

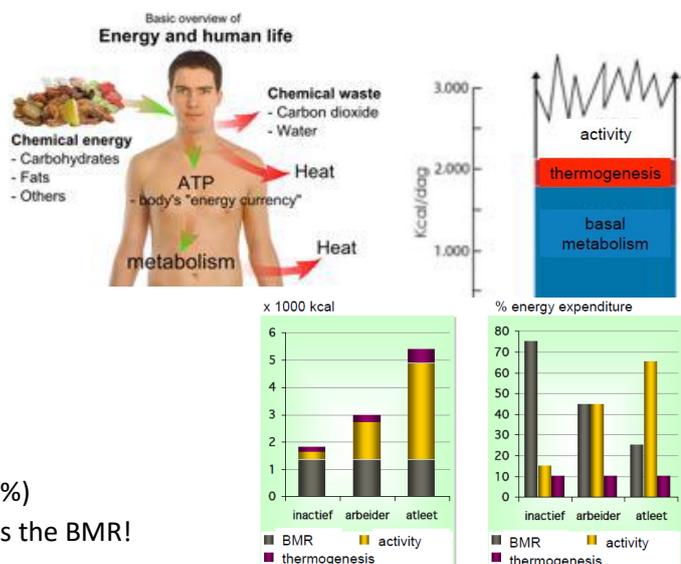
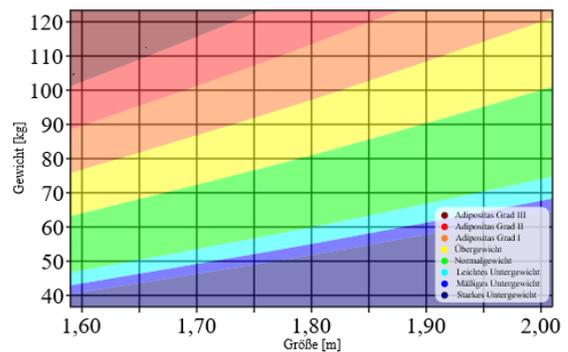
General Concepts of Nutrition

History

- Hippocrates (400AD): If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health.
- Pythagoras is said to have been the first to train athletes on a meat diet. The first athlete he did this with was Eurymenes. Formerly, [athletes] had trained on dried figs, moist cheese and wheat (→ protein as a major source of energy).
- Athletes have a diet containing a lot of proteins and additions, of which nobody knows if it is effective or not.

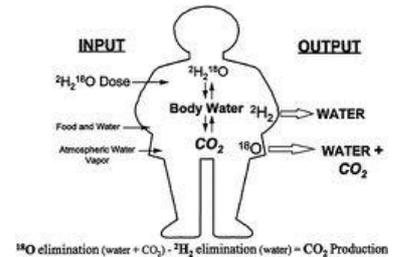
Definitions

- Obesity prevalence (obesity = $BMI \left(\frac{m}{l^2}\right)$ over 30)
- Obesity predisposes to many diseases
 - Type II diabetes -98%
 - Asthma -41%
 - Stroke -31%
 - Renal cancer -13%
- Intake of calories: 2000 /woman or 2500 /man
- So why are we getting obese? How to fight?
 - Weight watchers not prevent but declare what you eat
 - Atkins wants not to eat carbohydrates but meat
- Energy balance. Take first law of thermodynamics into account:
 $\Delta(\text{energy storage}) = \text{energy intake} - \text{energy expenditure}$
- diet induced thermogenesis can make up to 10%
- TEE (total energy expenditure) = BMR (basal metabolic rate; kcal/d) + AEE (activity induced energy expenditure) + DIT (diet induced thermogenesis; 10% BMR)
- Basal metabolic rate (BMR) is the minimum energy requirement needed to sustain life in a resting individual and is usually measured in kcal/day
- Factors that affect BMR
 - Body weight
 - Height
 - Gender (BMR man > BMR woman)
 - Age (BMR young > BMR old)
 - Body composition
 - Composition of LBM
 - Genes
 - Undernutrition (-20-50%)
 - Pregnancy (+ 20%)
 - Hormones (menstrual cycle)
 - Climate
 - Body temperature/disease (+13%)



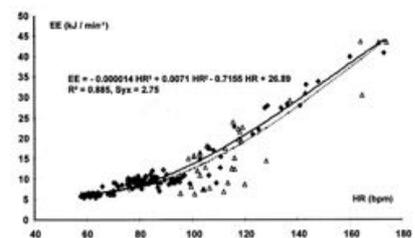
- The more muscles you have the higher is the BMR!
- BMR calculation for men:
 $BMR = 66.5 + (13.75 \times \text{weight [kg]}) + (5.003 \times \text{height [cm]}) - (6.755 \times \text{age [yrs]})$
- BMR calculation for women:
 $BMR = 655.1 + (9.563 \times \text{weight [kg]}) + (1.850 \times \text{height [cm]}) - (4.676 \times \text{age [yrs]})$

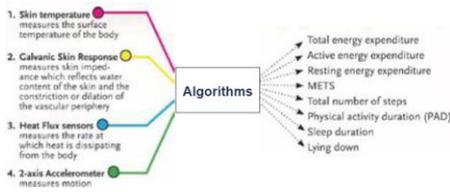
- Remind that this is only a regression, ok to be ± 500 calories!
- Assessment of AEE: direct calorimetry, the golden standard
Principle: all energy that is produced, is finally being converted to heat. Total energy expenditure can therefore be assessed directly by measuring heat production. 1cal is the amount of energy that is required to heat 1g of water by 1°C.
- Assessment of AEE: indirect calorimetry
Principle: Oxygen is required to generate energy (oxidation), so there is a relation between O₂ consumption and EE. O₂ consumption and CO₂ production can be measured. Per liter oxygen that is consumed: 4,85kcal energy produced. EE can therefore be estimated INDIRECTLY via assessment of oxygen consumption.



- Assessment of AEE: double labeled water
Principle: similar to indirect calorimetry. EE can be ESTIMATED by assessing CO₂ production. Assessment of the rate of disappearance of 2H versus 18O in urine allows to measure CO₂ production.
- What is activity?
 - “Any bodily movement produced by skeletal muscles that results in energy expenditure”
 - Exercise or non-exercise related
- MET = metabolic equivalent
 - 1 MET = BMR = basal metabolism = expenditure of 3.5 ml O₂/kg body weight/min = 1 kcal/kg body weight/hour
- PAL = physical activity level
 - Average daily energy expenditure (expressed in METs)
 - Daily TEE / BMR
 - Average PAL values 1.5 tot > 2.0
 - WHO: PAL ≥ 1.75 to avoid obesity
- Limitations!!!
 - PAL calculations are based on BMR data (CAVE!)
 - MET-values are only available for adult men
 - Movement efficiency is not taken into account: individual MET values needed
- Heartrate vs. AEE
The increase/decrease in heart rate (HR) is a direct indicator of the physiological response of the body to an increase/decrease in physical activity. Linear correlation during moderate and vigorous exercise, low correlation during low intensity exercise and rest. Interindividual differences in the correlation between HR and EE, Interfering variables: smoking, caffeine intake, stress, etc.

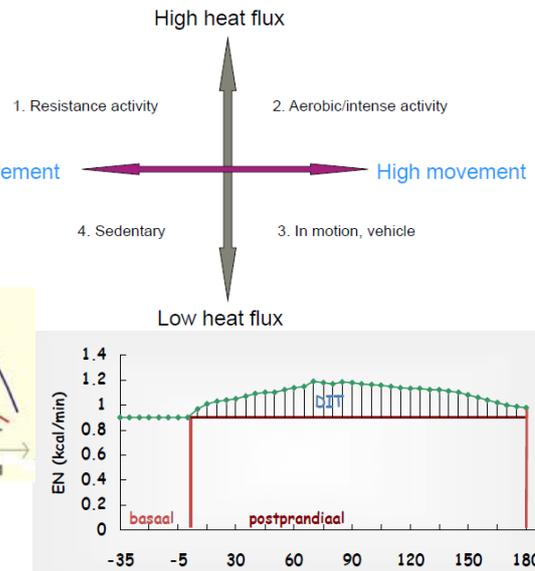
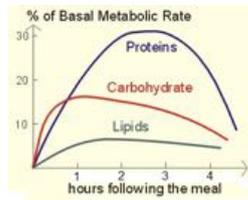
- Recent advances: increase input variables
 - Heart rate
 - Accelerometry
 - Heat flux
 - Skin temperature
 - Environmental temperature
 - Galvanic response of the skin
 - Combined with: information on age, sex, height, weight





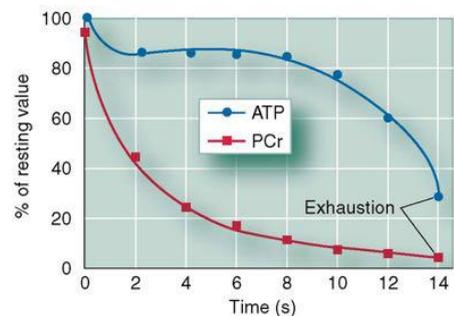
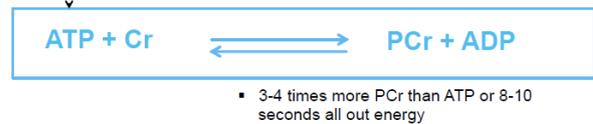
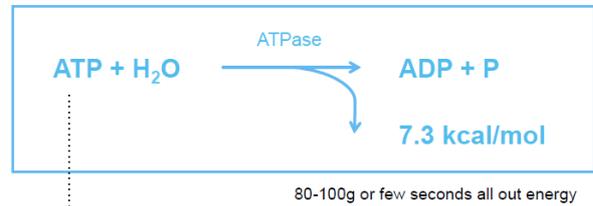
Validity studies????

- Diet induced thermogenesis
 - EE for digestion and nutrient absorption
 - Heat release (postprandial thermogenesis)



Nutrition to energy

- Extract energy from food and conserve it
- "Extract and transfer the chemical energy in ATP to power biological
 - work
 - muscle contraction
 - transport
 - synthesizing cellular molecules
- CreatineP supplementation is the only nutrient shown to have a real effect in exhaustive exercises
- CreatineP is more mobile than ATP, so transport of ATP from sites of energy production to sites of energy utilisation as CreatineP.
- **Glycolysis**
 - ATP = 2
 - NADH = 2 (= 5 ATP via ox.phos.)
 - Pyruvate = 2
- Glucose oxidation (TCA cycle)
 - GTP = 2
 - NADH = 8 (20 ATP)
 - FADH₂ = 2 (3 ATP)
- Total: 32 ATP = 34% efficiency



What is nutrition?

- Human nutrition is a complex multifaced scientific domain indicating how substances in foods provide essential nourishment for the maintenance of life.
- Process whereby cellular organelles, cells, tissues, organs, systems, and the body as a whole obtain and use necessary substances obtained from foods (nutrients) to maintain structural and functional integrity.
- Includes the spectrum of molecular to societal level
- Spectrum of molecular biology, genetics, biochemistry, chemistry, physics, food science, microbiology, physiology, phtology, immunology, psychology, sociology, political science, anthropology, agriculture, pharmacology, communications, and economics.
- Melting pot of different sciences

- Relationship Nutrition & Health (see figure beside)
 - Many other lifestyle and environmental factors influence health and well-being
 - direct links between nutrition and health are difficult to study
 - BUT nutrition is a major modifiable and powerful factor in promoting health, preventing and treating disease and improving quality of life.
- Difficult to see direct relationship between diet/nutrition and diseases!
- Development is most important time to intervene & prevent disease

Nutritional situation	Health consequences, outcomes
Optimum nutrition Food-secure individuals with adequate, balanced and prudent diets	→ Health, well-being, normal development, high quality of life
Undernutrition: hunger Food-insecure individuals living in poverty, ignorance, politically unstable environments, disrupted societies, war	→ <ul style="list-style-type: none"> • Decreased physical and mental development • Compromised immune systems • Increased infectious diseases • Vicious circle of undernutrition, underdevelopment, poverty
Overnutrition Overconsumption of food, especially macronutrients, plus: <ul style="list-style-type: none"> • low physical activity • smoking, stress, alcohol abuse 	→ Obesity, metabolic syndrome, cardiovascular disease, type 2 diabetes mellitus, certain cancers: chronic NCDs, often characterized by overnutrition of macronutrients and undernutrition of micronutrients
Mainnutrition Nutrition transition: Individuals and communities previously food insecure → confronted with abundance of palatable foods → some undernourished, others too many macronutrients and too few micronutrients	→ Double burden of infectious diseases plus NCDs, often characterized by overnutrition of macronutrients and undernutrition of micronutrients

Nutrients: the basics

- People eat food NOT nutrients
- It is the combination and amount of nutrients that determine health
- **Quality** intake that allows you to function at your best and promotes health
- **Quantity** of intake that promotes a healthy body weight
- **Foods** contain nutrients and are derived from plant or animal sources
- **Nutrients** are used by the body to provide energy and to support growth, maintenance and repair of body tissues (~50 identified)
- The six classes are:
 - Carbohydrates
 - Lipids (fats)
 - Proteins
 - Vitamins
 - Minerals
 - Water
- Several ways to classify the nutrients:
 - Organic or inorganic
 - Essential or nonessential
 - Macronutrient or micronutrient
 - Energy yielding or not
 - YES / macronutrients: Carbohydrates (primary source of energy; use as glucose, brain's only energy source, limited to 12-24 h; 4 kcal/g; ketone bodies may replace), Fats (alternative source, along with glucose; 9 kcal/g; stores are unlimited), Proteins (contain also N and S beside H,C,O; 4kcal/g)
 - Alcohol (7 kcal/g; non-nutrient as interfering with growth, maintenance and repair of body due to metabolites)
 - NO / micronutrients: Vitamins (essential, organic, micronutrient, not energy-yielding, easily destroyed), Minerals (essential, inorganic, micronutrient, not energy-yielding, indestructible), Water (essential, noncaloric)
 - Cholesterol is nonessential as the cholesterol-level in the blood doesn't depend on the intake of cholesterol
- Energy density
 - Measure of the kcal/g of food
 - ___ has the highest energy density of the 3 energy yielding nutrients
 - Foods with a high energy density provide more kcal/g than low density foods

- When seeing a lot of food the brain signals that you're nourished enough, otherwise the opposite
- Nutrients...
 - NOT in isolation
 - Interact with each other
 - Nutrients should be studied in the context of the total body function
 - Knowledge about the nutrients and their functions allows us to draw recommendations and determine nutrient requirements

Guidelines

- Carbohydrates: 55% thereof <10% added sugars. Potatoes, rice, bread grains products, sugar, honey, jams, soft drinks.
Non-digestible carbs: >30 g/d. Vegetables, fruits, whole grain products.
- Proteins: 10-15%. Meat, grains (bread), milk, fish, soya.
- Fats: 30-35 E%, saturated <10%, cholesterol < 300 mg/d. Meat, oils, butter, mayonnaise, cream, cookies, cheese, nuts. $\Omega 3$ (fatty fish, vegetable oil) and $\Omega 6$ (corn-oil, sunflower-oil, soya-oil) → 5:1.
- Alcohol: <3%. Beer wine, distilled liquors.
- Water: 2.5 l/d