

Nutrition in Infancy

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Characteristics of Infants

- Digestion, absorption & metabolism is similar to older children except:
 - Pancreatic amylase deficient until around 4th month
 - Fat absorption is inadequate
 - Stomach acidity is low

Calories

- Milk : sole source
- 110-120 Kcal/kg/day = 0-2 mos.
- 8.5 Kcal/kg = 2-6 mos.
- 105 Kcal/kg BW = 6-12 mos.
- Cow's/Human milk = 67 kcal/100ml
- Infant formula = 64-72 kcal/100 ml

Calories

Reasons for increased need:

- Rapid growth rate
- Great heat loss due to large body surface area
- Activity of the infant

Protein

- RDA: 6 mos = 2.2 g/kg
12 mos = 2.0 g/kg
- Human milk = 1.2 gms/100 ml
- Cow's milk = 3x more CHON

Disadvantage:

- increase blood urea
- high renal solute load
- AA pattern different from human milk

Protein

Deficiency:

- Marasmus
- Mental retardation
 - irreversible
 - Poor reading/writing skills
 - Less able to grasp knowledge

Carbohydrate

- Prevent hypoglycemia & ketosis
- Lactose: sole source
- Improves CHON, Ca^{2+} & Mg^{2+} absorption
- Provides galactosides: brain & nerve cell formation
- Laxative
- Human milk = 42% of total caloric value
- Cow's milk = 20%

Fat

- Must constitute 35-55% of TER
- Essential fatty acids: linoleic & alpha-linolenic acid (omega 3 series)
- EFA: retina & brain
- Ratio of linoleic to alpha-linolenic : 5-15
- Breastmilk = 30-40 mg/ml
- Cow's milk = 10-15 mg/ml

Vitamins

- Vit.A
 - RDA is 325 g retinol equivalents
 - Adequate: 850 ml BM w/ 170 IU/100ml
 - Formulas: 750 IU/100 kcal
- Vit.C
 - Gen low content in both CM & BM
 - BM: 5 mg/ml
 - Vit. C –rich beverages @ 6 mos to get at least 30 mcg daily

Vitamins

- Vit. D
 - Sunlight exposure
- Thiamine
 - RDA: 0.4 mg/day
- Riboflavin
 - Same as thiamine
- Niacin
 - 0.25/100 kcal

Vitamins

- Vit B₁₂
 - 0.5 mcg during 1st 5 mos. Of life
- Vit. E
 - 1/3 of adult RDA
 - 0.7 IU/100kcal for artificially-fed infants
- Vit. K
 - All infants: single IM/oral dose ASAP post-partum

Minerals

- Iron
 - 0.15-0.2 mg/100 ml
 - 4th month: RDA 15 mg/day
 - Iron fortification of milk formula after 4-6 mos.
- Calcium
 - BM = 33mg/100ml; Ca:P ratio is 2.3
 - Milk formula = 1.2 only
- Phosphorus
 - Intake of infants is quite low

Water & Electrolytes

- 70-75% of BW
- Mostly extracellular: prone to dehydration
- Special attention: fever, polyuria, diarrhea & during hot weather
- $\text{Na}^+ : \text{K}^+ \text{ not } \geq 1.0$
- $\text{Na}^+ : \text{K}^+$ = at least 1.5

Cl^-

Premature Infant

- Exteremly rapid growth rate
- Immature organs e.g. liver, kidneys
- higher Basal Metabolism: 30-50% more than full-term
- Small & frequent feedings:
parenteral/tubes
- 120-140 kcal/kg & 3-4 gm CHON/kg BW
- EAA & ascorbic acid

Premature Infant

- Vits. = 2x dosage for full terms
- Ca:P = 2.0
- Iron supplements @ 2 mos. = 2 mg/kg/day
- Milk from own mother: more appropriate than term milk/pooled human milk
- Pre-term HM = higher CHON, Na,Cl, Mg & Fe content but lower Ca & P content

Factors Affecting Nutritional Status

- Mother's attributes
- State of nutrition during pregnancy
- Feeding pattern
- Weaning & supplementation
- Illness
- BM: rich in long-chain polyunsaturated fatty acids
- LCPUFA – component of structural lipids in membranes of all organs

Breastfeeding

- 3 Ways:
 - Breast, Bottle, Mixed
- 1st 4-6 mos.
- BM is sterile
- Colostrum & Mature milk: anti-viral
 - Thru secretion of interferon
 - Thru direct phagocytosis
 - Thru secretory IgA

Breastmilk

- Contains antibodies vs. bact
- 3000x more lysozymes than CM
- 49% Fe is absorbed vs. 4-10% in MF
- Easily digested
- Non-allergenic
- Beneficial to mother's health
- Lactoferrin, Transferrin, Lactoperoxidase system
- Economical & convenient

Bottle Feeding

- Risk of contamination
- Prone to over-dilution
 - infective diarrhea
 - nutritional marasmus
 - heightened susceptibility to respi. infections
- Costly
- Asso. w/ infantile obesity or “protein-calorie malnutrition plus”

Mixed Feeding

- Combination of BM & BF, either one predominating
 - a. Complementary: bottle is given because mother's milk is insufficient
 - b. Supplemental: bottle is given to replace 1 or more feedings when mother is away for periods longer than feeding intervals; given at 4-6 mos

Breastmilk Substitutes

- Two types
 - a. Whey-adapted
 - b. Casein-predominant
- Fat mix of infant formula
 - a. Butterfat w/ vege oil
 - b. Mixture of vege oils
 - c. Animal fat (oleo) w/ vege oil

Breastmilk Substitutes

- Infant formula:
 - a. Starter = one intended to cover all the nutritional needs of the infant during the 1st 6 mos. of life
 - b. Follow-up = mixed feeding scheme for 6 mos. Onward; higher in CHON, Ca & Fe

Formula Preparation

- Aseptic
 - Ingredients & equipment are separately sterilized;
 - Contamination can occur during pouring stage
- Terminal
 - Formula is poured in clean bottles & sterilized
 - Scum formation possibly can clog nipple holes

Feeding Time

- Should be regular
- 2.5-2.7 kg = every 3 hrs
- 3.6-4 kg = every 4 hrs
- 2 mos. = baby sleeps thru the night after 10 pm feeding
- 2-3 mos = 4-5 feeding sched
- Best clock: baby's hunger

Feeding Time

6 months & below:

- As often as the child wants (D & N)
- At least 8x in 24 hrs
- Hunger signs:
 - Begins to fuss
 - Sucking fingers
 - Moving the lips

Weaning

- Gradual change from an all-milk diet to a diet composed of a variety of foods(6 mos)
- Early abrupt weaning
 - Maramus
 - Infections
 - kwashiorkor
- Late weaning
 - PEM
- Home-made food: multimix = cereal, animal/vege CHON , dark green leafy vege

Supplementary Feeding

- 6 mos = scraped banana, lugaw, iron-rich foods
- High-calorie CHON supplements(FNRI):
 - MRFCF (monggo-rice-coco flour-fish)
 - Nutri-pak (ground rice, shrimp/dilis, monggo,cooking oil,*skim milk)
 - Nutri-mix (cereals, MARC, RMS)
 - Commercial: Cerelac/Ceresoy

Supplementary Feeding

- Teething: chewy foods
- 7-8 mos = porridge w/ soft cooked egg, boiled fish, mashed liver, peanut-banana mash
- 9-12 mos = whole tender foods (chopped)
- 1 yr = 3 meals & in-between feedings
- 1-2 = same food w/ family but different consistency, texture & flavor

*Other list of supplementary foods: handouts

Common Disorders

- Diarrhea
- Vomiting
- Constipation
- Colic
- Measures:
 - Determine underlying cause
 - Maintain water & electrolyte balance
 - Modify milk formula

Indications of Good Nutrition

- Body weight gain
- BMI:
wt. in kg/ height in m²
- MUAC(mid upper arm circumference)
- Behavioral development
- Bowel movements
- Sleeping habits

Indications of Good Nutrition

- Developed motor coordination
- Well-formed muscles
- Grave's study
 - Vigor in any activity
 - Establishes interaction w/ mother at a distance
 - Less irritable

RDA @ 1 year

- Green leafy = 2 & ½ cups; yellow = 2 tbsp
- Vit C-rich foods = 2 tbsp
- Other fruits & vege = 2 tbsp each for both
- Fat = 2 tsp
- Meat, fish, poultry = 1 matchbox size
- Milk = 2 cups

RDA @ 1 year

- Eggs = $\frac{1}{4}$
- Dried beans = $\frac{1}{4}$ cup
- Nuts = 2 tbsp
- Rice (lugaw) = 2 $\frac{1}{2}$ cups
- Rootcrops (mashed) = 2 tbsp
- Sugar = 6 tsp

*RDA : pls refer to handouts

Advantages of Breastfeeding

- Contains exactly needed nutrients
- Nutrients: more easily absorbed from BM
- BM protects infants vs. infections
- BF helps foster close relationship between mother & baby
- Helps protect mother's health

NUTRITION IN PRESCHOOL AGE

- Early preschool age
 - Toddler
 - 1-3 years old
- Late preschool age
 - 4-6 years old

RDA by FNRI

Age	Body Wt. Kg.	Cal	Protein grams	Calcium grams	Iron mg.	Retinol Equivalent Act.	Vit. A I.U.	B1 mg.	B2 g.	Niacin mg. Equiv.	Vit. C mg.
1 – 3 years	13	1310	26	0.5	6	250	1800	0.7	0.7	9	35
4 – 6 years	18	1640	32	0.5	8	325	2300	0.8	0.8	11	45

ENERGY

- 55% - metabolic activities
- 25% - physical activities
- 12% - growth needs
- 9% - fecal loss (90- 100Kcal/kg)

FNRI estimate

1350 Kcal/day – 1-3 yr old children

250 Kcal/day – 4-6 yr old children

Protein Energy Malnutrition (PEM)

- Marasmus
- Kwashiorkor

Protein

- FAO recommendation
 - 1.5- 2g/kg body wt.

Deficiency symptoms

- Retarded growth
- Anemia
- Pigmentary changes of hair and skin
- Edema (kwashiorkor)

Vitamins

- vitamin A
- vitamin C
- vitamin B1
- vitamin B2

Minerals

- Calcium and iron
- Trace elements
 - iodine
 - fluoride
 - zinc

Zinc deficiency

- Dwarfism
- Retarded sexual development

TYPES OF AT- RISK FACTOR

BIOLOGICAL

- Mother
- Young child

ENVIRONMENTAL

- Cultural
- Socio- economic
- Geographic- climactic
- Miscellaneous

EARLY WARNING SIGNALS

- Community
- Individual

Reasons for nutritional vulnerability

- His mother may have another baby to whom she lavishes more attention
- He gets a small share of whatever food is on the table in proportion to his size
- He may choose from a common dish at the table foods that are not Nutritionally protective
- The previous major source of his protein intake in which is breast milk maybe suddenly withdrawn from him because mother is pregnant
- Mother may go back to work and he is left in the care of others

Food Recommended

Food Groups	Amount	Allowed Foods
1. Vegetables	2 servings, one should be leafy or yellow	All except strongly flavored for the younger children; chopped or cut in pieces
2. Fruits	2 servings, one should be Vit. C-rich	All; skin, seeds and long fibers, and if any removed
3. Rice or substitute	1 ½ to 2 ½ cups cooked	All except for whole kernel corn and malagkit
4. Milk	At least 2 cups	Chopped or ground lean meat liver, chicken; flaked fish; eggs; mashed beans; mild cheese
5. Meat or substitute	3-5 servings more if milk is refused; liver twice a week	
6. Fat	As needed	Cream, butter or margarine
7. Sugar	1 tablespoon	Sucrose, syrup, jams or jellies
8. Desserts	As needed or made from food allowance	Plain pudding, gelatin, ice cream, cakes and cookies

SCHOOLCHILD



CHARACTERISTICS

- Between 7 and 12 years
- Slow steady growth
- Increase body proportions
- Enhanced mental capabilities
- More motor coordination
- Body reserves are being laid down in preparation for the increased needs during the adolescent stage
- Growth rates vary within this period

NUTRIENT ALLOWANCES

- His nutritional needs differ from that of an adult on the ff. points
 - He is actively growing (girls at prepuberty stage experiences spurts of growth)
 - He is constantly active
 - He is changeable in his attitudes towards food
 - He cannot afford to eat foods poor in essential nutrients
- RDA classification of Filipino school children
 - 7 – 9 years old
 - 10 – 12 years old / pre-adolescence

Age	Energy	Protein 8%	Vitamins and minerals		
			Vitamin C	Calcium	Iodine
7 -9	80 – 90 Kcal/kg	35 gm	55mg	600 – 700 mg	70 – 80 mcg
10 -12	70 – 80 Kcal/kg	45 – 49 gm	65-70 mg		

FEEDING THE SCHOOL CHILD

1. Psychological factors

- Let him feel responsible for his own well-being
- Make him accountable for his diet
- Parents should take time out and spend time with the children

“ A HAPPY CHILD IS A HEALTHY CHILD ”

2. School environment

Goals of School feeding programs

- To improve the nutrition of school children by furnishing them wholesome food at the lowest possible cost
- To aid in strengthening the nutrition and health education program of the public schools
- To foster proper eating habits

3. Food Preference

FEEDING PROBLEMS

1. Inadequate meals
2. Poor appetite
3. Sweet tooth
4. Fast foods

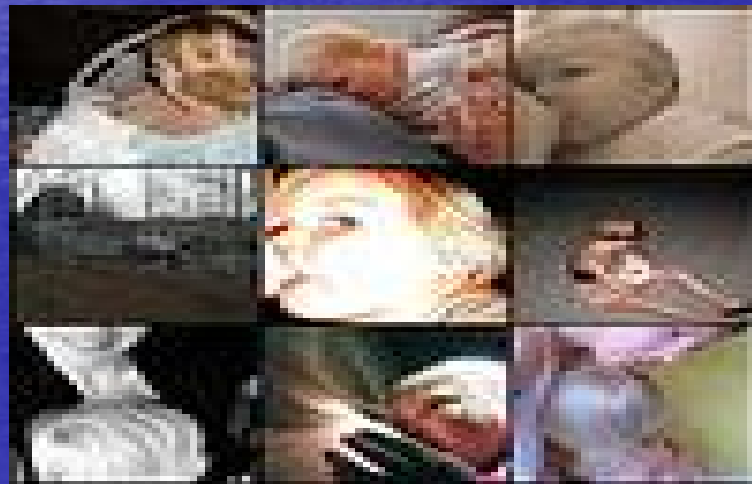
INDICATIONS OF GOOD NUTRITION

1. Clinical examination
 - EENT test
 - SE
 - UA
 - PE
2. Dietary analysis
 - Diet history/food record
 - General Eating habits
 - Nutrient intake
3. Anthropometric examination
 - Weight-for-age
 - Height-for-age
 - Weight-for-height

FOODS TO BE INCLUDED DAILY

Food item	Serving
Milk, whole	One or more cups
Meat, fish, poultry	3 or more servings
Dried beans and nuts	1/3 cup or more, cooked
Enriched rice and other cereals	4 or more cups, cooked
Rootcrops	1 or more medium pieces
Fat- butter, margarine, oil	6 teaspoon
Green and leafy vegetables	1/2 cup or more
Vitamin C-rich foods	One or more
Other fruits and vegetables	2 medium fruits or 8 or more tbsp vegetables
Eggs	2-3 a week
Sweets	6 teaspoons





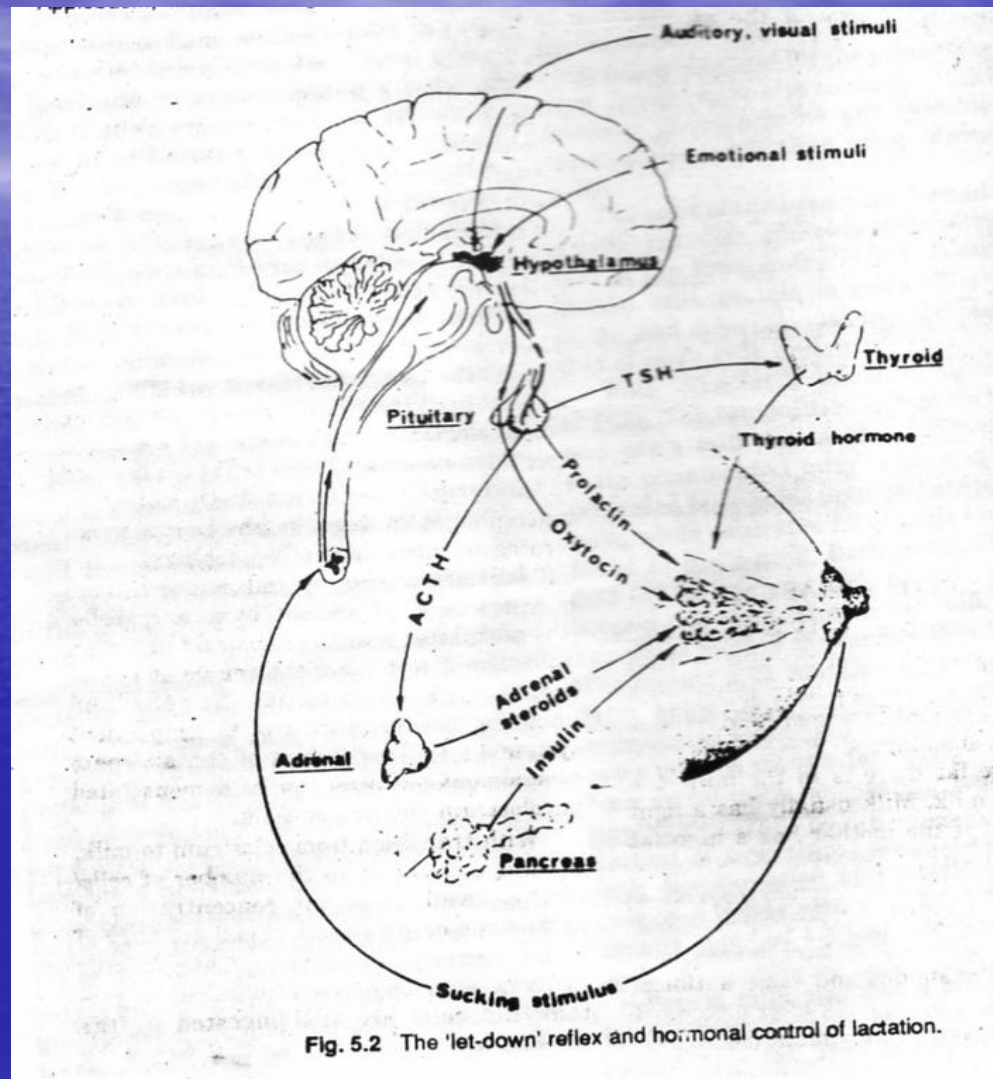
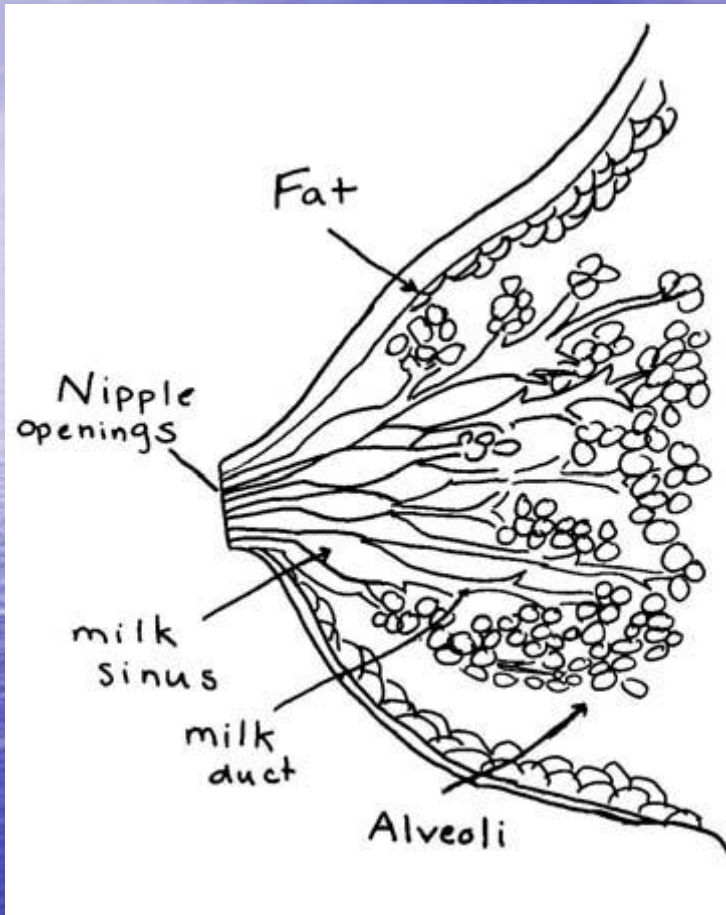


Fig. 5.2 The 'let-down' reflex and hormonal control of lactation.

Milk Ejection Reflex

The milk ejection reflex actually is a neuroendocrine reflex. The reflex has an afferent pathway (neural) and an efferent pathway (hormonal, blood-borne).

Afferent Pathway:

The greatest amount of innervation in the mammary gland is in the teats, where there are pressure sensitive receptors in the dermis. Mechanical stimulation of the teats activates pressure sensitive receptors in the dermis where the pressure is transformed into nerve impulses which travel via the spinothalamic nerve tract to the brain. The nerves synapse in the paraventricular and supraoptic nuclei in the hypothalamus. [A cluster of nerve cells in the brain is often called a nucleus. This is different from the nucleus of a single cell.]

Hypothalamic Nuclei and Oxytocin Synthesis

Neurons in these hypothalamic nuclei synthesize the oxytocin precursor and package it into vesicles. Oxytocin (an 9 aa peptide) is initially synthesized as a large molecular weight precursor which also contains the oxytocin-carrier peptide neurophysin. The precursor is proteolytically cleaved in the vesicle to yield oxytocin bound to neurophysin. The oxytocin-neurophysin complex is the intracellular storage form of oxytocin.

The oxytocin-containing vesicles are transported from the cell body (which is in the hypothalamus), down the axons to the neuron endings in the posterior pituitary. [This is called the hypothalamo-neurohypophysial tract.] The oxytocin-neurophysin is stored in neurosecretory granules called herring bodies in the axon ending.

The synthesis of oxytocin in the cell bodies and its transport to the axon endings occur separately from the milk ejection reflex.

When the cell bodies of the oxytocin-containing neurons are stimulated by impulses originating in the teat, an action potential moves down the axon to the neuron ending in the posterior pituitary, causing release of oxytocin and neurophysin (no longer bound together) into the blood.

The efferent pathway starts at this point.

Efferent Pathway:

The efferent pathway begins with the release of oxytocin into the blood. The oxytocin then travels to the mammary gland via the blood, binds to oxytocin receptors on the myoepithelial cells, causing them to contract, and resulting in increased intra-luminal (intramammary) pressure and ejection of milk from the alveolar lumen. Oxytocin receptors are associated with the myoepithelial cells, not the smooth muscle of the mammary gland.

In mice these receptors increase through-out gestation, but are fairly constant through lactation.

