

**Children Eating Insects:  
Love those Larvae and Grab Grubs for Grub**

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Gypsy Moth Caterpillars



"Caterpillars and meat play the same role in the human body"  
Yansi saying in Zaire

**Outline**

1. Normal child growth
2. Protein-energy malnutrition (PEM)
3. Complementary feeding
4. Insects for children (1-3 years of age)
5. Concepts of food
6. Decision points in insects as child foods

**Child Growth and Motor Development**



**Body Composition of Male Infants  
(Age 0-12 Months, 50<sup>th</sup> % ILE)**

Age (months)	Weight (Kg)	Fat (%)	Length (cms)
Birth	3.5	14	34.8
3	6.4	23	40.6
6	8	25	43.8
9	9.2	24	45.8
12	10.2	23	47

Expected : Double birth weight by 5-6 months, triple by 12 months

**Faces of Protein Energy Malnutrition (PEM):**



**Major Problems in International Nutrition**

- Protein Energy Malnutrition (PEM)
  - Infection-malnutrition cycle
- Micronutrient Deficiencies
  - Vitamin A
  - Iron
  - Zinc
  - Iodine
- Overweight, obesity, chronic diseases

### Worldwide Causes of Deaths in Children (<5 years of age) 2000-2003

- 10.6 million per year
- 42% in Africa
- 29% in Southeast Asia
- Diarrhea causes 27% of all non-neonatal (>1 month old) deaths
- **Undernutrition contributes to**
  - All deaths (53%)
  - Diarrhea deaths (61%)
- **Diarrhea + Undernutrition = Deadly Duo**
- Preventable by Existing, Available, Affordable Interventions

### Undernutrition: Prevalence

- More common in India than in Sub-Saharan Africa and rural > urban
- 33% of world's malnourished children in India
- World's children < 3 years of age
  - 46 % stunted
  - 47 % underweight
  - 16 % wasted
  - 74 % anemic
- 33% low birth weight
- 13% iodine deficiency
- <50% of households have iodized salt

### Effects of Malnutrition in Children < 5 Years of Age

- Excess infection
- Excess mortality
- Decreased activity
- Decreased cognitive development
- Poor school performance
- Combined with intrauterine malnutrition: permanent growth and cognitive delay

### Undernutrition: Assessment

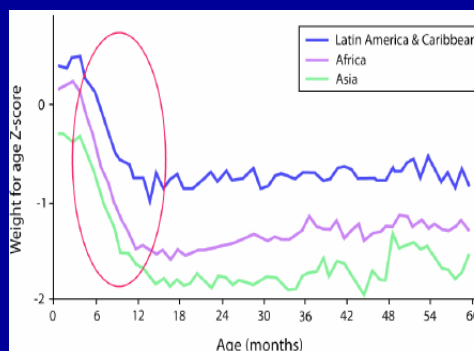
- Anthropometric: indices and time period
  - Stunting: low height for age: lifetime cumulative effects
  - Underweight: Low weight for age: recent and long-term
  - Wasting: Low weight for height: recent
  - Abnormal if < 80–90% of expected
  - Not specific to causes: intake, infections, food insecurity, inadequate health/environmental services, low birth weight, suboptimal childcare practices, income, or disparities in resources.
  - Must assess overall food chain to determine problem cause and solution

### Relative Risk of Preschool Child Death by Weight for Age

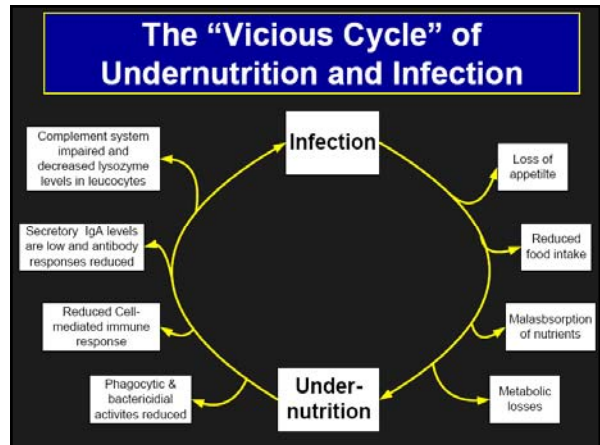
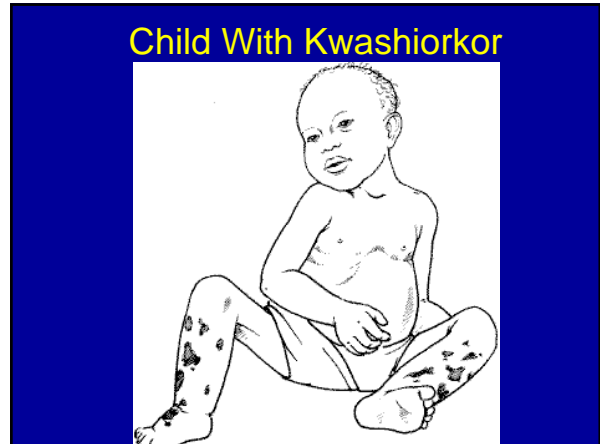
Cause	<-3 Z	-2 to -3 Z	-1 to -2 Z	≥ -1 Z
Diarrhea	12.5	5.4	2.3	1.0
ALRI	8.1	4.0	2.0	1.0
Malaria	9.5	4.5	2.1	1.0
Measles	5.2	3.0	1.7	1.0
All causes	8.7	4.2	2.1	1.0

S Fishman et al, CQHR, Vol1, WHO 2004

### Limited Window to Repair Childhood Undernutrition: Irreversible Growth Failure by Age 6-18 Months



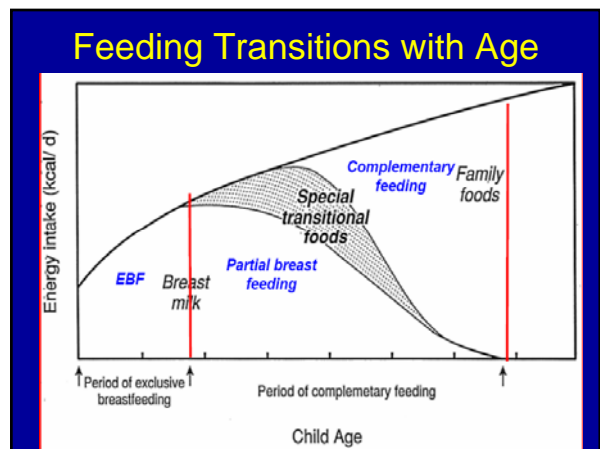
- ### Protein Energy Malnutrition (PEM)
- Inadequate intake of protein and energy
    - < Required for normal growth
    - Usually with micronutrient deficiencies
    - Spectrum: mild stunting to severe wasting
    - Sequential adaptive responses
      - Decreased activity and energy expenditure
      - Utilization of fat stores until depletion
      - Protein catabolism
        - Loss of muscle mass
        - Preservation of brain and viscera
      - Slowed growth



### Complementary Feeding

**Complementary foods**  
 Feedings other than breast milk  
 Fed along with breast milk

**Transition Foods**  
 Nutrient dense complementary foods designed to meet the nutritional needs of child



### Complementary Food Timing: The Weanling's "When" Dilemma

Late introduction may cause deficient energy and nutrient intake and poor growth

vs.

Early introduction can increase pathogen exposure and risk of infections, allergies and aspiration

### Complementary Food Type:

The Weanling's "What" Dilemma (Choose Well or Lose)

- Sanitary safe delivery
- Energy density affects total energy intake
- Nutrient density affects quality
- Breast milk displacement by less safe, nutrient and energy dense foods is adverse

### Complementary Foods Create Challenges

- Breast milk: insufficient after 6 months of age
- Need ~550 Cal. with 42% of energy from fat + breast milk for 1-2 year old
- Inappropriate feeding is major cause of PEM
- Most PEM occurs at 6-18 months of age
- Deficits often permanent



### Appropriate Complementary Foods: Principles

- Timely-Nutrient needs greater than breast feeding can provide
- Adequate in energy, macro- and micro-nutrients to meet needs of growing child
- Safe-hygienic
- Properly fed with awareness of child's appetite and satiety with appropriate frequency and methods

### Complementary Food Guidelines (WHO)

- 1. DURATION OF EXCLUSIVE BREASTFEEDING AND AGE OF INTRODUCTION OF COMPLEMENTARY FOODS.** Practice exclusive breastfeeding from birth to 6 months of age, and introduce complementary foods at 6 months of age (180 days) while continuing to breastfeed.
- 2. MAINTENANCE OF BREASTFEEDING.** Continue frequent, on-demand breastfeeding until 2 years of age or beyond.
- 3. RESPONSIVE FEEDING.** Practice responsive feeding, applying the principles of psychosocial care. Specifically: a) feed infants directly and assist older children when they feed themselves, being sensitive to their hunger and satiety cues; b) feed slowly and patiently, and encourage children to eat, but do not force them; c) if children refuse many foods, experiment with different food combinations, tastes, textures and methods of encouragement; e) minimize distractions during meals if the child loses interest easily; f) remember that feeding times are periods of learning and love - talk to children during feeding, with eye to eye contact.

### Complementary Food Guidelines (WHO)

- 4. SAFE PREPARATION AND STORAGE OF COMPLEMENTARY FOODS.** Practice good hygiene and proper food handling by a) washing caregivers' and children's hands before food preparation and eating, b) storing foods safely and serving foods immediately after preparation, c) using clean utensils to prepare and serve food, d) using clean cups and bowls when feeding children, and e) avoiding the use of feeding bottles, which are difficult to keep clean.
- 5. AMOUNT OF COMPLEMENTARY FOOD NEEDED.** Start at 6 months of age with small amounts of food and increase the quantity as the child gets older, while maintaining frequent breastfeeding. The energy needs from complementary foods for infants with "average" breast milk intake in developing countries are approximately 200 kcal per day at 6-8 months of age, 300 kcal per day at 9-11 months of age, and 550 kcal per day at 12-23 months of age. In industrialized countries these estimates differ somewhat (130, 310 and 580 kcal/d at 6-8, 9-11 and 12-23 months, respectively) because of differences in average breast milk intake.

### Complementary Food Guidelines (WHO)

**6. FOOD CONSISTENCY.** Gradually increase food consistency and variety as the infant gets older, adapting to the infant's requirements and abilities. Infants can eat pureed, mashed and semi-solid foods beginning at six months. By 8 months most infants can also eat "finger foods" (snacks that can be eaten by children alone). By 12 months, most children can eat the same types of foods as consumed by the rest of the family (keeping in mind the need for nutrient-dense foods, as explained in #8 below). Avoid foods that may cause choking (i.e., items that have a shape and/or consistency that may cause them to become lodged in the trachea, such as nuts, grapes, raw carrots).

**7. MEAL FREQUENCY AND ENERGY DENSITY.** Increase the number of times that the child is fed complementary foods as he/she gets older. The appropriate number of feedings depends on the energy density of the local foods and the usual amounts consumed at each feeding. For the average healthy breastfed infant, meals of complementary foods should be provided 2-3 times per day at 6-8 months of age and 3-4 times per day at 9-11 and 12-24 months of age, with additional nutritious snacks (such as a piece of fruit or bread or chapatti with nut paste) offered 1-2 times per day, as desired. Snacks are defined as foods eaten between meals-usually self-fed, convenient and easy to prepare. If energy density or amount of food per meal is low, or the child is no longer breastfed, more frequent meals may be required.

### Complementary Food Guidelines (WHO)

**8. NUTRIENT CONTENT OF COMPLEMENTARY FOODS.** Feed a variety of foods to ensure that nutrient needs are met. Meat, poultry, fish or eggs should be eaten daily, or as often as possible. Vegetarian diets cannot meet nutrient needs at this age unless nutrient supplements or fortified products are used (see #9 below). Vitamin A-rich fruits and vegetables should be eaten daily. Provide diets with adequate fat content. Avoid giving drinks with low nutrient value, such as tea, coffee and sugary drinks such as soda. Limit the amount of juice offered so as to avoid displacing more nutrient-rich foods.

**9. USE OF VITAMIN-MINERAL SUPPLEMENTS OR FORTIFIED PRODUCTS FOR INFANT AND MOTHER.** Use fortified complementary foods or vitamin-mineral supplements for the infant, as needed. In some populations, breastfeeding mothers may also need vitamin-mineral supplements or fortified products, both for their own health and to ensure normal concentrations of certain nutrients (particularly vitamins) in their breast milk. [Such products may also be beneficial for pre-pregnant and pregnant women].

**10. FEEDING DURING AND AFTER ILLNESS.** Increase fluid intake during illness, including more frequent breastfeeding, and encourage the child to eat soft, varied, appetizing, favorite foods. After illness, give food more often than usual and encourage the child to eat more.

### Edible Insects

- 70-90 % in Central Africa eat caterpillars
- Forest edible insects are free of pesticides in contrast to those from farms
- Insects as nutrient sources to prevent PEM
  - Protein: High in good quality protein
  - Calories: High in fat
  - Iron: Some are high

### Dietary Reference Intakes

**Recommended Dietary Allowance (RDA):** the average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group.

**Adequate Intake (AI):** the recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate—used when an RDA cannot be determined.

**Interpretations:**  
 For an individual usual intake at or above either RDA or AI has low probability of inadequacy  
 For groups AI at or above mean intake implies low probability of inadequate intake

### DRI 1-3 Year Old vs. Food Nutrient Contents/100 g

	Energy (C)	Total Water (g)	Carb (g)	Fat (g)	Linoleic (g)	Linolenic (g)	Protein (g)	Vit. A (mcg)	Calcium (mg)	Iron (mg)
1-3 year old	1000	1300	130	40**	7	0.7	13	300	500	7
Caterpillars Dried*	430	9	17	15	3	1.6	53			
Silk Worm pupae	98		2.3	5.6			9.6		42	1.8
Palm Weevil larvae dried		12		61			10			.6
Grasshopper small	153		4	6			21		35	5
Ground beef	288			21			24		10.6	2.5
Milk whole	60		5.4	3.3			3.3		106	.07
Fish* Dried	269	14		7.4			17			

\*Fresh caterpillars and fish are 75-80% water by weight  
 \*\* Franklin estimate based on 35% or calorie intake from fat as recommended for energy density of child feeding in developing countries

Essential Amino Acids	Requirement (mg/g protein)	Requirement 1-3 year old	Grasshopper mg/100g
Histidine	18	234	220
Isoleucine	25	325	420
Leucine	55	715	890
Lysine	51	663	570
Methionine + cysteine	25	325	430
Phenylalanine +Tyrosine	47	611	1660
Threonine	27	351	310
Tryptophan	7	91	70
Valine	32	416	570

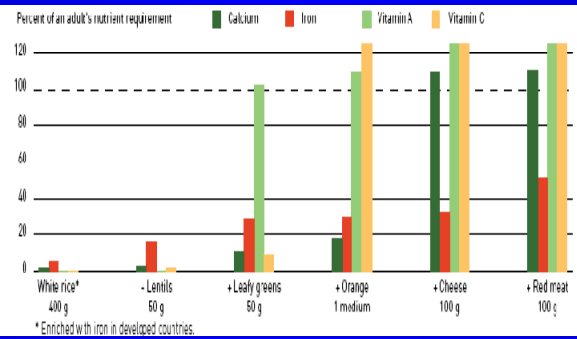
### Food Patterns and Amounts (g/d) to Meet Energy Needs of Non-Breast Fed 1-2 year olds (WHO)

Foods	Diet 1	Diet 2	Diet 3
<b>West Africa</b>			
Milk	340-350	340	340
Egg	0	0	-
Meat, poultry, fish, or liver	0-15	-	-
Maize/millet porridge	70-185	185	185
Cowpeas/soybeans	100	100	100
Groundnut soup	90-100	90	90
Taro leaf	0-40	40	40
Tomato	0	0	0
Orange juice	15-35	15	15
Oil	0	0	0
			3

Soybeans cooked/100g = 141 C, Pro 12 g, Fat 6 g, Carb 11 g Vit A 45 mcg, Ca 140mg, Fe 2.5 mg

1. All values are for prepared foods (cooked, as appropriate). Diet 1 includes dairy products, egg and other animal-source foods, Diet 2 includes dairy products and egg but no other animal-source foods, and Diet 3 includes dairy products but no other animal-source foods. Source: Dewey et al., 2004.  
2. Diets that do not contain animal-source foods (meat, poultry, fish or eggs, plus milk products) cannot meet all nutrient needs at this age unless fortified products or nutrient supplements are used.

### Dietary Variety Boosts Micronutrient Intake: Spice of Life



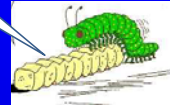
## Concepts of Foods

### Food Forms Fried Papuan Fry Larva vs. French Fry Potato



Plate 1. Baga larva (*Rhyacionia bilineata*) (Courtesy E. Ramandry)

Knock it off, idiot  
I'm a French Fry



### Food Concepts: Which is Yuk? Silk Worms vs. Chicken Nuggets

He was a bold man that first eat an oyster  
----- Jonathan Swift 1738  
Eat fish, live longer. Eat oysters, love longer-----social marketing



Glued and Chewed: McDonald's Nuggets are 44% chicken, the rest is corn, salt, and preservatives; glued with modified corn starch

### Are Bugs Part of Your Diet? They Already Are!

Product	Action Level
Apple butter	5 insects per 100g
Berries	4 larvae per 500g OR 10 whole insects per 500g
Ground paprika	75 insect fragments per 25g
Chocolate	80 microscopic insect fragments per 100g
Canned sweet corn	2 3mm-length larvae, cast skins or fragments
Commeal	1 insect per 50g
Canned mushrooms	20 maggots per 100g
Peanut butter	60 fragments per 100g (136 per lb)
Tomato paste, pizza, and other sauces	30 eggs per 100g OR 2 maggots per 100g
Wheat flour	75 insect fragments per 50g

Source: The Food Defect Action Levels: Current Levels for Natural or Unavoidable Defects for Human Use that Present No Health Hazard. Department of Health & Human Services 1989.

### Will Critter Cuisine Become Custom: Bait and See



### Decision Points in Insects as Infant Foods

- Nutrient requirements
- Baseline clinical and nutritional status
- Other nutritional practices/programs and nutrient sources/supplements
  - Complementary
  - Antagonistic interactions
  - Toxicity from excess
- Insect nutrient content specification and variation
  - Lifecycle stage and food source, order (15) and species (1500)
- Bioavailability of nutrients
- Texture and taste preferences: mother and child
- Feeding stage and skills: mother and child
- Cultural food beliefs and acceptability (what, when, where and how to feed child)-taboos and you

### Decision Points in Insects as Infant Foods

- Availability, accessibility, sustainability and scalability
  - Geography/habitat
  - Seasonality and climate
  - Production (food conversion efficiency and reproductive capacity)
  - Storage
  - Competition in marketplace
- Cost
- Preparation time and ease (allocation and constraints)
- Safety and appropriateness
  - Toxins/pesticides
  - Infection
  - Allergy
  - Inhibitors e.g. chitin
- Environmental benefits and risks
  - Pests, plants, people in same place---priorities

### Lion and Bull Story (LBS)

A hungry lion came upon a herd of  
cattle

He chased and caught the bull

He ate till full and let out a great roar

A nearby hunter heard the lion and

Shot him!

???? Moral of the story ????

### Moral of the LBS

When you are full of bull  
You should keep your  
mouth shut!!!!

### The End

**That's all folks**