OUTLINE

• Definition of nutrition and foods
• Body composition and the functions of the various nutrients
• Protein: definition, structure, functions, food sources, quality
• Inadequate protein intakes: PEM, kwashiorkor & marasmus
• HIV/AIDS and protein
• Conclusion
DEFINITION OF NUTRITION

• Science of
  > foods
  > nutrients and other substances
  > functions and actions in the body

• Significant role throughout life
• Food choices

(ASSAf, 2007; Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
DEFINITION OF FOODS

• Animal or plant products
• Taken into the body
• Yield energy and nutrients
• Maintenance of life and
• Growth and repair of tissues

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
COMPOSITION OF FOODS

- Water
- Macronutrients = protein, carbohydrates and fats
- Micronutrients = vitamins and minerals
- Similar to the composition of the body

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
BODY COMPOSITION

- 60% water
- 13-21% fat (men) / 23-31% fat (women)
- the rest
  - COH
  - protein (50%)
  - Vitamins
  - minerals

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
FUNCTIONS OF NUTRIENTS

• Water provides
  ➢ environment in which all the body’s functions are conducted
  ➢ medium for transporting

• Macronutrients provide
  ➢ major materials for building the body’s tissues, and
  ➢ yield energy for the body’s use or storage

* Micronutrients
WHAT IS PROTEIN?

• A vital structural and working substance in all cells in the human body

• Without protein – bones, skin and hair would have no structure

• Help muscles contract, blood clot and eyes to see

• “Of prime importance” – Greek meaning

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
STRUCTURE OF PROTEIN

• Amino acids (20)
  = building blocks of proteins

• Essential (9)
  = body cannot synthesize
    must be provided by diet/foods

• Non-essential (11)
  = body can synthesize from essential amino acids

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
SYNTHESIS OF PROTEIN IN BODY

- Proteins
  - Dietary amino acids
    - Amino acid pool
      - Synthesis of protein
  - Metabolic amino acids
QUALITY OF DIETARY PROTEIN

Determined by the amino acid content:
Complete = contains all 9 essential amino acids
(Also termed: high biological value)

Phenylalanine
Histidine, Isoleucine,
Lysine, Leucine,
Methionine, Tryptophan,
Valine, Threonine

Versus
Incomplete = lacking in one or more essential amino acids

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
PROTEIN QUALITY

Complete Protein

Contains the essential amino acids in the right proportions to promote growth and maintenance of the body

- Animal sources are complete proteins
  - Eggs (gold standard)
  - Milk, cheese
  - Meat, fish poultry
  - Only plant food = soy beans

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
INCOMPLETE PROTEINS

• Foods that are missing or low in one or more of the essential amino acids.

• Plant sources are incomplete proteins
  Legumes: beans, peas, lentils
  Cereals: rice, wheat, oats

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
FUNCTIONS OF PROTEIN IN THE BODY

• Building materials for growth and maintenance of blood, muscle and skin
• Act as enzymes (facilitate chemical reactions)
• Part of hormones (regulate body processes)
• Regulators of fluid balance
• Transporters
• Antibodies (inactivate foreign invaders)
• Source of energy and glucose

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
PROTEIN REQUIREMENTS

• Dietary goal = 15-20% of total energy intake
• RDA = 0.8g protein/ kg body mass/ day (adult)
• RDA for protein on average:
  ➢ 0-6 months : 9.1g/d (Adequate intake)
  ➢ 7-12 months : 13.5 g/d
  ➢ Children 1-3y : 13 g/d
  ➢ Children 4-8y : 19 g/d
  ➢ Children 9-13y : 34 g/d
  ➢ Adult man : 56 g/d
  ➢ Adult woman : 46 g/d
  ➢ Pregnancy &
  ➢ Lactation : 71 g/d

(Institute of Medicine, 2003)
MAJOR FOOD SOURCES

• Meat, fish & eggs
• Dairy products
• Legumes, dried beans, dried peas, soy

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
HOW MUCH PROTEIN IN FOODS?

• Meat, chicken and fish = 7g/30 g (oz)
• Meat alternatives:
  ➢ 1 egg = 7g
  ➢ 2T peanut butter = 8 g
  ➢ ½ cup cooked legumes = 7-8 g

• Vegetables = 2 g / 1/2 cup (100 g) cooked

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
HOW MUCH PROTEIN IN FOODS?

• **Dairy products:**
  - 250 ml (cup) milk = 7 g
  - 30 g (oz) cheese = 8 g
  - 250 ml (cup) yoghurt = 12 g

• **Bread, cereals**
  - 2 g per
  - 30 g (oz) slice of bread
  - ½ cup (100 g) of cooked oats, maize porridge
  - ½ cup (100g) pasta, rice

(Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
HEALTH RISKS OF LOW PROTEIN INTAKES

• Problems in developing countries:
  Kwashiorkor: edema
  Marasmus: wasting

• Caused by a deficit in energy and protein or protein quality

(ASSAf, 2007; Mahan & Escott-Stump, 2004; Whitney & Rolfes, 2008)
PROTEIN DEFICIENCY DISEASES

Kwashiorkor
- A protein deficiency occurs even though energy intake is adequate.

Marasmus
- Protein deficiency resulting from low energy intake.
- The dietary protein used for energy.
CONSEQUENCES OF PEM

• Vomiting, diarrhea, susceptibility to infection
• Behavioral changes: irritability (kwashiorkor) or apathy (marasmus)
• Growth failure
• Anemia
• Edema
• Skin changes
• Hair changes
• Loss of appetite
Critical points for nutrition in the life-cycle

- Perinatal period
- Neonatal period
- Infancy
- Pre-school years
- Childhood
- Adolescence
- Reproductive period
- Pregnancy
- Early neonatal period
  - Birth
  - 7 days
  - 28 days
- Adulthood
  - 10 years
  - 20 years
  - 5 years
HIV/AIDS

- >60% of people living with HIV/AIDS (PLHA) in SSA
- Both malnutrition and HIV rates are rising
- Malnutrition = serious danger for PLHA
- Risk of malnutrition increases significantly during the course of infection
- Good nutrition cannot cure AIDS or prevent HIV infection, but can:
  > help to maintain and improve nutritional status
  > delay progression of HIV disease

(CNHHA, 2005; PIWOZ, 2005)
HIV/AIDS and NUTRITION

• Complex relationship
• HIV progressively damages the immune system
• Malnutrition may increase the susceptibility of infection
• Both scenarios lead to susceptibility to a range of opportunistic infections such as weight loss and wasting, fever and diarrhea

(CNHHA, 2005; PIWOZ, 2005)
WASTING AND WEIGHT LOSS

• Wasting = severe nutritional manifestation of HIV/AIDS

• Wasting and weight loss in PLHA develop as a result of three overlapping processes:
  - Reduced dietary/food intake
  - Impaired nutrient absorption
  - Changes in metabolism

(CNHHA, 2005; PIWOZ, 2005)
WEIGHT LOSS PATTERNS

• Two typical patterns in HLPA:
  ➢ Slow and progressive weight loss from anorexia and GIT disturbances
  ➢ Rapid, episodic weight loss from secondary infection

• As little as 5% weight loss = associated with decreased survival

(CNHHA, 2005; PIWOZ, 2005)
CAUSES OF DECREASED FOOD INTAKE

- Mouth and throat sores
- Fatigue, depression, changes in mental state
- Side effects from medication, including nausea, vomiting, metallic taste, anorexia, abdominal cramps, diarrhea
- Economic factors affecting household food security:
  - Availability of food
  - Nutritional quality of the diet

(CNHHA, 2005; PIWOZ, 2005)
POOR NUTRIENT ABSORPTION

• Malabsorption accompanies diarrhea HIV-infected individuals = increased intestinal permeability and defects
• HIV infection may cause epithelial damage
• Poor absorption of fats and COH common
• Poor fat absorption affects the absorption of fat-soluble vitamins (A,E,) further compromising immunity and nutritional status

(CNHHA, 2005; PIWOZ, 2005)
CHANGES IN METABOLISM

• Infection increases energy and protein requirements:
  ➢ 10-15% increase in energy needs
  ➢ 50% increase in protein requirements

• Infections lead to inefficient utilization and loss of nutrients

• Infection increases demand for antioxidant vitamins (E,C,A) and minerals (Zn,Se,Fe)

(CNHHA, 2005; PIWOZ, 2005)
CHANGES IN METABOLISM cont

- Insufficient anti-oxidants leads to oxidative stress:
  - Increased HIV replication
  - Higher viral loads

- Wasting due to cachexia, anorexia, fever & catabolism of muscle tissue – significant loss of muscle mass due to metabolic changes in the acute phase response to infection

(CNHHA, 2005; PIWOZ, 2005)
## Metabolic alterations that accompany acute infections

| Protein                   | Increased urinary nitrogen loss   
|                          | Increased protein turnover         
|                          | Decreased skeletal muscle protein synthesis 
|                          | Increased skeletal muscle breakdown 
|                          | Increased hepatic protein synthesis  
| Lipid (fat)               | Hypertriglyceridemia               
|                          | Increased hepatic de novo fatty acid synthesis  
|                          | Increased triglyceride esterification 
|                          | Increased very low-density lipoprotein production 
|                          | Decreased peripheral lipoprotein lipase activity 
|                          | Increased adipocyte triglyceride lipase 
| Carbohydrate              | Hyperglycemia                       
|                          | Insulin resistance                  
|                          | Increased peripheral glucose utilization  
|                          | Increased gluconeogenesis           

Source: Babameto and Kotler (1997)
The vicious cycle of malnutrition and HIV

- Insufficient dietary intake
  - Malabsorption, diarrhea
  - Altered metabolism and nutrient storage. HIV affects the production of hormones involved in the metabolism of CCH, protein and fat

- Nutritional deficiencies

- Increased oxidative stress
  - Immune suppression

- Increased HIV replication
  - Hastened disease progression
  - Increased morbidity

Source: Semba and Tang (1999)
MOTHER-TO-CHILD TRANSMISSION (MTCT) OF HIV

MTCT of HIV during pregnancy, at the time of childbirth, and through breastfeeding

Without interventions to prevent MTCT, about 25-40% of infants become infected
- 5-10% are infected during pregnancy
- 10-20% are infected during childbirth
- 10-20% are infected over 2 years of breastfeeding
- 600,000 infants infected per year worldwide
NUTRITION AND MTCT – POSSIBLE MECHANISMS

• Maternal malnutrition can lead to:
  – Impaired immune system
    • More severe and frequent secondary infections
    • Decreased CD4 cell counts
  – Increased viral load in blood, genital secretions, breast milk
    • Low serum retinol
    • Low serum selenium
  – Increased risk of low birth weight, pre-maturity
  – Low fetal nutrient stores
    • Weakened infant immune system
  – Impaired integrity of mucosal barrier
    • Genital mucosa, placenta
    • Infant gastrointestinal tract, impaired mucosal immunity
INFANT FEEDING

• Maternal CD4, blood and BM viral load are associated with increased risk of HIV transmission during BF
• The risk of HIV transmission during BF is constant over time
• Data from several studies report that education/counseling increases frequency and duration of EBF
TREATMENT GOALS for PLHA

- Improve or develop better eating habits and diet
- Build or replenish body stores of micronutrients
- Prevent or stabilize weight loss
- Preserve and/or gain muscle loss
- Prevent food-borne illness
- Prepare for and manage symptoms that affect food consumption and dietary intake
- Provide nutritious food for PHLA

(CNHHA, 2005; PIWOZ, 2005)
PROMOTE A HEALTHY DIET

• Asymptomatic PLHA – increased body metabolism
• Adequate in energy, protein, fat and essential nutrients
• 10-15% more energy/day
• 50-100% more protein/day

(CNHHA, 2005; PIWOZ, 2005)
HEALTHY DIET cont

• HIV-adults (men and women):
  ➢ Increase energy intakes with additional 300-400 kcal (1200-1600 kJ) pd
  ➢ Increase daily protein intake with additional 25-30 g
• Select foods rich in anti-oxidants and B-vitamins

CNHHA, 2005; PIWOZ, 2005)
HEALTHY DIET cont

• In summary, a healthy diet should contain a balance of:
  ➢ COH and fats to produce energy
  ➢ Proteins to build and repair tissue
  ➢ Vitamins and minerals to protect against opportunistic infections

CNHHA, 2005; PIWOZ, 2005)
CONCLUSION

• Protein important for:
  ➢ Health and wellbeing throughout life cycle
  ➢ Infections
• Include protein-rich foods in all meals
• Industry
YOU CAN ENHANCE YOUR CHANCES FOR A LONG AND HEALTHY LIFE BY CHANGING YOUR:

MOTHER  OR  FATHER  OR  Your diet, activity level and behaviour
REFERENCES

THANK YOU!

wilna@vut.ac.za
or
wilnaold@lantic.net