

## Nutrition in Infancy and Childhood

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### **Recommended Reading:**

- Chapter 5 in: Medical Nutrition & Disease, Hark L, Morrison G, eds, 3rd edition, Blackwell Publishing, Malden, MA, 2003.
- Hall RT, Carroll RE. Infant Feeding. *Pediatrics in Review*. Vol 21, No 6. June 2000 (on reserve in library)
- Position of the American Dietetic Association: Dietary guidance for healthy children aged 2-11 years. (on reserve in library)

### **I. Objectives**

- A. Determination of Nutritional Needs for Infants
- B. Importance of Growth Charts
- C. Differences Between Human Milk and Commercial Formulas
- D. Indications for Specific Formulas
- E. Failure to Thrive
- F. Solid Foods
- G. Childhood Nutrition Issues

### **II. Nutritional Needs for Infants**

- A. Infants require relatively more calories than adults for maintenance as well as growth
  1. The RDA for infants age 0-12 months is 100 kcal/kg/day.
  2. The RDA for premature infants is 120 kcal/kg/day.
  3. Fluid requirements for infants can be calculated based on actual weight:  $(100 \text{ cc} \times 1^{\text{st}} 10 \text{ kg}) + (50 \text{ cc} \times 2^{\text{nd}} 10 \text{ kg}) + (20 \text{ cc} \times \text{remaining weight})$ .
- B. How calories are used
  1. Basal metabolism 45%
  - Activity 38%
  - New tissues growth 8-10%
  - Excreted 9%
  2. Normal growth:  $1^{\text{st}} 6 \text{ months of life} = 10\text{-}30 \text{ g/day}$   
 $6\text{-}12 \text{ months of life} = 13\text{-}18 \text{ g/day}$
  3. Premature infants require more calories for catch-up growth.
  4. Physically handicapped infants require less calories, since their activity levels are limited.
  5. Infants can generally tolerate up to twice their calculated fluid needs, assuming normal renal output.

C. Basic Feeding Guidelines

<u>Age</u>	<u>#feedings/day</u>	<u>ounces/feeding</u>	<u>%kcal from solids</u>
Term	6	3-4	
1-3 mo	5-6	5-6	
4-6	4-6	6-7	10
7-9	3-4	7-8	12-37
10-12	3	8	43-51

**III. Growth Charts**

- A. Growth charts represent the key health monitoring tool used by pediatricians
- B. Derived from multiple studies conducted by the National Center for Health Statistics and the CDC. The most recent update occurred this year.
- C. Charts are gender and age specific.
- D. Specific growth charts are available for certain medical conditions, i.e. Trisomy 21.
- E. Longitudinal plotting is essential for informative analysis of a child's growth and health.
- F. General guidelines
  - i. Charts are based on chronological age
  - ii. It is vital to follow an infant's pattern of growth- a decline in growth crossing two %ile lines represents a failure to thrive.
  - iii. A deficit of height for age represents chronic malnutrition, whereas a deficit of weight to height represents an acute process.
  - iv. Ideal body weight for children is generally the weight at the 50<sup>th</sup> %ile for the child's height.
  - v. As infants become more active during the second half of their first year of life, their weight gain slows down.
  - vi. BMI's are now used in assessment of children older than 2 years.

**IV. Human Milk versus Commercial Formulas**

- A. Carbohydrate
 

Human milk	lactose
Commercial formulas	lactose, sucrose, glucose polymers, corn syrup solids, maltodextrins, modified corn or tapioca starch
- B. Fats
 

Human milk	14% polyunsaturated 42% monosaturated 44% saturated
Commercial formulas	soy, corn, safflower, coconut, palm, MCT Blends
- C. Protein
 

Human milk	70% whey: 30% casein
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Cow-milk formula	20:80, 60:40
Soy	soy protein isolate
Hydrolyzed	casein hydrolysate
Amino acid	free amino acids

- D. The American Academy of Pediatrics supports human milk as the optimal food for the first 12 months of life.
1. Human milk contains many hormones and growth factors not in commercial formulas
  2. Human milk has a documented benefit of decreased infections in infants: gastroenteritis, respiratory infections, UTI's, otitis media, necrotizing enterocolitis

**V. Indications for Special Formulas**

- A. Soy formulas
1. Recommended: galactosemia, hereditary/transient lactase deficiency, IgE-mediated cow milk allergy, vegetarian diet
  2. NOT recommended: prevention of colic or allergy, cow milk protein enteropathy/enterocolitis
- B. Hydrolyzed protein formulas
1. Useful for cow and soy protein intolerance (Nutramigen, Alimentum)
  2. Can be used for malabsorption due to CF, SBS, biliary atresia, intractable diarrhea, severe malnutrition (Pregestimil)
  3. Disadvantages: poor taste, expensive, high osmolality
- C. Higher caloric density formulas can be bought or made for premature infants.

**VI. Failure to Thrive**

- A. Failure to thrive (FTT) is defined as weight at less than the 3<sup>rd</sup> %ile for age, or weight that has decreased and crossed 2 %ile lines. Generally, FTT is used in reference to children under age 2 years.
- B. FTT can have organic and/or non-organic causes. By far, non-organic causes are most common.
1. Organic causes:
    - a. decreased intake: poor PO intake  
anorexia  
vomiting  
gastroesophageal reflux
    - b. inadequate digestion: pancreatic insufficiency  
celiac disease  
IBD  
Milk-protein enteropathy

- c. increased requirements:
  - SBS
  - Lactase deficiency
  - thyroid disease
  - BPD
  - CHF
  - CF
  - Cancer
  - Immunodeficiency
- 2. Non-organic causes
  - a. Poverty/financial constraints
  - b. Maternal depression/stress
  - c. Cultural/language barriers

**VII. Solid Foods**

- A. As infants get older, caloric requirements decrease:

<u>Age</u>	<u>cal/kg/d</u>
0-12 months	100
1-3 years	100
4-6 years	90
7-10 years	70
11-14 years	47-55
15-18 years	40-45
- B. Cereal and pureed foods are introduced at 4 to 6 months of age, with progression to chopped foods by 8 to 9 months of age.
- C. As a rule, fat limitation should not be instituted until after 2 years of age.
- D. The USDA Food Guide Pyramid provides a model for a balanced diet. As a rule, energy obtained from fats should be limited to 30% of daily intake.

**VIII. Childhood Nutritional Issues**

- A. Growth significantly slows down after the first year of life.
  - 1. From 2 years until puberty, children gain 2 to 3 kg per year and 5 to 8 cm per year.
  - 2. Obesity is a growing problem, with more than 25% of children ages 2 to 18 years old overweight.
- B. Goal is to foster healthy eating habits.
- C. Specific issues
  - 1. Toddlers
  - 2. Preschoolers
  - 3. School-aged children
  - 4. Dieting

## 5. Supplements

### IX. Conclusions

- A. Infants have different nutritional requirements than adults.
- B. Breast-feeding is the preferred food during the first 12 months of life, with supplemental solids offered after 4 months of age.
- C. Growth charts are a vital part of monitoring infant growth and nutritional status.
- D. Specialized formulas are available for certain circumstances.
- E. Failure to thrive has many causes.

### Additional Selected References

- Wagner CL, Anderson DM, Pittard WB. Special properties of human milk. *Clin Pediatrics* 283-293, 1996.
- Zenel, JA. Failure to Thrive: A General Pediatrician's Perspective. *Pediatrics in Review*. Vol 18, No 11. November 1997.
- Gahagan S, Holmes R. A Stepwise Approach to Evaluation of Undernutrition and Failure to Thrive. *Pediatric Clinics of North America*. Vol 45, No 1. February 1998.
- Kleinman, RE, ed. *Pediatric Nutrition Handbook, Fifth edition* (American Academy of Pediatrics). 2004.

### Review Questions

1. A child with Down's syndrome would be plotted on the same growth chart as a child without any illness.
  - a. true
  - b. false
2. A child with severe cerebral palsy requires the same amount of calories per day as a healthy child.
  - a. true
  - b. false
3. A 5-year-old boy requires how many cal/kg/day?
  - a. 100
  - b. 85
  - c. 70
  - d. 90
4. Skim milk is appropriate for a 14 month old to drink.
  - a. true
  - b. false

Answers: 1-b, 2-b, 3-d, 4-b