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Twelve to Twenty-Four Months: A Nutritionally Critical but Often Neglected Period

Lynda Clark Lowry MS PHEc and Helen A. Guthrie PhD, RD

There is a paucity of research that measures the food intake as well as nutritional requirements of 12 -24 month old children. The amount of food actually consumed rather than deposited on the face, floor and table, is difficult to quantify. As a result, feeding guidelines tend to be quite general in spite of the unique physical, behavioural and social characteristics of the toddler.

A recent report,[1] combined anthropometric measurements with three-day dietary histories to provide evidence of the need for more specific dietary guidance for this age group during the transition from a predominantly milk/formula-based diet to one based on a more adult style diet. Their findings support the recommendation of the Advisory Committee for the 1995 Dietary Guidelines for Americans[2] that a separate guideline be established for one- to two-year-olds.

This longitudinal study involved monthly three-day dietary intakes and measurements of anthropometric growth indices of 55 healthy children from 12 to 18 months of age. Criteria for participation included:

- birth weight over 2500 grams,
- no congenital abnormalities or perinatal complications,
- no jaundice treated with phototherapy and no hospitalization,
- no micronutrient supplementation during the 6 months prior to the study and
- birthweight, length and head circumference between the 10th and 90th percentile of NCHS reference values.

Children were drawn from middle to higher socioeconomic households with access to regular medical supervision. The mothers averaged 33 years of age. Ethnically they were less diverse than the general population and could be considered at very low health risk. Anthropometric findings of weight, length and arm circumference showed that most children were characterized as 'lean'. No more than 10% were above the 50th percentile for tricep skinfolds and no more than 30% had subcutaneous skinfold measurements above the 50th percentile.

Dietary findings revealed a significant increase in total energy intakes from 12 months, which leveled off from 16 to 18 months. The percentage of calories from each energy source remained stable during the study period. At 12 months 22% of toddlers had received less than 30% of calories from fat and at 18 months this segment had increased to 33%. At 18 months, length was positively related to total fat intake but not to percentage of energy from fat and also to total energy intake but not to carbohydrate or protein intake.

Intake of vitamin E and iron decreased from 12 to 18 months, in spite of an increased energy intake. Only 20% met the recommended intake for iron and 9% met the recommended intake of vitamin E at 18 months. One possible cause of this low vitamin E intake is the fact that nutrient analysis databases have limited information on vitamin E for many foods. Similarly, the best sources of vitamin E are foods that are not typically given to toddlers – wheat germ, salad dressings, nuts and seeds. Not surprisingly, none of the children with fat intakes providing less than 30 percent of energy calories met the RDA for vitamin E at 12 months and only one did at 18 months. Intakes of vitamins A, C, D, B6, B12, folate, zinc and calcium met or exceeded the recommended intakes throughout the study.

Mean energy intake was1100 kcals per day at 18 months. The children showed normal growth and level of subcutaneous fat.

It is important to note that the interpretation of data relative to the contribution of specific foods was complicated by the fact that the standards for labelling nutrient content of foods in the U.S. are based on 1968 RDA's[3]. This interpretation is also challenged by the fact that authors used RDA values for five nutrients and DRIs for four others.

Implication for Dietary Guidance

At 12 months, 22% and at 18 months, 33% of the children studied consumed fat at a level below 30 percent of calories. In addition, a positive relationship was shown between fat intake and length. Consequently, strategies such as the use of non-fat dairy products promoted for adult family members are inappropriate for children during a period of rapid growth both physically and mentally.

The finding that iron intake decreased during the period of the study coupled with evidence that iron plays an important role in motor and mental development and that the negative effects of low intakes early in life may not be reversed by increased intakes later in childhood suggests the need to stress dietary adjustments to insure recommended iron intakes. Concern about early iron intakes is reinforced by the fact that at 18 months the prevalence of iron deficiency anemia in the United States is 9%, almost twice the U.S. public health goal of 5 percent.[4] A number of studies have shown that as many as 65% of some cultural and socio-economic groups of Canadian infants and toddlers, are iron deficient.[5-8] Prolonged bottle-feeding is also associated with increased cow's milk intake and lower (but not significantly), iron stores.[9]

Dietary guidance for the second year of life to promote diets which will better meet the needs for vitamin E and iron identified in this study and in the Third Report on Nutrition Monitoring in the US[10] should emphasize commonly consumed foods such as meats and iron-fortified cereals. This is especially important as the child is weaned from iron-fortified formula and enriched infant cereals that were major contributors to the intake of these nutrients in the first year of life. While vitamin E deficiencies have only been reported in pre-term infants and those with medical complications, the low dietary intakes relative to recommended amounts deserve some attention. Parents should be encouraged to choose whole grain bread products when introducing breads into the diet, and to use margarine as a source of vitamin E.

In a related report[11], the authors indicated that infants who were breast fed throughout the first year of life had a higher energy intake at 18 months than did those who received breast milk for a shorter time or not at all. The authors attributed this finding to the fact that breast feeding mothers who followed the recommendations of the American Dietetic Association and the American Academy of Pediatrics and breastfeed for the first year, exerted less control over feeding behavior at 18 months. They suggested that infants, whose mothers attempted to control eating practices, were less able to adjust their intake in response to the energy content of foods.

Nutrition Recommendations for the Second Year of Life

There are nine nutrition recommendations from Canadian and U.S. sources that are relevant to the 12 – 24 month old child:

1. Breastfeeding is the optimal method of feeding infants. Breastfeeding may continue up to two years of age and beyond if the child is growing normally.[12]
2. The Canadian Paediatric Society and the American Academy of Pediatrics differ slightly in their recommendations for the introduction of whole cow's milk. According to the Canadian Paediatric Society, pasteurized whole cow's milk may be introduced at 9 to 12 months of age[12] and continued throughout the second year of life. The American Academy of Pediatrics advises that parents wait until 12 months to introduce whole cow's milk.[13]
3. Low-fat milk (1% and 2%) is not routinely recommended in the first two years.[12,14]
4. Skim milk (no fat) is inappropriate in the first two years.[12]
5. Soy, rice or other vegetarian beverages, whether or not they are fortified, are inappropriate alternatives to breast milk, cow's milk or soy-based formula, or pasteurized whole cow's milk in the first two years.[12]
6. Dietary fat restriction during the first two years is not recommended because it may compromise the intake of energy and essential fatty acids and adversely affect growth and development. [12,14]
7. For infants between the ages of six months to two years who are living in areas where the household water supply contains less than 0.3 ppm fluoride, daily supplementation with 0.25 mg fluoride is recommended.[12, 15]
8. Continue to offer iron-fortified foods beyond one year of age to provide sufficient iron.[12]
9. Parents wanting a vegetarian-based diet for a term infant can be advised to offer commercial soy-based infant formula during the first two years of life.[12,16]

Managing the Feeding Process

Managing the feeding process of a toddler is as important as food choices since preferences and healthy eating skills are being formed during this critical period. It is also a time when growth rate slows, food intake decreases and parents are often concerned that the child is not eating enough. Appetite can be erratic and sporadic. This is normal. If food intake is emphasized or enforced too much, then there will be a battle between child and adult. "Toddlers would rather exert their independence than eat."[17] Parents and caregivers are encouraged to recognize and respond to their toddler's verbal and non-verbal hunger cues and to the signals of satiety. It is the responsibility of the parents and caregivers to offer a variety of choices that are rich in all vitamins and minerals (especially iron) and are not low in fat. It should be up to the child to determine when he/she is hungry and how much to eat.

Toddlers often present at physician's offices, described by parents as picky eaters[18]. Mild or transient appetite and problems with food fads are common and normal. Children who are food refusers, may have a history of difficult eating, associated with vomiting, gastroesophageal reflux and milk intolerance. A review in a previous issue of this publication, identified the concern of excessive juice intake for infants and toddlers[19]. Smith and Lifshitz found that 16% of their sample of 50 toddlers aged 14-27 months, referred to a failure to thrive clinic, drank more than 12 fluid ounces per day. These growth deficiencies disappeared once their diets were corrected[20]. Parents should be reminded that infants and toddlers should not be given juice from bottles or covered cups that allow them to consume throughout the day and they shouldn't be given juice at bedtime. This predisposes the infant to dental caries. Juice intake should be limited to four to six ounces per day for children one to six years old[21].

Food refusal can be characteristic when the infant drinks excessive amounts of milk or only accepts purees after one year. Milk drinking will reduce the appetite for food. Excessive dependence on the bottle can reduce the opportunity for the child to experience an appetite for foods with more texture. Some toddlers revert back to purees when they experience difficulty in handling foods that are chopped or mashed. This is a complex texture for some children. The process may be better if foods that dissolve rapidly in the child's mouth, such as bread sticks, are offered. Parents should be encouraged not to resort to offering only those textures that will be accepted. Gradually increasing the viscosity of well-liked foods by adding boiled, mashed potatoes, and offering foods that dissolve easily are strategies that will increase children's confidence in their ability to manage solid foods. Parents who use persuasion, argument, threats, tricks and withdrawal of preferred foods will not be effective in establishing good eating habits and achieving a healthy diet for their child.

The child should be sitting comfortably and safely while eating without toys or television for distraction. Regular meal times and snacks, rather than grazing on food left around the house all day allows for the opportunity to respond to hunger and satiety. Self-feeding should be encouraged. Offering solids before milk helps the child learn to differentiate between hunger and thirst.

Health professionals are often asked to recommend quantities of food to be eaten for a particular age. It is important to give a range of amounts and emphasize child size servings and the role of the child in determining how much to eat. Older infants often need four to six small feedings a day in addition to their milk feedings[22]. The size of these non-fluid milk feedings may easily change from day to day.

Summary

In summary, health professionals are reminded to counsel patients, clients and parenting groups to choose foods that are not restricted in fat, that are rich in iron, that include sources of vitamin E and that offer a variety of choices. Parents should be made aware of the unique behavioural characteristics of this age so that the goal of achieving healthy diets and eating habits is reached. In addition, weight, height and head circumference growth should be monitored to help assess nutritional adequacy.

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Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids

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Among the tasks assigned to the Dietary Reference Intakes Panel on Dietary Antioxidants and Related Compounds was the charge to develop a definition of a dietary antioxidant. The panel adopted the following stringent definition: "A dietary antioxidant is a substance in foods that significantly decreases the adverse effects of reactive species, such as reactive oxygen and nitrogen species, on normal physiological function in humans".[1] According to this definition, vitamin C, vitamin E, and selenium meet the requirements of the definition; ß-carotene and other carotenoids do not. The panel also developed Dietary Reference Intakes (DRIs) for the selected nutrients as detailed below.

Vitamin C

The vitamin C content of human milk varies, with values during the latter half of the first year lower than during the first months of lactation. By the twelfth month of lactation, studies demonstrated that the vitamin C content declined by 8-12%.[1] In addition, the effect of supplement intake on vitamin C content of human milk is unclear. In the first 6 months of lactation, values of 34 mg/L to 83 mg/L have been noted in mothers not taking vitamin C supplements. In mothers taking 45 to greater than 1000 mg vitamin C daily, milk content was 45-115 mg/L.[1] These findings made it impossible to conclusively determine the influence of maternal vitamin C intake and its effect on human milk. It is known, however, that exclusively human milk-fed infants are well protected against vitamin C deficiency. Therefore the Adequate Intake (AI) for vitamin C for infants 0-6 months of age was based on the average volume of daily milk intake and the average vitamin C concentration of the milk. Once solid foods are introduced, they make a significant vitamin C contribution to the diet. The AI for infants 7-12 months was derived from the amount of vitamin C provided by foods as well as the amount provided by human milk during the second six months of life.

Because no direct data were found on which to base the Estimated Average Requirement (EAR) for children aged 1-3 years, the panel chose to base it on relative body weight. As shown in Table 1, the Recommended Dietary Allowance (RDA) for children aged 1-3 years is less than the AI for infants. Different data were used to estimate these values; therefore, comparisons are not appropriate.

Insufficient data on adverse effects in infants and concern about the infant's ability to handle excess amounts of vitamin C were the two reasons that no Tolerable Upper Intake Level (UL) for vitamin C was determined for infants 0-12 months of age. The panel recommended that the only source of vitamin C should be from food and formula. Limited toxicity data on toddlers is available. Osmotic diarrhea and gastrointestinal disturbances noted in adults were the most relevant effects on which to base the UL. Data on older children are consistent with adult findings, indicating a lowest-observed adverse effect level of 3 grams/day on a body weight basis. The UL for toddlers was therefore extrapolated based on body weight differences.

Vitamin E

Vitamin E's major role in the body appears to be as an antioxidant. There are eight naturally occurring forms of vitamin E, but only the *a*-tocopherol form is maintained in human plasma. Of the forms of *a*-tocopherol, only the 2*R*-stereoisomeric forms are maintained in human plasma. Recommended intakes were established based on the

2*R*-stereoisomeric forms of *a*-tocopherol. The Tolerable Upper Intake Levels were based on all forms of supplemental *a*-tocopherol.[1]

In infants 0-6 months, the AI was determined based on the mean volume of milk intake per day and the amount of vitamin E in the milk. The value for infants 7-12 months of age was extrapolated from the AI of infants 0-6 months. No data were found on which to base an EAR for children aged 1-3 years, making it necessary to extrapolate from adult values based on lean body mass and need for growth.

An upper limit of vitamin E intake for infants was not possible to determine due to insufficient data on adverse effects in this age group as well as concern about the infant's ability to handle excess amounts. The only recommended source of intake of vitamin E for infants is food or formula. The UL for children aged 1-3 years was extrapolated from adults due to lack of information.

Selenium

The major forms of selenium in the diet are highly bioavailable. Selenium has a variety of known biological functions including, defense against oxidative stress, regulation of thyroid hormone action, and regulation of the redox status of vitamin C and other molecules.[1]

The AI for infants aged 0-6 months was based on the amount of human milk intake and the average selenium content of human milk. For infants aged 7-12 months, selenium content of human milk as well as weaning foods were taken into account. No data were available on which to base the EAR for children 1-3 years of age. The EAR was therefore based on the same criteria of adequacy as adults: that amount of selenium intake expected to maximize plasma glutathione peroxidase activity. This amount is expected to be sufficient to prevent Keshan disease in all children. Keshan disease is a cardiomyopathy that occurs almost exclusively in selenium-deficient children.

The UL pertains to selenium from food and supplements. Chronic toxicity of selenium can occur, with the most frequent features being hair and nail brittleness and loss. The UL was based on data showing that a human milk intake of 60µg was not associated with adverse effects. This value was multiplied by the estimated average intake of human milk/day for infants 0-6 months. The values for infants 7-12 months of age and children 1-3 year of age were based on the value for infants adjusted for weight.

ß-Carotene and Other Carotenoids

The carotenoids include *a*-carotene, ß-carotene, lycopene, lutein, zeaxanthin, and ß-cryptoxanthin. This report did not establish a requirement for any of the carotenoids for any gender or life stage group based on their antioxidant activity. Establishing a requirement for carotenoids based on vitamin A activity was done when the Dietary Reference Intake for vitamin A was set. The report that covers vitamin A in addition to other vitamins and minerals will be covered in a future edition of *In-Touch*.

ULs were also not set for the carotenoids. The panel noted that no adverse effects other than carotenodermia (yellowish discoloration of skin as a result of elevated carotene concentrations) have been reported from consumption of ß-carotene and other carotenoids in foods. Research results on supplements were more conflicting. Two recent clinical trials reported an increase in lung cancer associated with supplemental ß-carotene in current smokers. Other studies have not shown this association. Due to the inconsistent data, no UL could be derived; however, the panel advised against ß-carotene supplements with three exceptions. Supplemental ß-carotene may be used:

- as a provitamin A source;
- to prevent vitamin A deficiency in populations with inadequate vitamin A intake; and
- in patients suffering from erythropoietic protoporphyria (a photosensitivity disorder).

Table 1. Summary of Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, ß-Carotene and Other Carotenoids[1]

Nutrient	0–6 Months	7–12 Months	1–3 Years
Vitamin C			
AI	40 mg/day vitamin C	50 mg/day vitamin C	–
EAR	–	–	13mg/day vitamin C
RDA	–	–	15 mg/day vitamin C
UL	Not Set[a]	Not Set[a]	400 mg/day vitamin C
Vitamin E			
AI	4 mg/day *a*-tocopherol	5 mg/day *a*-tocopherol	–
EAR	–	–	5 mg/day *a*-tocopherol
RDA	–	–	6 mg/day *a*-tocopherol
UL	Not Set[a]	Not Set[a]	200 mg/day any form of supplementary *a*-tocopherol
Selenium			
AI	15 µg	20 µg	–
EAR	–	–	17 µg
RDA	–	–	20 µg
UL	45 µg	60 µg	90 µg
ß-Carotene and Other Carotenoids			
AI	Not Set[b]	Not Set[b]	–
EAR	–	–	Not Set[b]
RDA	–	–	Not Set[b]
UL	Not Set[c]	Not Set[c]	Not Set[c]

[a] Source of intake should be from formula and food only.
[b] Although no DRIs are proposed, existing recommendations for the consumption of carotenoid-containing fruits and vegetables are supported.
[c] A UL has not been set; ß-carotene supplements are not advisable for the general population.

Reference

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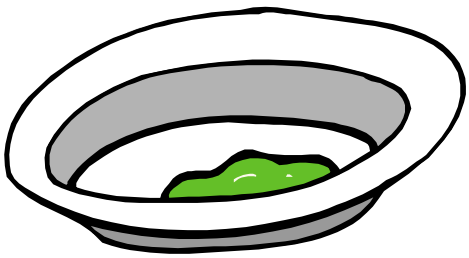
Meet the Challenge of Feeding an Infant 12-24 Months of Age

- Breastfeed during the first year of life if at all possible. At 9 to12 months of age, pasteurized whole milk from a cup may be introduced*. Note: Breastfeeding can continue until 2 years and beyond if it is mutually beneficial for the mother and baby.
  - Wait until after 2 years of age to switch to lower fat milks.
- Schedule regular meals and snacks (3 meals plus 1 to 2 snacks).
  - Ensure that your child is seated comfortably and safely without the distraction of toys or television.
- Encourage self-feeding in an unhurried atmosphere.
  - Offer a variety of foods to achieve a balanced diet.
- Limit fruit juice consumption to 4 to 6 ounces daily.
  - Focus on foods that are good iron sources:
    - Iron-fortified infant cereals
    - Meats and poultry cut into small pieces to prevent choking
    - Dried beans and peas that are cooked and mashed



- Accept the division of responsibility for feeding: it is your responsibility as the parent to offer a variety of nutritious foods on a regular schedule; it is your child's responsibility to decide whether and how much to eat[1].

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*The Canadian Paediatric Society recommends introducing pasteurized whole cow's milk at 9 to 12 months; the American Academy of Pediatrics advises parents to wait until 12 months.

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