"We are guilty of many errors and many faults, but our worst crime is abandoning the children, neglecting the foundation of life. Many of the things we need can wait. The child cannot. Right now is the time his bones are being formed, his blood is being made and his senses are being developed. To him we cannot answer "Tomorrow". His name is "Today"."
~Gabriela Mistral, 1948

Importance of Nutrition

From being severely malnourished (weight 4.75 kg), this 2-year old girl gained 32% more weight in 3 weeks (weight 6.28), but she also gained an appetite for living. Source: WHO.
Learning Objectives

- Define key terms related to nutrition
- Describe the determinants of nutritional status
- Discuss nutrition needs at different stages of the life cycle
- Discuss the burden of nutrition problems globally
- Review the costs and consequences of the burden of nutrition problems
- Discuss measures that can be taken to address key nutrition problems in cost-effective ways
- Discuss important successes that countries have had in dealing with nutrition issues
Brief Review of HUMAN NUTRITION

- FOOD is a mixture of chemicals
- NUTRIENTS are essential chemicals in foods
- 6 classes of nutrients found in food:
  1. Carbohydrates
  2. Lipids
  3. Proteins
  4. Vitamins
  5. Minerals
  6. Water
New Food Pyramid

Exercise
- Adults should be physically active for at least 30 minutes most days of the week, children for 60 minutes.
- Sixty to 90 minutes of daily physical activity may be needed to prevent weight gain or sustain weight loss.

Old food pyramid
- Presented food groups as a hierarchy, with grains as the base of a healthy diet, and each group having a suggested number of servings.
- Emphasized limits on fats, oils and sweets, which were represented as the tip of the pyramid.

- Most fat should be from fish, nuts and vegetable oils.
- Limit solid fats, such as butter, margarine or lard.
- Keep consumption of saturated fats, trans fats and sodium low.
- Choose foods low in added sugar.

Oils

Categories
- Grains
- Vegetables
- Fruits
- Milk
- Meat and beans

Recommendation
- Half of all grains consumed should be whole grains.
- Vary the types of vegetables you eat.
- Eat a variety of fruits. Go easy on juices.
- Eat low-fat or fat-free dairy products.
- Eat lean cuts, seafood and beans. Avoid frying.

Daily Amount
- Grains: 6 oz.
- Vegetables: 2.5 cups
- Fruits: 2 cups
- Milk: 3 cups
- Meat and beans: 5.5 oz.

Recommended nutrient intakes at 12-calorie levels can be found on mypyramid.gov.
Macronutrients vs. Micronutrients

**Macro**
- Nutrients such as carbohydrates, fat, or proteins, that are needed in relatively large amounts in the diets

**Micro**
- Nutrients such as a vitamin or mineral that is needed in relatively small amounts in the diet
- Enables body to produce enzymes, hormones & other substances essential for proper growth and development
- Vitamin A, iodine & iron are most important in global public health terms

Fruits & Veggies are important sources of nutrients, especially micronutrients. Photo by Peggy Greb, USDA

Nothing will benefit human health and increase chances for survival of life on Earth as much as the evolution to a vegetarian diet.

-- Albert Einstein
Changes With Age

- Nutrition changes throughout the life span
- Physiological demand for certain nutrients also differs by gender

### Pregnancy
- **Increased requirements**: energy, protein, essential fatty acids, vitamin A, vitamin C, B-vitamins (B1, B2, B3, B5, B6, B12, folate, choline) & calcium, phosphorus**, magnesium, potassium, iron, zinc, copper, chromium, selenium, iodine, manganese, molybdenum

### Lactation
- **Increased requirements**: vitamins A, C, E, all B-vitamins, sodium, magnesium**
- **Decreased requirements**: iron

### Infancy, childhood
- **Increased requirements**: energy, protein, essential fatty acids

### Adolescence
- **Increased requirements**: energy, protein, calcium, phosphorus, magnesium, zinc (females only)

### Early adulthood (ages 19–50)
- **Increased requirements for males compared with females**: vitamins C, K; B1, B2, B3, and choline; magnesium, zinc, chromium, manganese
- **Increased requirements for females compared with males**: iron

### Middle age (ages 51–70)
- **Increased requirements**: vitamin B6, vitamin D

### Elderly (age 70+)
- **Increased requirements**: vitamin D
- **Decreased requirements**: energy; iron (females only)
Model Growth Chart

- Series of **percentile curves** of selected body measurements based on distribution in US children
- Used to track growth of infants, children, and adolescents since 1977
- Tool that contributes to forming an overall clinical impression for child
The body mass index (BMI) is a measure of weight in relation to height. It is calculated as follows:

$$BMI = \frac{\text{body weight in kilograms}}{\text{height (in metres)}^2}$$

A person with a BMI over 25 kg/m² is considered to be overweight. A person with a BMI over 30 kg/m² is considered obese. The risk of heart attacks, strokes and diabetes increases as BMI increases. Ideally, the BMI should be maintained between 18.5 and 24.9 kg/m².
Body Mass Index

BMI score

- <16: Severe underweight
- 16 – 17: Moderately underweight
- 17 – 18.5: Mildly underweight
- 18.5 – 25: Healthy range
- 25 – 30: Mildly overweight
- 30 – 40: Moderately obese
- >40: Severely obese

Physical symptoms that become more pronounced as BMI declines:
- Thin for their height
- Inadequate energy for normal activity
- Listless, lethargic
- Susceptible to disease
- Poor maternal and infant health
- Health problems caused by macro- and micronutrient deficiencies

Physical symptoms of healthy BMI levels:
- Normal, active life
- Less risk of illness
- No nutrition-related health problems, given a well-balanced diet

Physical symptoms that increase in frequency as BMI increases:
- Sedentary lifestyle
- Cardiovascular diseases
- Diabetes
- Risk of certain cancers
- Health problems caused by macro- and micronutrient imbalances
### TABLE 8-3 Key Terms and Definitions

- **Anemia**—Low level of hemoglobin in the blood, as evidenced by a reduced quality or quantity of red blood cells
- **Body mass index (BMI)**—Body weight in kilograms divided by height in meters squared (kg/m²)
- **Iodine deficiency disorders (IDDs)**—The spectrum of IDD includes goiter, hypothyroidism, impaired mental function, stillbirths, abortions, congenital anomalies, and neurological cretinism
- **Low birthweight**—Birthweight less than 2500 grams
- **Malnutrition**—Various forms of poor nutrition. Underweight or stunting and overweight, as well as micronutrient deficiencies, are forms of malnutrition.
- **Obesity**—Excessive body fat content; commonly measured by BMI. The international reference for classifying an individual as obese is a BMI greater than 30.
- **Overweight**—Excess weight relative to height; commonly measured by BMI among adults. The international reference for adults is as follows:
  - 25–29.99 for grade I (overweight)
  - 30–39.99 for grade II (obese)
  - > 40 for grade III
  For children, overweight is measured as weight-for-height 2 z-scores above the international reference.
- **Stunting**—Failure to reach linear growth potential because of inadequate nutrition or poor health. Stunting is measured as height-for-age 2 z-scores below the international reference.
- **Undernutrition**—Poor nutrition. The three most commonly used indexes for child undernutrition are height-for-age, weight-for-age, and weight-for-height. For adults, undernutrition is measured by a BMI less than 18.5.
- **Underweight**—Low weight-for-age; that is, 2 z-scores below the international reference for weight-for-age. It implies stunting or wasting and is an indicator of undernutrition.
- **Vitamin A deficiency**—Tissue concentrations of vitamin A low enough to have adverse health consequences such as increased morbidity and mortality, poor reproductive health, and slowed growth and development, even if there is no clinical deficiency.
- **Wasting**—Weight, measured in kilograms, divided by height in meters squared, that is 2 z-scores below the international reference.
- **Z-score**—A statistical term, meaning the deviation of an individual’s value from the median value of a reference population, divided by the standard deviation of the reference population.

Malnutrition: The Silent Crisis

• **Definition**: Failure to achieve nutrient requirements which can impair physical and/or mental health

• May result from consuming **too much or too little** food, shortage or imbalance of key nutrients

• **Two types:**
  – Undernutrition
  – Overnutrition
Overnutrition: Obesity Epidemic

“Encased in fat in youth, encased in a coffin in middle age.”

~Chinese proverb
Overnutrition

• 1 billion adults worldwide overweight
  – 300 million obese
• Increased consumption of foods high in saturated fats and sugars, reduced physical activity
• Consumption of too many calories or too much of any specific nutrient
As your weight increases to reach the "overweight" and "obesity" levels, your risks for the following conditions will also increase:

1. Coronary heart disease
2. Type 2 diabetes
3. Cancers (endometrial, breast, and colon)
4. Gynaecological problems (abnormal menses, infertility)
5. Dyslipidemia (high total cholesterol or high levels of triglycerides)
6. Stroke
7. Liver and gallbladder disease
8. Sleep apnea and respiratory problems
9. Osteoarthritis (a degeneration of cartilage and its underlying bone within a joint)
10. Hypertension (high blood pressure)
Nutrition Transition

- Transition from unprocessed to processed foods
- Already occurred in wealthy countries and among richer people in poor countries
- Spreading to developing countries
- Linked with growing trend toward diet-related non-communicable diseases

As incomes rise, even poor nations have access to diets relatively high in fat. A diet containing 20 percent fat corresponded with a GNP of US$ 1,475 in 1962. By 1990, that figure was only US$ 750.

Source: Adapted from B. Popkin, Bellagio, Italy, 2001.
Changes in Calories per Day

Average daily calories per capita available from US food supply, adjusted for spoilage and other waste

1970
- Meat, Egg, Nuts: 463
- Grains: 432
- Dairy: 267
- Added Fat: 410
- Added Sugar: 125
- Fruit: 70
Total: 2168

2008
- Meat, Egg, Nuts: 482
- Grains: 625
- Dairy: 257
- Added Fat: 641
- Added Sugar: 459
- Fruit: 86
Total: 2673

http://thesocietypages.org/graphicsociology/tag/food/
Prevalence of obesity*, ages 20+, age standardized
Both sexes, 2008

Prevalence of obesity (%)
- <10
- 10–19.9
- 20–29.9
- ≥30
- Data not available
- Not applicable

* BMI ≥30kg/m²

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization
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Women aged 20–49 in 57 low- to middle-income countries

Prevalence of underweight

Prevalence of overweight

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0025120
Undernutrition

• Hunger has 3 meanings:
  – strong desire or need for food
  – discomfort, weakness, or pain caused by a prolonged lack of food
  – strong desire or craving

• "We know that a peaceful world cannot long exist, one-third rich and two-thirds hungry." ~Jimmy Carter

• “If we can conquer space, we can conquer childhood hunger.” ~Buzz Aldrin
Undernutrition Defined

• **Poor health** resulting from depletion of nutrients due to inadequate nutrient intake over time

• Associated with poverty, alcoholism, & some types of eating disorders

• Measures include:
  - underweight for age
  - too short for age (stunted)
  - dangerously thin for height (wasted)
  - deficient in vitamins and minerals
The Nutritional State of The World

• Important progress in reducing malnutrition
  – Underweight
  – Micronutrient deficiency
• Remains deplorable
  – Nutritional problems remain fundamental cause of ill health, disability, and death for infants, children, and pregnant women
Fighting Hunger Worldwide

The cost of hunger to developing nations is an estimated US$450 billion per year.

It takes only 25 US cents for WFP to give a hungry schoolchild a cup of food with all the nutrition needed for the day.

The number of undernourished people worldwide is just under 1 billion – equivalent to the population of North America and Europe combined.

Hunger Map 2011

<table>
<thead>
<tr>
<th>Category</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>&lt;5%</td>
<td>5-9%</td>
<td>10-19%</td>
<td>20-34%</td>
<td>≥35%</td>
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<td>Description</td>
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<td>Very low</td>
<td>Moderately low</td>
<td>Moderately high</td>
<td>Very high</td>
<td>data</td>
</tr>
</tbody>
</table>

Source: The State of Food Insecurity in the World 2011, Food and Agriculture Organization of the United Nations. Please note that the SOFI 2011 data is in some cases based on 2009 so may not always reflect the present-day situation in individual countries.

© 2011 World Food Programme

The designations employed and the presentation of material in this map do not imply the expression of any opinion whatsoever on the part of the UN or its agencies concerning the legal status of any country, territory or area, or concerning the delimitation of its frontiers.

* The use of the term “Jersey” in the United Nations Secretariat is a courtesy to India and Pakistan is representative of the United Nations’ feeling for the purposes of the United Nations.

** A dispute exists between the governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).
Bolivian man

Pedro Quispe, 35, supports four children and his wife by working on a farm near Lake Titicaca in Bolivia. Some mornings he begins the day with a meal of boiled maize, some chuño (a preserved potato) and fried broad beans. Two or three times a week, his wife serves him wallaque, a soup made of carachi fish from the lake plus potato, onion, peppers (aji amarillo), koa (an aromatic herb), lard and salt.

Mr Quispe walks one hour to get to the fields. After working for several hours he has a snack of chuño eaten with sauce made of peppers (aji molido), onion and tomatoes.

On his return home in the evening his wife serves him soup made of rice, potato, onion, carrots, lard and salt. The soup is eaten with a paste called quispina made from a grain (Chenopodium quinoa) indigenous to the Andean Highlands. He enjoys a cold barley drink, called pito de cebada retostada, with water and sugar.

Mr Quispe needs a lot of energy to do agricultural work, walk long distances and do the heavy tasks that his wife cannot do in the home. It is estimated that a man in this mountainous region needs at least 2 800 kcal per day to maintain his level of activity and health. Yet Mr Quispe’s diet provides only 75 percent of the dietary energy he requires because he consumes too little fat and carbohydrate. Because his diet is poor, he also lacks calcium and vitamin C.
**Pakistani adolescent girl**

<table>
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<tr>
<th>Macronutrients in Tahira's diet, in kilocalories</th>
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<tbody>
<tr>
<td>Protein</td>
<td>Fat</td>
</tr>
<tr>
<td>Without egg [1 569 kilocalories]</td>
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<td>164</td>
<td>225</td>
</tr>
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</table>

| With egg [1 640 kilocalories]                  |  |
| 192      | 288       | 1160         |

| An adequate diet for Tahira [2 200 kilocalories]|  |
| 220      | 660       | 1320         |

| Micronutrients as percent of requirement |  |

<table>
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<td>Vitamin A</td>
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<td>Vitamin C</td>
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<tr>
<td>Calcium</td>
<td>15</td>
</tr>
<tr>
<td>Iron</td>
<td>35</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>With egg</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>60</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>25</td>
</tr>
<tr>
<td>Calcium</td>
<td>16</td>
</tr>
<tr>
<td>Iron</td>
<td>40</td>
</tr>
</tbody>
</table>

Tahira Khan is a newly married 15-year-old in an isolated hill community in Pakistan. In the morning she fetches water to boil for chai (tea), which she drinks with milk and sugar. She and her mother-in-law prepare the family breakfast; after the men leave for the fields Tahira eats her share, one paratha (a type of pancake) made of whole wheat flour and ghee (butter). Once or twice a week she also has an egg fried in ghee.

She and her mother-in-law spend most of the day on household chores. In the afternoon Tahira eats a chapati, a light white bread, with potato and eggplant flavoured with tomatoes, onions and red pepper, cooked in ghee. When the men return from the fields, Tahira serves their evening meal and then eats hers: another chapati and mixed vegetables cooked in ghee.

As the village is difficult to reach, the family depends on their gardens for most of their food, so the variety is limited. Tahira's diet contains nearly adequate levels of protein, but it is of low quality because it comes mostly from wheat. Pulses improve the quality of the protein but she does not get enough of them. Her diet is particularly deficient in fats and also lacks sufficient carbohydrates.

Her limited diet is a concern because she is still growing. In particular, she needs more calcium to nourish her future children and to be stored for her later years. If Tahira becomes pregnant, she and her infant will be at risk because of her diet. Poor nutritional status contributes to high levels of infant and maternal mortality in Pakistan.
Key Nutrition Statistics

- 30% of children worldwide underweight or stunted
- 50% of young child deaths due to nutrition-related causes
Key Determinants

• Three underlying factors:
  – Household food security
  – Care for mothers & children
  – Health & environment

• Overall, nutrition is related to poverty
  – Basic determinants include political, economic & cultural structure

Must address these issues to solve hunger problem!
| Goal 1—Eradiate Poverty and Hunger | Link—Poor nutritional status is both a cause and a consequence of poverty. Improving income and nutritional status will improve health status. |
| Goal 2—Achieve Universal Primary Education | Link—Children who are properly nourished enroll in school at higher rates than undernourished children, attend school for more years, and perform better while they are there than undernourished children. |
| Goal 3—Promote Gender Equality and Empower Women | Link—Women suffer very high rates of some nutritional deficiencies, such as iron deficiency anemia, that constrain their health and their productivity. Improving the nutritional status of women will enhance their income earning potential and ability to be more productive in all of their work. |
Goal 4—Reduce Child Mortality
Link—About half of all child deaths worldwide are associated with malnutrition. It will not be possible to make major strides in reducing child mortality without significant improvements in the nutritional status of young children.

Goal 5—Improve Maternal Health
Link—Maternal health and pregnancy outcomes are intimately connected to the nutritional status of the pregnant women.

Goal 6—Combat HIV/AIDS, malaria, and other diseases
Link—Poor nutritional status makes people more susceptible to illness and to being sick for longer periods of time. Good nutrition is especially important for people suffering some health conditions, such as TB and HIV/AIDS. Supplementation with some micronutrients, even in the absence of anti-retroviral therapy, can lengthen the time that HIV positive people can go without progressing to full-blown AIDS.
Progress: Underweight Prevalence

Source: http://www.unmillenniumproject.org/documents/HTF-SumVers_FINAL.pdf
Proportion of children under age five who are underweight, 1990 and 2009 (Percentage)

- Southern Asia: 43% (2009), 52% (1990)
- Sub-Saharan Africa: 22% (2009), 27% (1990)
- South-Eastern Asia: 30% (2009), 18% (1990)
- Western Asia*: 11% (2009), 7% (1990)
- Eastern Asia: 15% (2009), 6% (1990)
- Northern Africa: 10% (2009), 6% (1990)
- Caucasus & Central Asia: 7% (2009), 5% (1990)
- Latin America & the Caribbean: 10% (2009), 4% (1990)
- Developing regions: 30% (2009), 23% (1990)

http://mdgs.un.org/unsd/mdg/Resources/Static/Products/Progress2011/11-31339%20(E)%20MDG%20Report%202011_Book_LR.pdf
High Risk Hunger Groups

• **Rural poor**
  - majority live in poor, rural communities in developing countries
  - often produce food, cultivate crops on small plots of land, fish or raise animals
  - may not own land and work as hired hands, often work is seasonal & must move during the year

• **Urban poor**
  - produce little or no food, do not make enough money to purchase food
  - cities expected to double in size in next 20 years—access to affordable food will be a large challenge

• **Victims of catastrophes**
  - families forced to abandon homes and farms from natural disasters and armed conflicts
  - face threat of hunger and starvation
Fome Zero in Brazil

Key elements of Brazil’s Fome Zero (Zero Hunger) Project

- Income improvement
  - Income and employment generation policies
  - Agrarian reform

- Access to affordable food
  - People’s restaurants
  - Expanded workers’ meal programmes
  - Agreements with supermarkets and farmers’ markets

- Increase basic food supply
  - Support for family farms
  - Incentives for production for family consumption
  - Investments in rural infrastructure

- Emergency actions
  - Cash for food purchases
  - Free food in schools
    - Food banks
    - Food security stocks

Source: Projeto Fome Zero
### TABLE 8-1 Selected Links Between Nutrition and the Health of Mothers and Children

Good maternal nutrition is essential for good outcomes of pregnancy for the mother.

Exclusive breastfeeding for 6 months promotes better health for infants than mixing breastfeeding with other foods during that period.

Nutritional deficits in fetuses and in children under 2 years of age may produce growth and development deficits in infants and young children that can never be overcome.

About half of all deaths in children under five years worldwide are associated with nutritional deficits.

Underweight and micronutrient deficiencies in children make those children more susceptible to illness, cause illnesses to last longer, and can lead to deaths from diarrhea, pneumonia, and malaria that might have been preventable.
Breast Milk Nutrition

- Breast milk provides **optimal nutrition** for a growing infant
  - Contains adequate minerals and nutrients, immune components, cellular elements and other host-defense factors that provide various antibacterial, antiviral and antiparasitic protection
- WHO recommends **exclusive breastfeeding** during 0-6 months
  - Continue to receive breast milk 7-12 months & during year 2
- Non-breast fed babies have **increased risk** of morbidity & mortality (diarrheal diseases & acute respiratory infections)
- In Brazil, infants <12 months that only had powdered or cow’s milk:
  - 14x more likely to die from diarrheal disease
  - 4x more likely to die from acute respiratory infection

Source: http://www.cdc.gov/breastfeeding/data/nis_data/  
2007 data most current/ Jan. 2011
Percent of Children Ever Breastfed

Global Trends in Breastfeeding

FIGURE 2

Benefits to Baby & Mom

• Breastfed children have 6x greater chance of survival in the early months than non-breastfed children
  – Reduces deaths from acute respiratory infection and diarrhea
• Especially important in developing countries with a high burden of disease and low access to clean water and sanitation
• Industrialized countries also at greater risk:
  – US had 25% increase in mortality among non-breastfed infants
  – UK found 6 months exclusive breast feeding linked to 53% decrease in hospital admissions for diarrhea and 27% decrease in respiratory tract infections
• Contributes to maternal health:
  – Reduces risk of post-partum hemorrhage
  – Delays return to fertility
  – Reduces type 2 diabetes and breast, uterine and ovarian cancer
Impact of hunger and malnutrition throughout the life cycle

OLDER PEOPLE malnourished
- Reduced capacity to care for child
- Inadequate food, health and care

WOMAN malnourished
- Inadequate foetal nutrition
- Higher maternal mortality

PREGNANCY low weight gain

BABY low birthweight
- Higher mortality rate
- Impaired mental development
- Increased risk of adult chronic disease
- Untimely/inadequate weaning
- Inadequate catch-up growth
- Frequent infection

CHILD stunted
- Reduced mental capacity
- Inadequate food, health and care

ADOLESCENT stunted
- Inadequate food, health and care
- Reduced physical capacity and fat-free mass

Source: Seres, ACC/SCN
<table>
<thead>
<tr>
<th>Key Nutritional Needs</th>
<th>Sources</th>
<th>Selected Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>Milk, eggs, chicken, and beans</td>
<td>Proper growth of children and immune functions</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>Liver, eggs, green leafy vegetables, orange and red fruits and vegetables</td>
<td>Proper immune function and prevention of xerophthalmia</td>
</tr>
<tr>
<td>Iodine</td>
<td>Selected seafoods and plants grown in iodine containing soil</td>
<td>Growth and neurological development</td>
</tr>
<tr>
<td>Iron</td>
<td>Fish, meat, poultry, grains, vegetables, and legumes</td>
<td>Prevent iron deficiency anemia, prevent low birthweight and premature babies</td>
</tr>
<tr>
<td>Zinc</td>
<td>Red and white meat and shellfish</td>
<td>Promote growth, immune function, and cognitive development</td>
</tr>
</tbody>
</table>
Protein-Energy Undernutrition

- **Most widespread** form of malnutrition
  - Prevalent in Africa, Central & South America, East
- Condition of infants and children
- Develops after children are weaned from the breast
- **Micronutrient deficiencies linked to its development**
- Puts children at risk for delayed growth
  - Insufficient height for age
  - Wasting (often because of recent acute malnutrition)
  - Increased risk of abdominal fat, cardiovascular disease
- Impaired psychological development
Marasmus

- Type of malnutrition resulting from chronic protein-energy undernutrition
- Characterized by **wasting** of muscle and other body tissue
- Physical term for starvation
Kwashiorkor

- Type of malnutrition that occurs primarily in young children who have an infectious disease
- Diets supply marginal amounts of energy and very little protein (mostly carbs)
- Common symptoms include poor growth, edema, apathy, weakness, and susceptibility to infections
- Diarrhea & anemia compound problem

Kwashiorkork: edema from hypoalbuminemia
Nutrition Programs

- Plumpy’nut
- High Energy Biscuits
- Baby scales
Vitamin A

- Vitamin A needed for
  - Vision (night, day, colour)
  - Epithelial cell integrity (against infections)
  - Immune response
  - Haemopoiesis
  - Skeletal growth
  - Fertility (male and female)
  - Embryogenesis

Keratomalacia, damage shows a softened hyperkeratotic epithelium and may thus become secondarily infected.
Vitamin A Deficiency

- More than **one million children** die as a result of VAD annually

- VAD prevalent among poor who depend mainly on rice as daily energy source (400 million)
  - Rice does not contain β-carotene (provitamin A)

- Most severely affects children and pregnant women
  - Compromises immune systems of 40% of children <5
  - Predisposes infants and children to diarrheal disease
  - Usually co-existing with PEU
  - 250,000 to 500,000 children to go blind every year
Vitamin A Supplementation

- % of children receiving at least one dose
- % of children receiving two doses (fully protected)

Year: 1999-2005

- 1999: 50%
- 2000: 56%
- 2001: 59%
- 2002: 58%
- 2003: 61%
- 2004: 68%
- 2005: 75%
Iodine

• Primary function in body is as a substrate for synthesis of the thyroid hormones
• Crucial for normal growth and development
• Iodine deficiency results when iodide intake < 20 µg/day
• Nearly 1.6 billion people, including 500 million children, live in areas at risk for Iodine Deficiency Disorders
• Leading cause of intellectual impairment, most preventable cause of mental retardation
Iodine Deficiency

• Goiter and endemic cretinism common in developing world
  – Prevalence of cretinism from 3-15% in severely affected rural populations
  – Squinting of eyes, deafness, and primitive brain reflexes

• Mild deficiency may reduce IQ by 10-15%
  – Supplements given to school-age children can improve performance on tests of intellectual functioning

• Mild deficiency may have increased rates of stillbirths, perinatal mortality, and infant mortality
Cretinism

• Caused by severe iodine deficiency

• Severe physical & mental retardation
  – A man and 3 females (age range 17-20 years old) with myxedematous cretinism
  – Republic of the Congo in Africa, a region with severe iodine deficiency

Source: Emedicine. Photo by F. DeLaire.
Iodine Deficiency Map

Degree of public health significance of iodine nutrition based on median urinary iodine: 1993-2006

Category of public health significance (based on median urinary iodine):
- Moderate iodine deficiency (20-49 µg/L)
- Mild iodine deficiency (50-99 µg/L)
- Optimal (100-199 µg/L)
- Risk of iodine induced hyperthyroidism (200-299 µg/L)
- Risk of adverse health consequences (>300 µg/L)

Salt Iodization

- **Iodizing table salt** is one of the best and least expensive methods of preventing IDD
- 5¢ a year and a teaspoon of iodine for a lifetime
- Over 70% of US households use iodized salt
- Trick is to provide universal salt iodization

<table>
<thead>
<tr>
<th>Country</th>
<th>Around 1995</th>
<th>Around 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>35%</td>
<td>72%</td>
</tr>
<tr>
<td>Congo, Dem. Rep.</td>
<td>12%</td>
<td>72%</td>
</tr>
<tr>
<td>Indonesia</td>
<td>50%</td>
<td>73%</td>
</tr>
<tr>
<td>Cambodia</td>
<td>7%</td>
<td>73%</td>
</tr>
<tr>
<td>Mali</td>
<td>1%</td>
<td>74%</td>
</tr>
<tr>
<td>Madagascar</td>
<td>1%</td>
<td>75%</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>27%</td>
<td>76%</td>
</tr>
<tr>
<td>Egypt</td>
<td>28%</td>
<td>78%</td>
</tr>
<tr>
<td>Syrian Arab Republic</td>
<td>36%</td>
<td>79%</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>31%</td>
<td>84%</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>19%</td>
<td>84%</td>
</tr>
<tr>
<td>China</td>
<td>51%</td>
<td>90%</td>
</tr>
<tr>
<td>Mexico</td>
<td>28%</td>
<td>91%</td>
</tr>
<tr>
<td>Georgia</td>
<td>8%</td>
<td>91%</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>20%</td>
<td>92%</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>33%</td>
<td>93%</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>7%</td>
<td>94%</td>
</tr>
<tr>
<td>Armenia</td>
<td>70%</td>
<td>97%</td>
</tr>
</tbody>
</table>
Salt Iodization Map


- 90 per cent or more
- 50–89 per cent
- Less than 50 per cent
- Data not available

Note: Adequately iodized salt contains 15 parts per million (ppm) or more of iodine.


Iron Deficiency

- Most common micronutrient disorder in the world
- Leads to **severe anemia**, diminished learning capacity, increased susceptibility to infections & risk of death in pregnancy/childbirth
  - Causes profound fatigue
  - Usually leads to shortage of vitamins B6, B12, and folate
Iron Supplementation

- Iron supplements to pregnant women, and to young children
- Fortification of wheat or maize flour
- Sprinkles
Zinc Deficiency

• 20% of world’s population affected
  – Range from 4 to 73% in some regions
• 800,000 deaths annually
• Associated with malaria (18%), lower respiratory tract infections (16%) and diarrhea (10%)
• Characterized by impaired immune function
  – Severe cases: short stature, hypogonadism, skin disorders, cognitive dysfunction, anorexia

2: Dietary sources of zinc

<table>
<thead>
<tr>
<th>Food</th>
<th>Amount</th>
<th>Zinc (mg)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oysters</td>
<td>6</td>
<td>19.3</td>
</tr>
<tr>
<td>Liver (cooked)</td>
<td>100 g</td>
<td>5.3</td>
</tr>
<tr>
<td>Lamb (lean, cooked)</td>
<td>100 g</td>
<td>4.8</td>
</tr>
<tr>
<td>Beef (lean)</td>
<td>100 g</td>
<td>3.9</td>
</tr>
<tr>
<td>Pork (lean)</td>
<td>100 g</td>
<td>3.1</td>
</tr>
<tr>
<td>Fortified breakfast cereal</td>
<td>45 g</td>
<td>1.8</td>
</tr>
<tr>
<td>Chicken (lean, cooked)</td>
<td>100 g</td>
<td>1.7</td>
</tr>
<tr>
<td>Baked beans</td>
<td>1 cup</td>
<td>1.4</td>
</tr>
<tr>
<td>Cheese (low fat)</td>
<td>30 g</td>
<td>1.2</td>
</tr>
<tr>
<td>Spinach (cooked)</td>
<td>1 cup</td>
<td>0.9</td>
</tr>
<tr>
<td>Broccoli</td>
<td>1 cup</td>
<td>0.7</td>
</tr>
<tr>
<td>Bread (wholemeal)</td>
<td>1 slice</td>
<td>0.4</td>
</tr>
<tr>
<td>Spinach (raw)</td>
<td>1 cup</td>
<td>0.2</td>
</tr>
</tbody>
</table>

* Recommended daily intake, 12 mg.
• Zinc deficient soil
  – Very important to people with limited protein in diet
  – Zinc fertilizer may be effective intervention

• Human risk of zinc deficiency

Intestinal Nematodes

• More than 500,000 species
• Some are free living
• Complete digestive system
• Egg, larvae (molts), adults
• Male & female adults
• Long-lived

Ascaris lumbricoides
Ascaris lumbricoides

- Large intestinal roundworm - up to 35 cm
- Estimated **1.4 billion infected** worldwide
- 4 million in United States (immigrants)
- ♀ produce 200,000 eggs daily - survive in soil more than 1 year
- Geophagia
Roundworm

- Asymptomatic with small numbers
- Fever, spicy foods might make worms exit body abruptly via nose, mouth, rectum
- Malabsorption of fat, protein, carbohydrates, and vitamins
- Results in growth retardation
Collection of roundworms from small village in India
Malnutrition and Infection

- Two causal pathways:
  1. infection leads to malnutrition
  2. malnutrition increases susceptibility to infections

Difficult to resolve, pathways may occur concurrently
Malnutrition continues to be a worldwide crisis
Major killer of children <5
Not only a health crisis, but continues cycle of poverty
“Steals child’s natural curiosity, dulls intellect, and leads to lifetime learning disabilities”
Interesting Stats

• Who is responsible for farming in Africa? Asia?
• 70% of the world’s hungry are _______ & _______.
• 1 out of 3 households, the _____ are the sole breadwinners.
• Food aid is far more likely to reach the mouths of needy children when distributed by?
• What is the most extreme form of poverty?
Practice Questions

• Identify 6 classes of nutrients. What is different about the new food pyramid?
• How do nutrition requirements change as we age?
• Define malnutrition. What is the nutrition transition?
• Name 3 diseases that are linked to overnutrition.
• What region has the most hunger? What are 3 key factors underlying child nutrition?
• What are the benefits of breastfeeding to baby, mom?
• Match key nutrients to their dietary source.
• Describe 3 nutrient deficiencies & what is being done to solve the problem.
• How does infection increase malnutrition (roundworm example)?
In Summary...

• Nutritional status is a major determinant of health status
• Important bearing on the health of pregnant women and of pregnancy outcomes
• Major determinant of birthweight of children, how children grow, and extent to which their cognitive functions develop properly
• Linked to the strength of one’s immune system and ability to stay healthy
• There are known cost-effective interventions to address key nutritional concerns
• Focus on breastfeeding, appropriate complementary foods, selective supplementation, fortification
• Focus on growth monitoring, behavior change, and community-based approaches