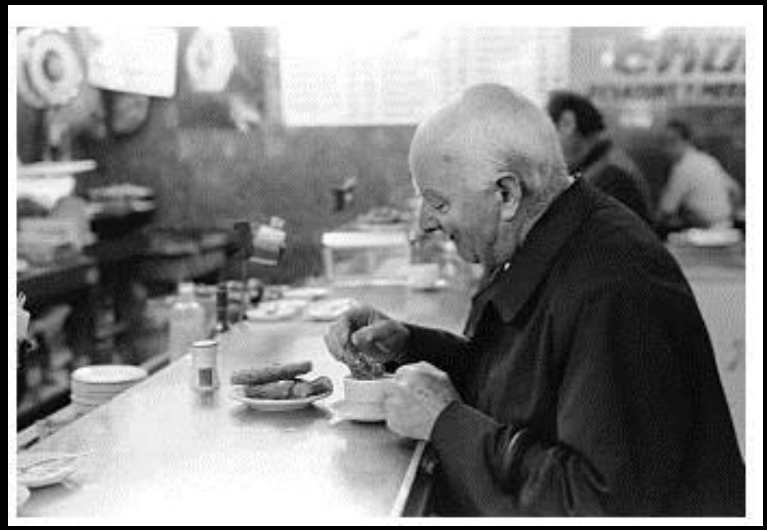
營養與老化 (00070115)
Nutrition and Aging
Nutrient Metabolism, Requirements, and Food Selection Patterns



http://www.diet.com/info/img/nwaz_01_img0015.jpg

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Learning Objectives

- Nutrient Metabolism
- Nutrient Requirements
- Food Selection Patterns
- Age and Food Intake

References

- Geriatric Nutrition: The Health Professional's Handbook (2006, 3rd ed) Chernoff, R, Jones and Bartlett Publishers, Inc.
- Nutrition in Aging (1997, 3rd ed) Schlenker, ED, McGraw-Hill Higher Education

Carbohydrate Metabolism

- normal metabolic function is maintained on a daily intake of 50~100 g carbohydrate
- carbohydrate-free diet

  stored triglycerides are broken down

  fatty acid oxidation

  produce ketone bodies

  a breakdown of body protein

  loses of potassium, sodium and fluid

Carbohydrate Metabolism

- very-low carbohydrate diet

  for weight loss

  substitute protein for carbohydrate

  inappropriate for older individuals

    excessive intake of protein

    ↑ N waste

    – Stress on renal system

http://www.biblelife.org/cholesterol-linch-big.jpg

Carbohydrate Metabolism

- foods high in dietary fiber are associated with appropriate serum lipoprotein patterns

  ↓ incidence of cardiovascular disease, DM, colon cancer

  fiber supplements are unnecessary

  contribute to bowel dysfunction and interfere with absorption of important minerals

http://www.sheerbalance.com/gfx/blog/fiber.jpg

Lipid Metabolism

- **essential fatty acids:**

  linoleic acid (18:2 ω-6 $\triangle^{9,12}$) $\rightarrow\rightarrow\rightarrow$ arachidonic acid (20:4 ω-6 $\triangle^{5,8,11,14}$)

  linoleic acid intake: 1~2% of total calorie intake

  prevent clinical or biochemical signs of def.

  1 T of vegetable oil: ~6 g linoleic acid

  the ratio of linoleic acid to ω-3 fatty acids: related to physiological functions (platelet aggregation, the development of CHD, inflammatory responses, the development of rheumatoid arthritis)

Lipid Metabolism

- linolenic acid (18:3 ω-3 $\triangle^{9,12,15}$) $\rightarrow\rightarrow\rightarrow$ EPA (20:5 ω-3 $\triangle^{5,8,11,14,17}$), DHA (22:6 ω-3 $\triangle^{4,7,10,13,16,19}$)
- ω-3 PUFA in the oil of fatty fish

  ↓ serum triglycerides and total cholesterol

  interfere with synthesis of lipoprotein (VLDL)
  effect on composition of LDL-cholesterol by changing cholesterol/protein ratio
- ↑ 1 mg/dL in HDL-cholesterol

  ↓ 2% in the risk of CHD in M

  ↓ 3% in the risk of CHD in F

Protein Metabolism

- lose body protein when ↑ age

  ↓ body potassium

  ↓ skeletal muscles

  25% bw – at birth

  45% bw – young adults

  27% bw – after 70 yr

  ↓ maximal oxygen consumption

- two possible hypotheses:

  ↓ the need for proteins and amino acids

  inadequate intake of proteins and amino acids

Protein Metabolism

- **3-methylhistidine: amino acid breakdown product of major muscle proteins**

  excretion in urine in proportion to total muscle protein turnover (TMPT)
- **labeled glycine → measure total body protein turnover (TBPT)**
- **TBPT – TMPT = nonmuscle protein turnover**
- **older people: ↑ TBPT**

  ↓ contribution of TMPT to TBPT

  due to less muscle mass

Protein Metabolism

- TMPT: 20% of TBPT in older M

  30% of TBPT in younger M
- older people: ↑ visceral organs to total protein metabolism
- liver, kidney, heart ↑ rate of protein metabolism
- glutamine: important in maintaining the cells of immune system

  inadequate protein intake → ↓ no. of T cells & neutrophils

Protein Metabolism

- aging process → ↓ sensitivity of skeletal muscles and adipose cells to the action of insulin and transport of glucose

  → glucose intolerance

- plasma amino acid levels and protein metabolism: sensitive to insulin action

  promote plasma amino acids, esp. BCAA, into skeletal muscles for protein synthesis

Protein Metabolism

- trp →→→ serotonin

  trp competes with BCAA, phe, tyr for transport across cell membrane into brain

  synthesis in platelet, intestinal mucosa, pineal body

  ↓ gastric secretion, ↑ vasoconstriction
- insulin ↓ plasma amino acid levels, ↑ uptake of trp, ↑ neurotransmitter synthesis

  older adults: ↓ the ratio of trp to competing amino acids (BCAA, phe, tyr) in plasma

  affect trp uptake and neurotransmitter production

Nutrient Requirements

- **physiological changes**

  ↓ hydrochloric acid secretion in the stomach

  ↑ pH

  overgrowth of bacteria in the small bowel

  affect bioavailability of certain vitamins (folate, vitamin B_{12}), certain minerals (iron, calcium, copper, and zinc), and protein

http://www.health-care-training-uk.co.uk/images/nutrition%20elderly.jpg

Nutrient Requirements

Dietary Reference Intakes (DRIs) by Department of Health, Taiwan, 2002

51~70 yr (*vs.* 31~50 yr)		71 yr + (*vs.* 31~50 yr)	
Males	**Females**	**Males**	**Females**
↓ Energy	~ no change	↓↓ energy	↓ energy
↓ protein	↓ protein	↑ protein	↑ protein
no change	↓ iron	no change	↓ iron
↑ vitamin D	↑ vitamin D	↑ vitamin D	↑ vitamin D
~ no change	no change	↓ vitamin B_1	↓ vitamin B_1
~ no change	~ no change	↓ vitamin B_2	↓ vitamin B_2
↑ vitamin B_6	↑ vitamin B_6	↑ vitamin B_6	↑ vitamin B_6
~ no change	no change	↓ niacin	↓ niacin

Energy

- **Baltimore Longitudinal Study of Aging:**

  energy need at 30 yr: 2700 kcal/d

  energy need at 80 yr: 2100 kcal/d
- **NHANES II:**

  24-34 yr consume 2700 kcal/d

  65-74 yr consume 1800 kcal/d
- **RDA for 51 yr+: 30 kcal/kg/d reduced from 36-37 kcal/kg/d for adults**
- **DRIs (Taiwan) for 71 yr+ : M 20.3 kcal/kg/d F 18.1 kcal/kg/d**

Protein

- ↓ protein requirement
  ↓ LBM and ↑ fat with age
  ↓ the rate of total body protein synthesis / bw
  ↓ serum albumin level
  ↓ daily albumin synthesis

http://www.health-care-training-uk.co.uk/images/nutrition%20elderly.jpg

Protein

- ↑ protein requirement
- keep the same requirement as adults (12~20% protein)

  ↓ efficiency of absorptive and metabolic process

  ↓ total food intake associated with ↓ physical activity

http://www.health-care-training-uk.co.uk/images/nutrition%20elderly.jpg

Protein

- chronic renal failure: restrict protein intake
- other chronic diseases, injury, and surgery: may need more protein
- DRIs (Taiwan) for 71 yr+: **1.0** g/kg *vs* adult **0.9** g/kg

http://www.health-care-training-uk.co.uk/images/nutrition%20elderly.jpg

Fat

- ↑ TC with age:
  ↑ LDL production
  ↓ fractional clearance of LDL
  ↓ LDL receptors activity
- if TC is 250 mg/dL → predict 60 yr will get atherosclerosis; if TC is 300 mg/dL → predict 50 yr will get atherosclerosis
- goal: maintain TC as low as realistics
  ↓ saturated fatty acids & cholesterol intake
  maintain desirable bw
  30% or less of energy as fat

Carbohydrate

- ↓ renal function
- ↑ bacterial enzyme activity in small bowel
- ↑ activity in colonic microflora in the presence of unabsorbed carbohydrate
- ↓ lactase activity

  glucose intolerance

  ⇒ dietary carbohydrate **55-60%** with a high proportion of complex over simple sugars
- adverse metabolic effects of sucrose ingestion on carbohydrate and lipid metabolism: hyperglycemia and hyperlipidemia

Calcium

- AI: 1000 mg
- related to osteoporosis
- ↓ intestinal calcium absorption in both sexes
- achlorhydria
- ↓ vitamin D intake and activation (↓ 1,25-dihydroxycholecalciferol)
- smoking, alcohol abuse, high sodium, protein, phosphorus and caffeine intake, steroid use
- ↑ calcium requirement

Calcium

- alcohol alters calcium and bone metabolism
- high sodium → induces hypercalciuria
  competing with calcium for renal tubular resorption
- high protein → ↑ urinary calcium
  ↓ renal tubular resorption of calcium
  2× protein intake → ↑ 50% urinary calcium
- high caffeine → ↑ urinary calcium

Phosphorus

- **AI: 800 mg**
- **high phosphorus Ca/P ≤ 1/3 → hypocalcemia, secondary hyperparathyroidism, osteoporosis**
- **parathyroid hormone and active vitamin D:**

  ↑ intestinal calcium absorption

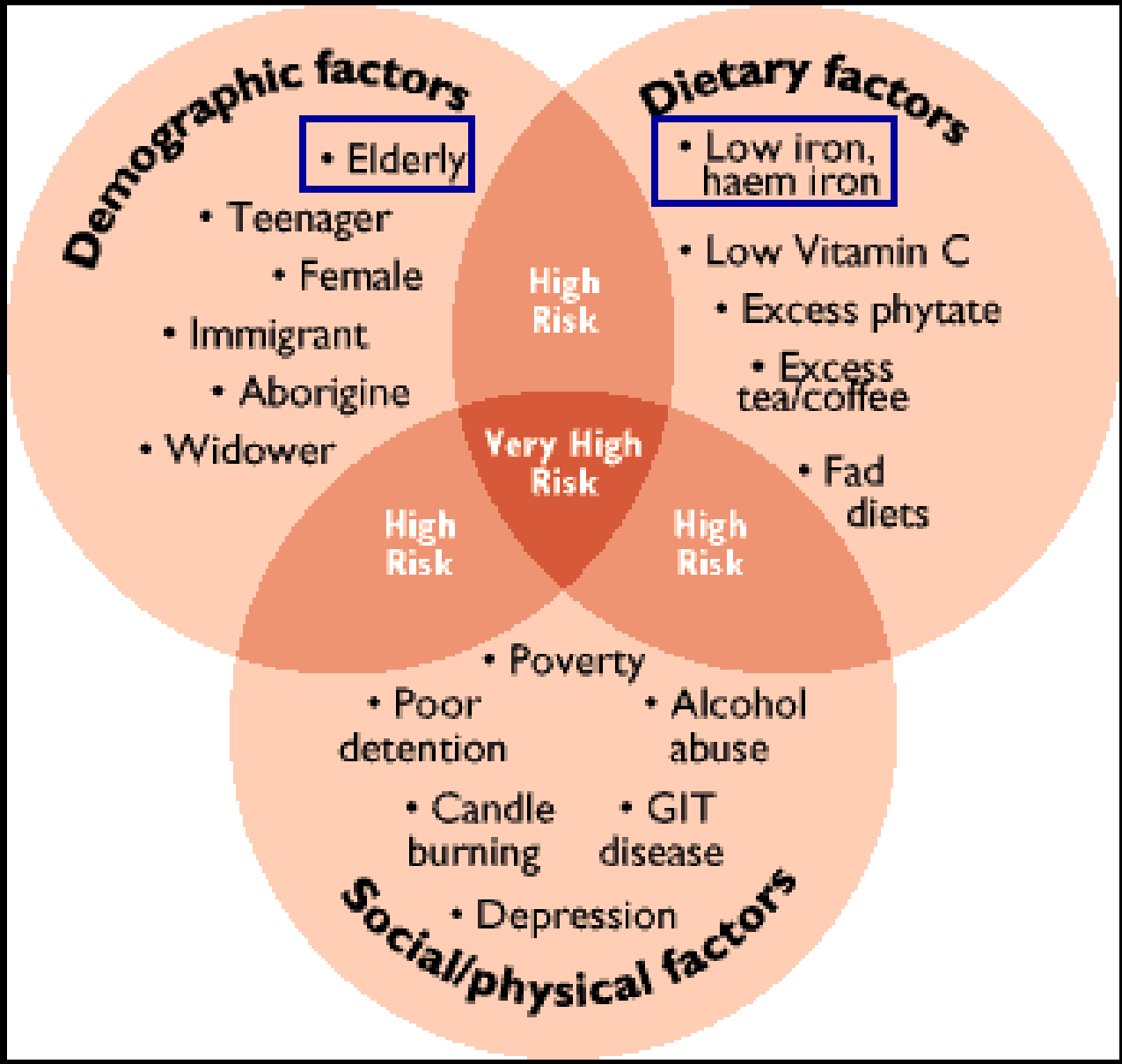
  ↑ bone and renal resorption

  ↑ serum calcium
- **hyperparathyroidism: stimulates the conversion of 25-(OH) vitamin D to 1,25-$(OH)_2$ vitamin D in kidney (stimulates 1α-hydroxylase activity)**

Iron

- **RDA: 10 mg**
- **inadequate iron intake**
- **blood loss due to chronic diseases**
- **↓ nonheme iron absorption**
  secondary to hypo- or achlorhydria
  ⇒ iron deficiency

http://www.thailabonline.com/blood/sec31a3.jpg



http://www.vanderbilt.edu/AnS/psychology/health_psychology/IronDeficiencyAnemia.htm

Vitamins

- vitamin A: RDA ♂ - 600 μg RE, ♀ - 500 μg RE

  higher serum retinyl ester levels in the elderly

  ↓ clearance (57 min *vs* 31 min) of lipid-rich lipoprotein carrying retinyl esters
- folate: RDA: 400 μg

  ↑ pH

  overgrowth of bacteria in the small bowel

  ⇒ folate malabsorption

Vitamins

- vitamin B_{12} RDA: 2.4 μg

  low intake

  impaired absorption (↓ intrinsic factor secretion)

  ↓ digestive release of vitamin B_{12} from food

  bacterial overgrowth in small bowel (competition with intestinal cells for vitamin B_{12})

  ↓ serum vitamin B_{12}
- vitamin D AI: 10 μg

  ↓ sunlight exposure

  impaired renal 1α-hydroxylase

Influences on Food Choices

- **psychological factors:**
  - **social activity**
  - **self-esteem**
  - **nutritional knowledge**
  - **bereavement**
  - **loneliness**
  - **symbolism of food**
  - **mental awareness**
  - **food aversion/faddism**

http://www.thailandparadise.com/thaifoodnew/thaifood2.jpg

Influences on Food Choices

- **physiological factors:**

  appetite

  taste acuity/olfactory acuity (anosmia)

  dental status

  prescribed diets

  chronic disease

  food intolerance

  health status

  physical status/physical exercise

  use of drug

http://hammockbridge.com/home/images/stories/fresh_fruit.jpg

Influences on Food Choices

- **socioeconomic factors:**
  - **age/sex**
  - **income**
  - **cooking facilities**
  - **daily schedule**
  - **retirement/leisure time**
  - **education**
  - **distance to food store**
  - **availability of transportation**
  - **availability of familiar foods**

http://2.bp.blogspot.com/_Ry9ok2KQbkU/S46fWMg5xhI/AAAAAAAAAMU/j7h0dDvuYOk/s320/retirement.jpg

Age and Food Intake

- **The National Food Consumption Survey (NFCS)**

  ♂ **peak calorie consumption: 20~29 yr**

  mean intake: 2,501 kcal

  mean intake by age 70: 1,875 kcal

  ♀ **peak calorie consumption: 20~29 yr**

  mean intake: 1,634 kcal

  mean intake by age 70: 1,386 kcal

Age and Food Intake

- 第三次國民營養健康狀況變遷調查 (82/7~85/6)

  ♂ peak calorie consumption: 25~34 yr

  mean intake: 2,412 kcal

  mean intake (55~64 yr): 2,075 kcal

  ♀ peak calorie consumption: 35~54 yr

  mean intake: 1,696 kcal

  mean intake (55~64 yr): 1,485kcal

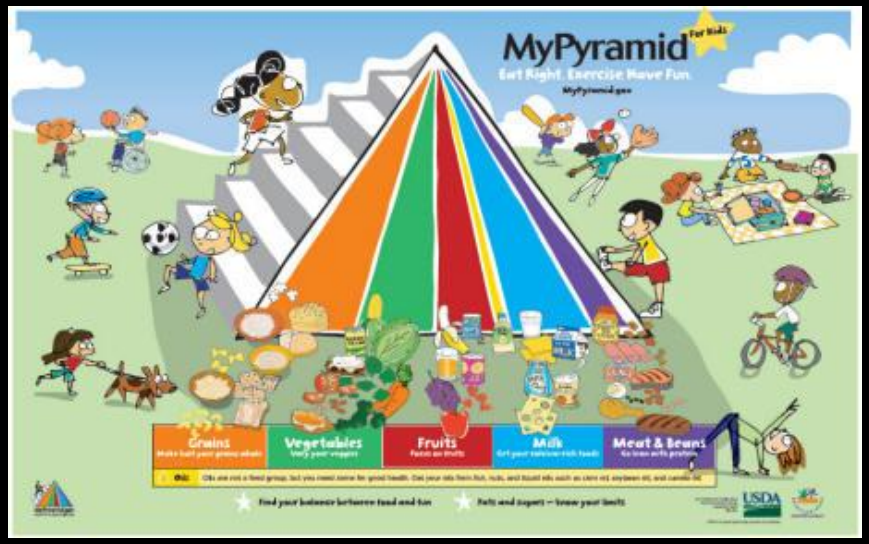
Age and Food Intake

- **Baltimore Longitudinal Study of Aging (BLSA) 1960~1987**

  ⇳ protein 15% ⇒ 16% total energy (stable)

  fat 42% ⇒ 34% total energy (⇓)

  carbohydrate 39% ⇒ 44% total energy (⇑)



http://betterkidcare.psu.edu/angelunits/onehour/eating/ChildFoodPyramidSm.gif

Age and Food Intake

- 第三次國民營養健康狀況變遷調查 (82/7~85/6)

  ♂ protein (25~34 yr) 15.0% ⇒ 14.7% (55~64 yr) (stable)

  fat (25~34 yr) 37.3% ⇒ 35.0% (55~64 yr) (⇓)

  CHO (25~34 yr) 47.7% ⇒ 50.3% (55~64 yr) (⇑)

  ♀ protein (25~34 yr) 16.1% ⇒ 15.3% (55~64 yr) (stable)

  fat (25~34 yr) 34.0% ⇒ 29.2% (55~64 yr) (⇓)

  CHO (25~34 yr) 49.8% ⇒ 55.5% (55~64 yr) (⇑)

Patterns of Food Intake

- ⇓ milk (important for Ca, protein, vitamin A, D, and B_2)
- 60~70 yr young seniors: consume more high fiber food and more fresh vegetables
- 75~85 yr older seniors: consume more high fat food
- vegetarians: higher intakes of vitamin A, Ca, Mg, P, carbohydrate (*vs* non-vegetarians)

  lower intakes of fat and vitamin B_{12}

滷味看性格

嘉南藥理科技大學食品科學系 05/08/08

- 從你最愛吃的滷味種類中，挑出前五名
- 第一喜歡的，就是最近的十年，然後以此類推
- 滷蛋：穩中求勝型、穩紮穩打型
- 軟米血：享受生活型、個性不耐單調 、不安於室
- 甜不辣：保守安逸型
- 豆干：量力而為型 、典型內勤
- 海帶：忠誠負責型、個性循規蹈矩、有上司緣、成就非凡

http://popblog.tvbs.com.tw/blog/yummytvbs/file_db/20070713192502.JPG

Summary

- Nutrient Metabolism
- Nutrient Requirements
- Food Selection Patterns