Disorders of nutrition
Nutrition in dentistry

Nutrition

- Provision of energy to organism (in the form of chemical energy)
  - 1 kcal – 4,186 kJ

nutrient	kJ/g
proteins	17,2
lipids	38,9
saccharides	17,2

- Provision of organic and anorganic substancies for the body development

Basal metabolsm vs. metabolism during physical activity

- Basal metabolism – basal metabolic rate
  - energy expended daily at rest (transport mechanisms, biosynthesis, thermoregulation, functioning of the vital organs)
  - 5 900 – 8 400 kJ/day

organ	% of BMR
liver	26%
brain	18%
hearth	9%

- Meatbolism during physical activity

activity	kJ/h
watching TV	250
cleaning	1090
cleaning of the windows	1130
sex	1600
swimming	2800
running	3750

Optimal nutrition

- Optimal energy intake
- Optimal basic nutrients ratio – proteins, lipids (↑ PUFA, ↓ cholesterol), carbohydrates
- Optimal intake of fibre (25-35 g/day)
- Optimal intake of vitamins and minerals (3-5 portions of fruits a 3-5 portions of vegetable/day)
- Lower intake of salt (3 - 5g/day)

Necessary food components

- saccharides
- lipids
- proteins

- vitamins
- minerals - Na, K, Ca, Cl, Mg, P
- trace elements - Fe, Zn, Cr, Cu ...
- fibre
- water

Recomended energy intake

55 - 60 % - saccharides

max. 30 % - lipids

cca 10 % - saturated fatty acids

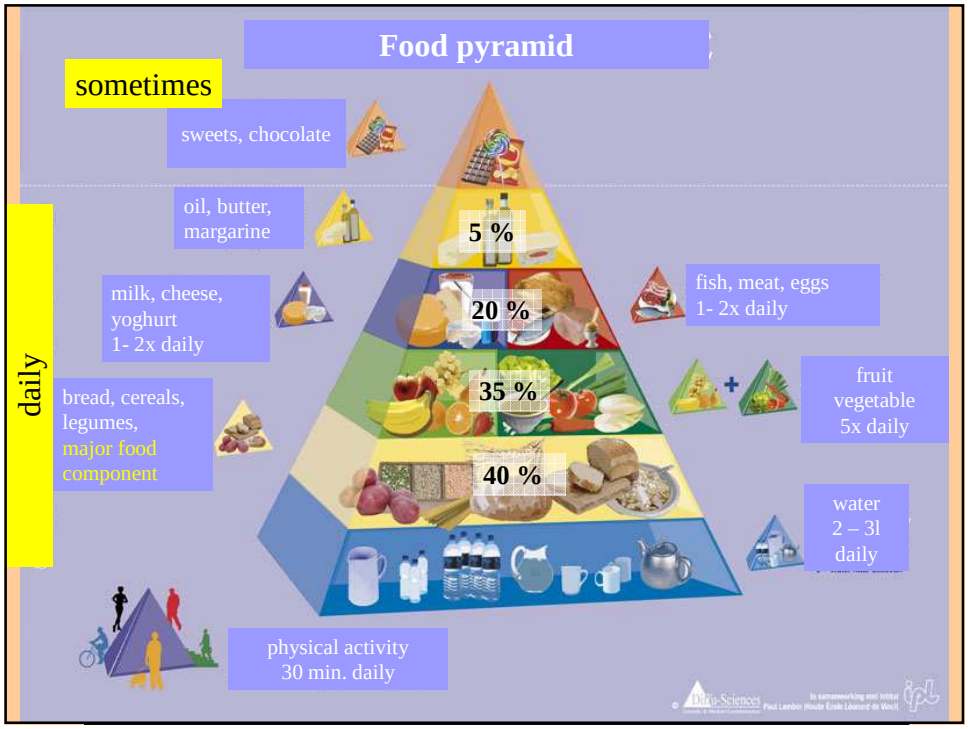
cca 10 % - monounsaturated fatty acids

cca 10 % - polyunsaturated fatty acids

(n-6 and n-3 polyunsaturated FA)

lower than 300 mg/day - cholesterol

10 – 15 % - proteins



Disorders of nutrition

Inadequate nutrition

- Undernutrition
  - quantitative - starvation
    - chronic undernutrition
  - qualitative - kwashiorkor
    - vitamin deficiency
    - trace elements deficiency
- Overnutrition
  - obesity (adiposity)
  - vitamin excess

Malnutrition

Causes

- exogenous
  - inadequate intake of nutrients (starvation, loss of appetite, mental anorexia)
- endogenous
  - disorders of digestion
  - disorders of absorption
  - disorders of metabolism
  - increased nutrient requirements (hyperthyroidism, gravidity, lactation, convalescence...)
  - loss of body fluids (bleeding)
  - loss of proteins (nephrotic syndrome)

Higher risk of malnutrition

- poor people
- sucklings and children
- adolescents in period of accelerated growing
- old people
- people on radical diet
- vegetarians
- alcoholics and people on drugs
- patients with AIDS
- patients with chronic GIT, liver, kidney diseases

Starvation

Metabolic changes during starvation

the body mobilizes reserves

- the stores of glycogen are converted to glucose (12 - 24 h)
- glucose is produced by gluconeogenetic pathway in liver
- ↓ concentration of glucose

↓

- ↓ concentration of insulinu, ↑ concentration of glucagon

↓

- ↑ lipolysis a β-oxidation of fatty acids

↓

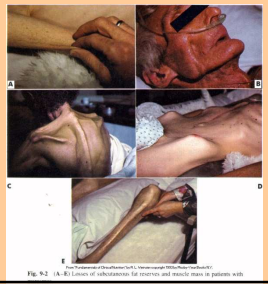
- hyperlipidaemia, ketoacidosis
- after using of fatty stores – catabolism of proteins

Protein Energy Malnutrition - PEM

Marazmus

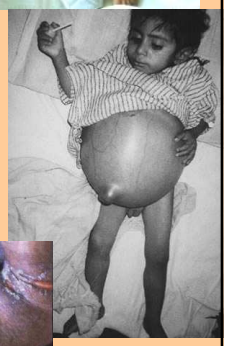
- inadequate intake of all nutrients
- cause: poorness, psychic disease, starvation...

- signs in children: weight loss, muscle atrophy, weakness, fatigue, decreased immune function, anaemia, delayed wound healing
- in adults: kachexia



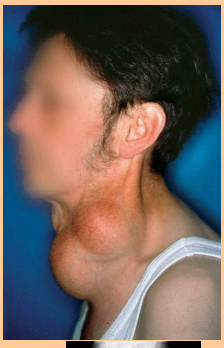
Kwashiorkor

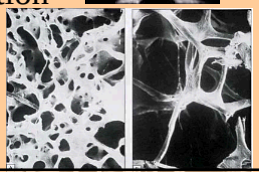
- protein malnutrition (can be adequate energy supply - saccharides)
- signs: oedema, growth retardation, weight loss, skin and hair depigmentation thin and sensitive skin, diarhea, anaemia, apatia, muscle atrophy, immunodeficiency
  low serum protein concentration



Specific (qualitative) malnutritions

- protein deficiency - kwashiorkor
- iodine deficiency – endemic goitre
- vitamin A deficiency – xerostomia, xeroftalmia
- Fe, folic acid, vit. B_{12} deficiency – anaemias
- vitamin D, Ca, Mg, P deficiency – osteopaties (rickets, osteomalacia, osteoporosis)
- tiamin deficiency - beri-beri
- riboflavin deficiency – oral cavity inflammation
- niacin deficiency - pelagra
- vitamin C - scurvy





Eating disorders

Mental anorexia

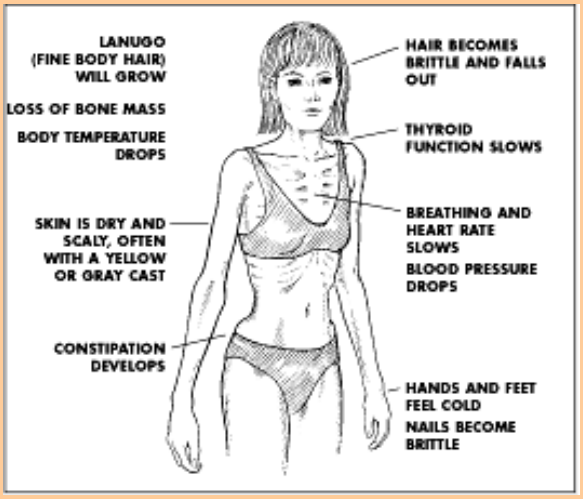
anorexia (gr.) - lack of desire to eat

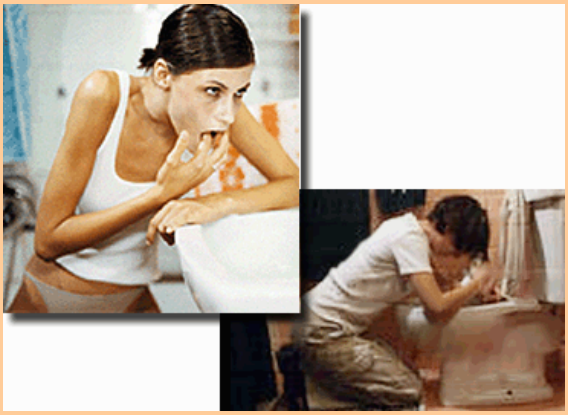
- anorexia nervosa - eating disorder characterized by extreme weight control

Diagnostic criteria

- obsessive fear of gaining weight, control body weight through voluntary starvation, excessive exercise, diet pills...
- pathological fear of being obese
- amenorrhoea in women

Symptoms





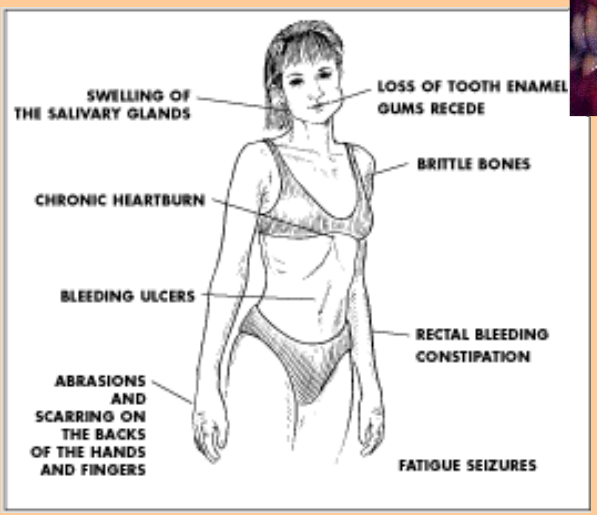
Mental bulimia

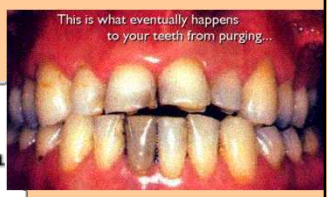
- mental bulimia – eating disorder characterized by repeated episodes of overeating followed by exaggerated weight control

Diagnostic criteria

- strong desire to eat (big amount and strange combination)
- to avoid being fat – vomiting, laxatives abuse, diuretics abuse, episodes of starvation,
- pathological fear to be obese

Symptoms



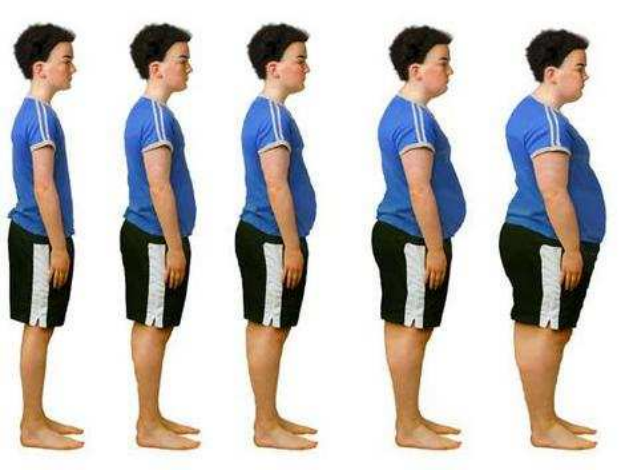


Other eating disorders

Binge eating, an eating disorder with episodes of uncontrollable eating. During these episodes, a person rapidly consumes an excessive amount of food. They try to hide this behaviour from others, and often feel ashamed about being fat or depressed about their overeating. Eating binges can be followed by so-called compensatory behaviour: purging, fasting and heavy exercising.

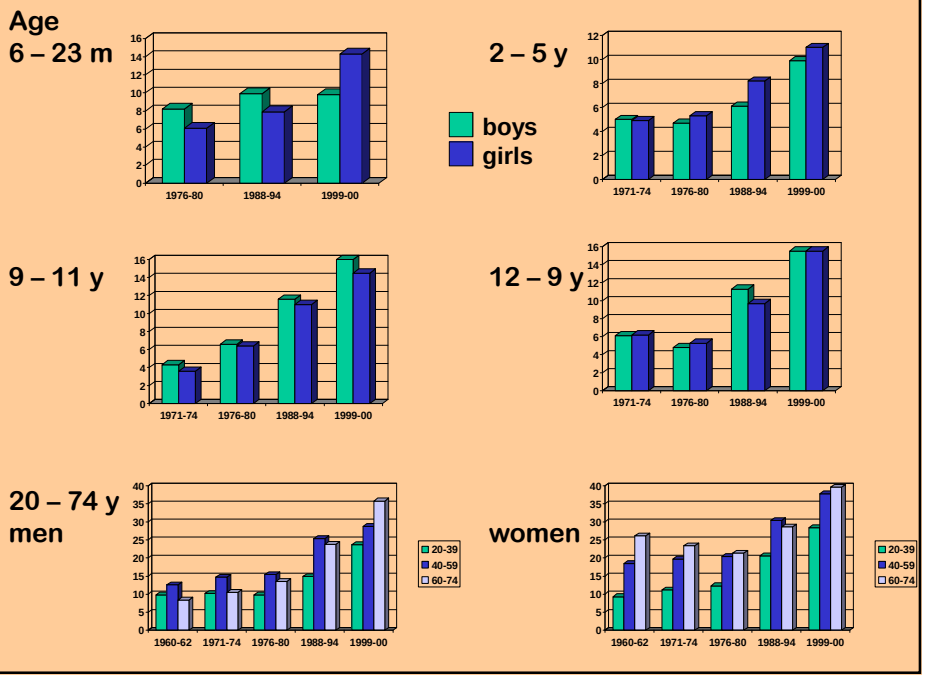
Night eating syndrome, an eanting disorder, parasomnia, characterized by a pattern of late-night binge eating.

Obesity



- Obesity (adiposis, fatness) – metabolic disorder, abnormal or excessive fat accumulation in organism

Prevalence of obesity



Definitions

- Obesity: adiposity – accumulation of fat tissue

- Overweight – weight increased above the normal values

(BMI increased – fat, but also muscles, water, baby...)

Etiology

- Disequilibrium between energy intake and expenditure
  - Diet
  - Sedentary lifestyle
  - Eating disorders –binge eating, night binge eating

- WHO – average energy intake
  - 1963 – 9660 kJ
  - 1971 – 10 250 kJ
  - 1992 – 11 420 kJ
  - 2010 – 12 200 kJ

Etiology

- Genetics
  - Genetic diseases - Prader-Willli sy.
  - The thrifty gene hypothesis - poor nutrition during early childhood → obesity (diabetes mellitus type 2 and metabolic syndrome).

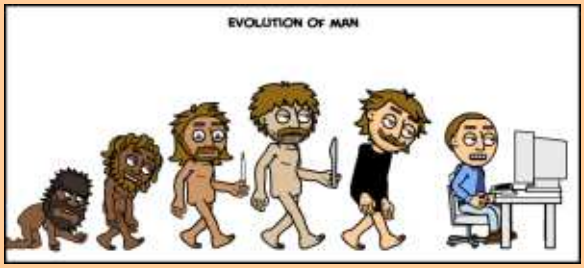
- Endocrine diaseases
  - rare
  - Cushing syndrome, hypothyreodism, hypogonadism, growth hormon deficiency, insulinoma

Etiology

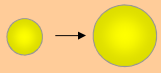
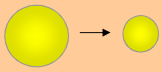
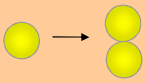
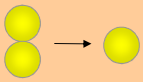
- Hypotalamic obesity
  - Stroke, tumor
  - Very rare in humans
- External factors
  - Medications – antidepressants, insulin, hormonal contraception
  - Decreased physical activity
  - Easy availability of food
  - social, economic, cultural, psychical factors

Thrifty gene hypothesis

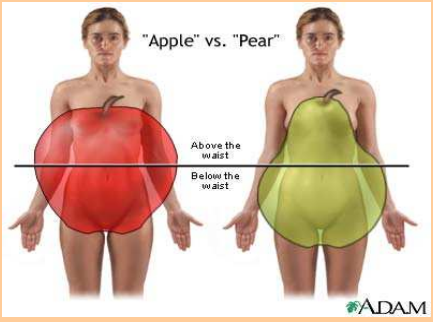
- The ***thrifty gene*** **hypothesis** states that connections between low quality fetal and infant growth followed by diabetes mellitus type 2 and metabolic syndrome caused by poor nutrition during early childhood, produces permanent effects in glucose-insulin metabolism. Genes which predispose to diabetes (called 'thrifty genes') were historically advantageous, but they became detrimental in the modern world. Thrifty genes are genes which enable individuals to efficiently collect and process food to deposit fat during periods of food abundance.



Growth of adipose tissue

- **hypertrophy**  **(**  **possible)**
- **hyperplasia**  **(**  **impossible)**

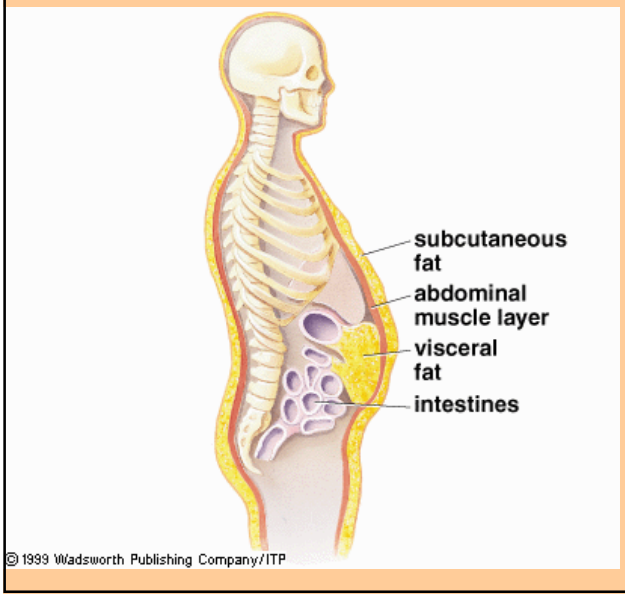
Types of obesity



- Abdominal obesity
- Belly fat, central obesity, android obesity, apple type, men type
- Visceral obesity

- Gynoid obesity
- Lower body obesity, gluteal-femoral obesity, pear type, female type

Types of fat localisation



- Subcutaneous fat
- Visceral fat

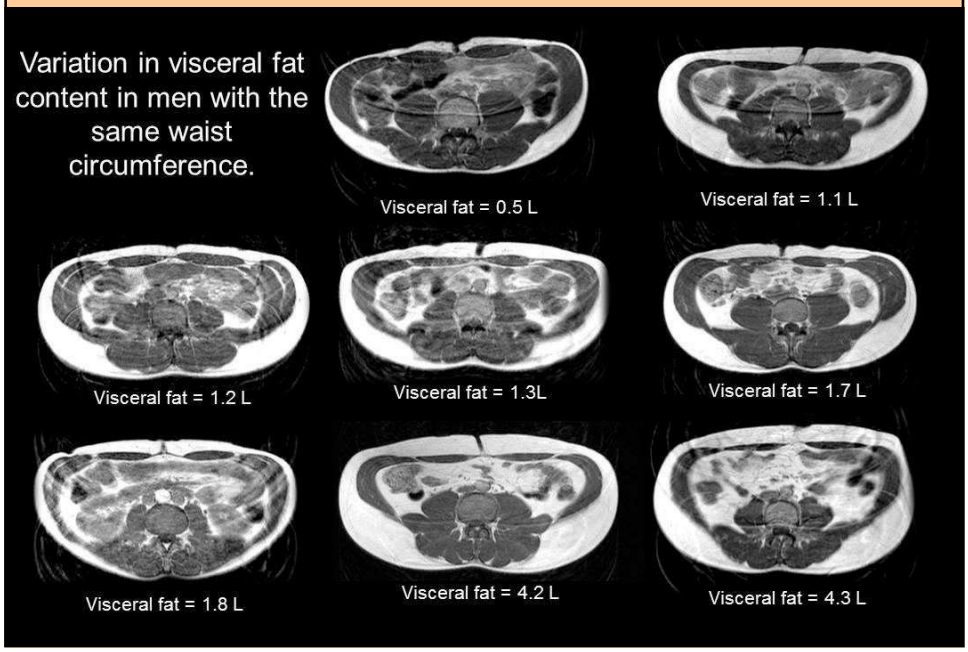
Visceral fat

- Intraabdominal adipose tissue

Amount of visceral fat and subcutaneous/visceral fat ratio depends on:

- Genetic predisposition
- Gender
  - Men in any age (testosteron)
  - Women after menopause
- Age
  - Older people
- Total amount of fat in organism
- Energy intake

Visceral fat



„Metabolic obesity“ Why is visceral fat risky?

- It has increased lipolytic activity – leads to hyperlipidemia
- Causes hyperinsulermia and insulin resistence
- Produces hormons

consequently

- Visceral fat is risk factor of:
  - Cardiovascular diseases
  - Diabetes mellitus type 2
  - Some cancers – cancer of endometrium, ovaries, prostata...

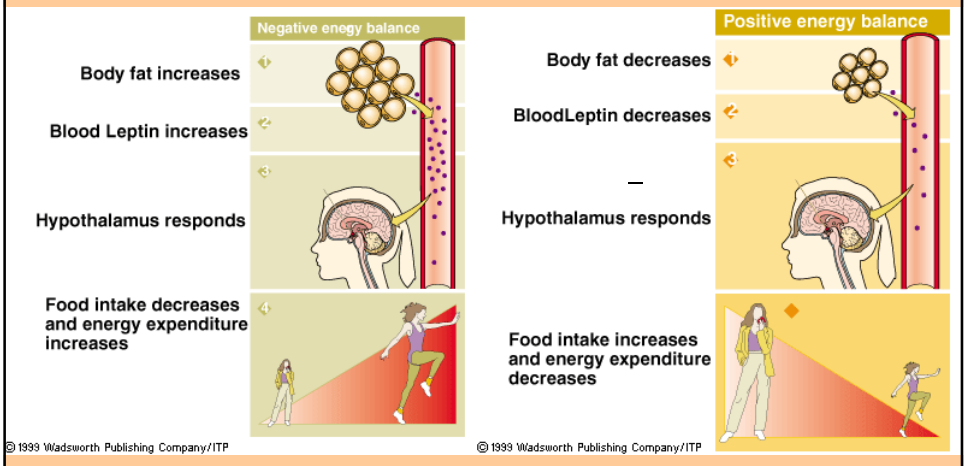
Hormons produced by adipose tissue

- Leptin
- Estrogens
- Angiotenzinogen – promotes the development of hypertension in obese people

  (produced mainly in liver)
- Adiponektin – regulates glycemia, and oxidation of fatty acids

- Other substances – TNF, IL-6...

Leptin



Metabolic syndrome

metabolic syndrome X, syndrome X, insulin resistance syndrome, Reaven's syndrome

Metabolic syndrome is a combination of medical disorders that increase the risk of developing cardiovascular disease and diabetes.
It affects one in five people, and prevalence increases with age.

Signs and symptoms

- Fasting hyperglycemia — diabetes mellitus type 2 or impaired fasting glucose, impaired glucose tolerance, or insulin resistance
- High blood pressure
- Central obesity
- Decreased HDL cholesterol
- Elevated triglycerides

Metabolic syndrome

New classification - Berlin 2005

At least three of the following signs:

- Abdominal obesity
  waist circumference
  men > 94 cm
  women > 80 cm
- Elevated triglycerides
  TAG > 1,7 mmol/l
- Reduced HDL-cholesterol
  men < 0,9 mmol/l
  women < 1,1 mmol/l
- Elevated blood pressure
  ≥ 130/85 mmHg
  or use of medication for hypertension
- Elevated fasting glucose
  ≥ 5,6 mmol/l
  or use of medication for diabetes

Classificiation of obesity

- Body mass index
  (BMI) = mass(kg)/(height (m)^2
- Brocc´s index (old)
  Normal weight = height in cm – 100
  Ideal weight = (height in cm – 100) – 10-15%
- Skin fold
  (biceps, triceps, subscapular, suprailiacal...)
  Fat: men 10 – 20% of body weight
  women 20 – 30% of body weight

Classification of obesity based on BMI

Classification	BMI (kg/m^2)	Risk of obesity
underweight	<19	low
normal	19-24,9	average
overweight	25-29,9	moderate increased
obesity *class I* *class II* *class III*	≥30,0 30,0-34,9 35-39,9 ≥40,0	 medium serious morbid

Measurement of skin fold

Classificiation of obesity

- **Waist to hip ratio** (WHR)

  WHR > 1,0 in men

  > 0,8 in women = abdominal obesity

- **Waist circumference**

  Men > 94 cm, women > 80 cm - increased risk

  Men > 102 cm, women > 88 cm - very increased risk

Assesment of subcutaneous fat

Complications of obesity

- Metabolic complications
  - Insulin resistance – hyperinsulinemia – DM type 2
  - dislipidemia
  - hyperuricemia...
- Endocrine disesases
  - hypogonadism
  - Hyposecretion of growth hormone...
- CVS diseases
  - hypertension
  - ICHS
  - arrhytmias
- Respiratory diseases
  - Pickwick syndrome
  - Sleep apnoea syndrome...
- GIT and liver
  - gastroezofageal reflux
  - cholelitiasis
  - pankreatitis
  - liver steatosis...
- Gynekologic complications
  - oligomenhorhea
  - complications during pregnancy...
- Onkologic complications
  - Kolorectal ca...
- Psychosocial complicaytions
  - social discrimination
  - depression
  - eating disorders
- Other

Nutrition in dentistry

Eating disorders

- Erosion and damage of enamel – caused by vomiting
- Xerostomia – dryness of oral mucous– vomiting, starvation, undernutrition, dehydratation
- Caries – mainly teeth with damaged enamel (vomiting)
- Gingivitis – caused by dryness of mucous and undernutrition
- Swollen parotid salivary glands – bilateral painless swelling of parotid salivary glands caused by frequent vomiting
- Degenerative arthritis of temporomandibular joint – vomiting, undernutrition
- Bleeding in oral cavity –vit. C karency

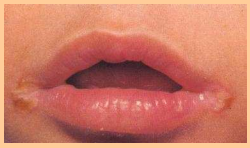
Vitamins

Vitamin	Chemical name	Solub.	Deficiency disease	Overdose disease	Food sources
Vitamin A	Retinol, retinal, + carotenoids including beta carotene	Fat	Night-blindness Hyperkeratosis Keratomalacia	Abnormal softening of the skull bone Drowsiness Liver damage Skin and hair changes Vision changes ...	Liver, orange, ripe yellow fruits, leafy vegetables, carrots, pumpkin, squash, spinach, fish, soy milk, milk
Vitamin B_1	Thiamine	Water	Beriberi Wernicke-Korsakoff syndrome		Pork, oatmeal, brown rice, vegetables, potatoes, liver, eggs
Vitamin B_2	Riboflavin	Water	Ariboflavinosis Glossitis Angular stomatitis		Dairy products, bananas, popcorn, green beans, asparagus
Vitamin B_3	Niacin, niacinamide	Water	Pellagra		Meat, fish, eggs, many vegetables, mushrooms, tree nuts
Vitamin B_5	Pantothenic acid	Water	Paresthesia		Meat, broccoli, avocados
Vitamin B_6	Pyridoxine, pyridoxamine, pyridoxal	Water	Anemia Peripheral neuropathy		Meat, vegetables, tree nuts, bananas

Vitamin	Chemical name	Solub.	Deficiency disease	Overdose disease	Food sources
Vitamin B_7	Biotin	Water	Dermatitis enteritis		Raw egg yolk, liver, peanuts, leafy green vegetables
Vitamin B_9	Folic acid folinic acid	Water	Megaloblastic anemia Birth defects	.	Leafy vegetables, pasta, bread, cereal, liver
Vitamin B_{12}	Cyanocobalamin hydroxycobalamin methylcobalamin	Water	Megaloblastic anemia	Acne-like rash	Meat and other animal products
Vitamin C	Ascorbic acid	Water	Scurvy	Kidney stones	Many fruits and vegetables, liver
Vitamin D	Cholecalciferol (D3) Ergocalciferol (D2)	Fat	Rickets Osteomalacia	Irritability Constipation Muscle weakness Metastatic calcification of the soft tissues	Fish, eggs, liver, mushrooms
Vitamin E	Tocopherols tocotrienols	Fat	Sterility Abortions Mild hemolytic anemia in newborn infants	Increased congestive heart failure seen in one large randomized study	Many fruits and vegetables, nuts and seeds
Vitamin K	Phylloquinone menaquinones	Fat	Bleeding diathesis		Leafy green vegetables such as spinach, egg yolks, liver

Vitamins B deficencies

angular cheilosis



atrophy of filliform papilae

glositis

mucositis

glossodynia

candidiasis

inflamed gingiva

halitosis

xerostomia

aphtous ulcers

Vitamin C

Oral signs and symptoms

- Deficiency: Scurvy – red swollen gingiva, gingival friability, periodontal destruction, increased tooth mobility and exfoliation, sore burning mouth, soft tissue ulceration, increased risk of candidiasis, malformed teeth (inadequate dentine)

Other symptoms

- Deficiency: fragility of vessel wall, impaired development of bones

Vitamin A

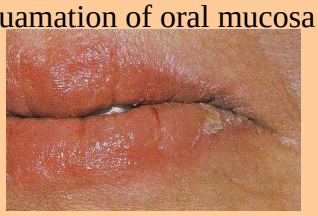
Oral signs and symptoms

- Deficiency: impaired tissue healing and regeneration, desquamation of oral mucosa, keratosis, increases risk of candidiasis, gingival hypertrophy and inflammation, leukoplakia, decreased taste sensitivity, xerostomia, disturbed enamel development, increased caries risk
- Excess: impaired wound healing

Other symptoms

- Deficiency: night blindness, xerophtalmia, mucosa dryness
- Excess: hepatosplenomegalia, anaemia, hair loss

desquamation of oral mucosa



keratosis

gingival hypertrophy and inflammation

leukoplakia

xerostomia

disturbed enamel development

caries

Vitamin D

Oral signs and symptoms

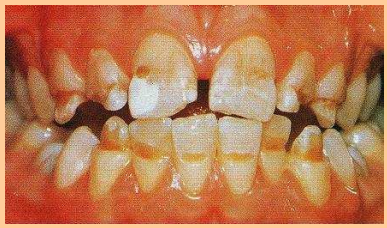
- Deficiency: osteoporosis, osteomalacia, rickets, incomplete mineralisation of teeth
- Excess: pulp calcification, enamel hypoplasia

Other symptoms

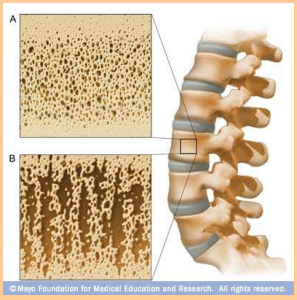
- Deficiency: osteoporosis, osteomalacia, rickets
- Excess: Ca mobilisation from bones, kidney stones

- pulp calcification

enamel hypoplasia



osteoporosis



rickets

Vitamin K

- Phylloquinone, menaquinones
- Function – blood clotting

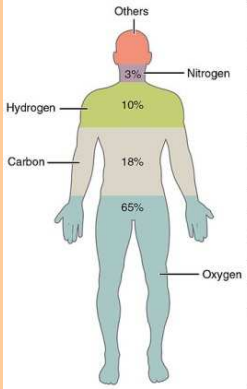
Oral signs and symptoms

- Deficiency: increased risk of bleeding

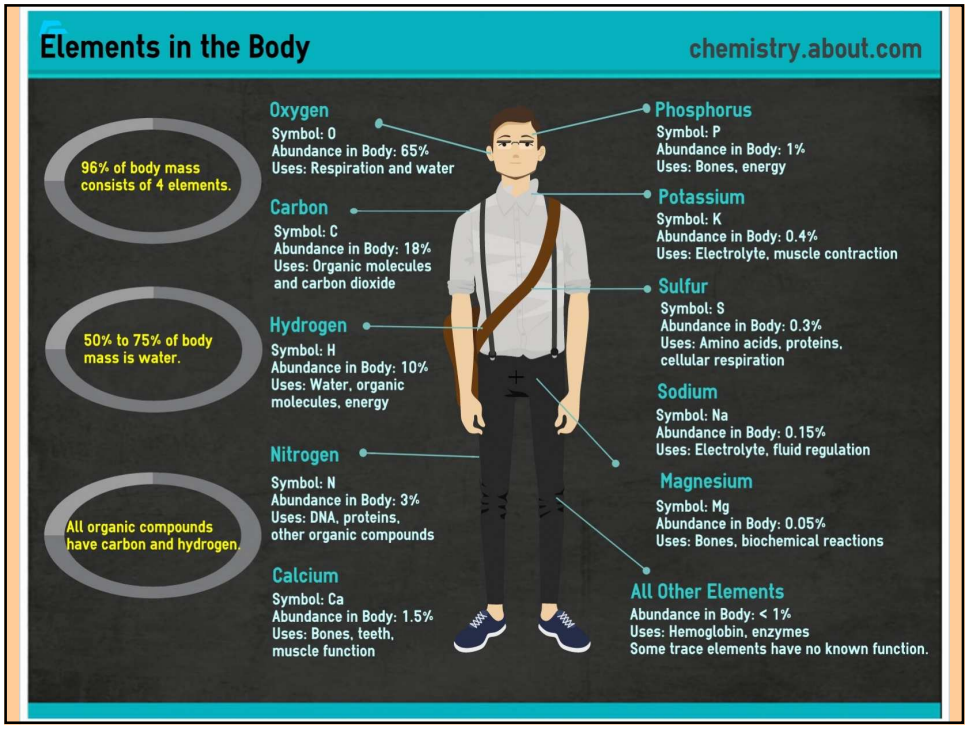
Minerals

Biogenic elements

Group		Elements
Basic elements		C, O, H, N, P, S
Electrolytes		Na, K, Ca, Mg, Cl
Trace elements	Metals	Fe, Cu, Zn, Sn, V, Cr, Mo, Mn, Co, Ni
	Nonmetals	I, F, S, Se, Si



Element	Symbol	Percentage in Body
Oxygen	O	65.0
Carbon	C	18.5
Hydrogen	H	9.5
Nitrogen	N	3.2
Calcium	Ca	1.5
Phosphorus	P	1.0
Potassium	K	0.4
Sulfur	S	0.3
Sodium	Na	0.2
Chlorine	Cl	0.2
Magnesium	Mg	0.1
Trace elements include boron (B), chromium (Cr), cobalt (Co), copper (Cu), fluorine (F), iodine (I), iron (Fe), manganese (Mn), molybdenum (Mo), selenium (Se), silicon (Si), tin (Sn), vanadium (V), and zinc (Zn).		less than 1.0



Iron

- Amount in human organism – 4 - 5g
- Daily intake – 10 – 15 mg
- Daily loss – 1 – 2 mg
- Heme complexes – hemoglobin, myoglobin, catalase, cytochromes
- Transport – transferrin
- Storage - ferritin
- Food sources: red meat, lentils, beans, poultry, fish, leaf vegetables, tofu...

Iron

Oral signs and symptoms

- Deficiency: angular cheilosis, pallor of lips and oral mucosa, sore, burning tongue, glossitis

Other symptoms

- Deficiency: microcytic anaemia
- Excess: hemochromatosis

Calcium

- The most abundant mineral in the human body
- In the adult body - approximately 1 kg, 99% in the skeleton in the form of calcium phosphate salts.
- Plasma concentration – 2.5 mmol/l
- Functions:
  - bones, teeth structure
  - cellular signalization
  - coenzyme for clotting factors
  - activation of muscle contraction
- Food sources – milk, cheese, eggs, lentils, nuts...

Calcium

Oral signs and symptoms

- Deficiency: incomplete mineralisation of teeth, rickets, osteomalacia, osteoporosis, bone fragility, increased tooth mobility and premature loss

Other symptoms

- Deficiency: rickets, osteomalacia, osteoporosis

Zinc

- Function
  - ≈ 300 enzymes
  - structural ion in transcription factors (Zinc fingers)
  - maturation of leucocytes
  - important for taste and olfactory receptors
  - important for insulin crystals structure
- Food sources - meat

Zinc

Oral signs and symptoms

- Deficiency: loss of taste and tongue sensation, delayed wound healing, increased susceptibility to periodontal disease, candidiasis, xerostomia, caries

Other symptoms

- Deficiency: impaired immune function

Fluoride

Source

- water fluoridation, products for oral hygiene

Oral signs and symptoms

- Deficiency: decreased resistance to caries
- Excess: enamel hypoplasia (fluorosis)

Magnesium

Oral signs and symptoms

- Deficiency: alveolar bone fragility, gingival hypertrophy

Phosphorus

Oral signs and symptoms

- Deficiency: incomplete mineralisation of teeth, increased susceptibility to caries if deficient during tooth formation, increased susceptibility to periodontal disease

Other nutrients

Carbohydrate

Oral signs and symptoms

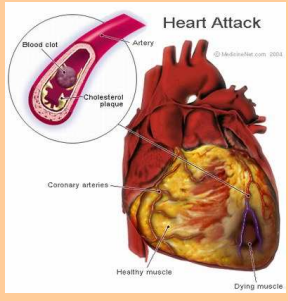
- Deficiency: decreased risk of caries
- Excess (except fibre): caries

Fats

Oral signs and symptoms

- Deficiency: angular cheilosis, pallor of lips and oral mucosa, sore burning tongue, atrophy of filliform papillae, increased risk of candidiasis, glossitis
- Excess: no effect

but



Proteins

Oral signs and symptoms

- Deficiency: defect of tooth composition, eruption pattern, resistance to decay, increased susceptibility to soft tissue infraction, poor tissue healing and regeneration
- Excess: no effect

Water

Oral signs and symptoms

- Deficiency: dehydratation and fragility of epitelial tissue, decreased muscle strength for chewing, xerostomia, burning tongue