Infants should be offered water as part of a feeding to allow them an opportunity to fulfill fluid needs without an obligatory intake of extra calories. When fluid intake is low or extrarenal losses are increased as in illness, additional water should be provided. Infants who cry because they are thirsty may be offered the breast or a bottle in the mistaken belief that the crying indicates hunger.

SODIUM

Commercially prepared baby foods currently contain no added salt. The bland flavor of these foods may lead some mothers to add salt to these foods to suit their own taste preferences. This practice should be discouraged.

The sodium intake of infants in our society is highly variable. It rises from 1 mEq/kg/day in the breast-fed infant to 6 mEq/kg/day in the older infant receiving whole cow's milk and table foods salted to adult taste. Available evidence indicates that the normal infant adapts appropriately to this range of sodium intakes.[9] Currently, long-term studies on growth, blood pressure, and appetite for salt of infants subjected to these practices are underway.

The variety of sodium intakes among infants in the United States places some infants at the extremes of the normal range. The pediatrician should recognize this factor in dealing with acute illnesses that alter salt and water requirements and inquire about the dietary practices of the infant as part of his clinical evaluation.

FOOD SENSITIVITY

The gastrointestinal tract is permeable to macromolecules during early infancy. In addition, the production of IgA antibody is low in the neonate and does not reach appreciable levels until about 7 months of age. IgA antibody secreted from the intestinal mucosa on stimulation of food protein is specifically directed against that food protein. This antibody could thereby decrease the amount of antigenic material passing through the mucosa. These considerations provide an argument for breast-feeding alone during the nursing period and for using only hypo-allergenic foods during the transitional period, especially in infants with a family history of allergy.[2]

It has been estimated that 0.3% to 7% of infants are sensitive to cow's milk and other foods such as soy protein.[10] However, any such estimates are tentative because of the lack of simple, reliable, and objective means to verify the diagnosis of food allergy. There is a tendency to ascribe a variety of symptoms to food allergy; this may lead to the unjustified elimination of valuable foods from the diet.

Diagnosis and management of food allergy calls for a thorough evaluation of the patient's history, elimination of the suspected foods from the diet, and then subsequent challenge with the individual food to determine whether or not clinical symptoms recur.[11] Results of dietary manipulation must be weighed against other findings before concluding that the reaction is an allergic response to the food in question. When there are no clues about which food(s) may be responsible for symptoms, it is advisable to select a diet composed of fewer foods and to select those which rarely cause allergic reactions.[12] Some advocate withholding the more allergenic foods, such as cow's milk, eggs, and wheat, from the diet for the first 6 or 9 months of life to prevent or decrease the risk of developing an allergy to these and other substances.[13-16]

OBESITY

The use of infant formulas and the age of introduction of supplementary foods may be factors in the development of obesity. There is some evidence that artificially fed infants develop and gain weight more rapidly[17-23] than breast-fed infants; the tendency to encourge infants to finish a bottle feeding may be a predisposing factor. In addition, solid foods do not appear to displace calories from formula; rather they tend to constitute an additive supply of calories. Additional studies are clearly required since some investigators have found no relationship between age of introduction of supplementary foods to development of or to persistence of obesity.[24,25]

Caloric density of commercial prepared foods varies considerably and is a factor in calorie intake. For example, strained fruits contain 45 to 80 calories/100 gm (135 gm/jar), strained vegetables 25 to 75 calories/100 gm (128 gm/jar), meats 90 to 120 calories/100 gm jar, and egg yolks 195 calories/100-gm jar. Most commercial foods are labeled to indicate calorie as well as nutrient content.

RECOMMENDATIONS AND CONCLUSION

Supplemental foods should be introduced when the infant is able to sit with support and has good neuromuscular control of the head and neck. At this stage of development, the infant will be able to indicate a desire for food by opening his mouth and leaning forward, and to indicate disinterest or satiety by leaning back and turning his head away. At this time, about 4 to 6 months of age, a variety of foods should be introduced one a time, at intervals of a week or more. The sequence of foods is not critical, but iron-fortified, single-grain infant cereals are a good early choice. The addition of individual (not mixed) vegetables, fruits, or meats introduce a variety of foods and set the pattern for a diversified diet. With the background of these guidelines for infants as a group, the age of introduction of supplemental foods for individual infants cannot be set rigidly; rather, it depends on rate of growth, stage of development, and level of activity.

On the basis of present knowledge, no nutritional advantage results from the introduction of supplemental foods prior to 4 to 6 months of age. This conclusion is essentially the same as in the Committee statement of 1958, but it deserves reemphasis because of the continuing widespread and possibly harmful effects of introducing supplemental foods at 1 or 2 months of age, or earlier.

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MALE PSYCHOLOGIC HEALTH

Good mental health may prolong good physical health. "... Being chronically anxious, depressed, or emotionally distressed can ... produce profound effects on host susceptibility to disease." In a study of 204 men studied over 40 years, 59 with the best mental health did well (two dead or chronically ill by age 53). Of the 48 with the worst mental health 18 became chronically ill or died. Other variables including alcohol use, tobacco use, obesity, and longevity of ancestors were assessed and these did not affect the significance of the differences. "... Good mental health retards midlife deterioration in physical health ... stress does not kill us so much as *ingenious adaptation to stress* (call it good mental health or mature coping mechanisms) *facilitates our survival.*"

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