

**Q9 Define basal metabolic rate and list the factors that affect it. (60% of marks) Describe the ways it may be measured. (40% of marks) (Sept 2013)**

Basal metabolic rate (BMR) – the amount of energy liberated by catabolism of food per unit time. Measured under standardized conditions 12 hours after a meal, at rest, in the absence of physical or emotional stressors, at a comfortable temperature (20-25 degrees Celsius).

Normal value – 70kcal/hr for a 70kg male or 40kcal/m<sup>2</sup>/hr

Factors that affect BMR:

- Age → BMR increases when growing actively (neonates have double the BMR of adults). Decreases by 2-3% per decade throughout adult life, probably due to decrease in skeletal muscle mass
- Gender → males have a 10-15% higher metabolic rate than females due to greater skeletal muscle mass.
- Body size → mainly due to differences in skeletal muscle mass, hence BMR usually calculated based on body surface area
- Sleep → reduces BMR by 10-15% due to a reduction in skeletal muscle and CNS activity
- Hormones →
  - Thyroxine stimulates oxidation and increases heat production within cells (maximal thyroxine secretion is associated with a rise in metabolic rate by 50-100%)
  - Catecholamines increase BMR
  - Testosterone increases BMR by 10-15% (mainly due to its anabolic effect on skeletal muscle mass)
  - Growth hormone increases BMR by 15-20% due to direct effect on cellular metabolism
- Pregnancy and lactation → BMR increases by about 15% during the latter stages of pregnancy
- Nutritional status →
  - Postprandial → BMR rises by 4-30% for 3-12 hours after a meal (thermogenic effect of food). This is mainly due to oxidative deamination of food in the liver. Much greater effect for protein (known as the specific dynamic action of protein) than CHO or fat
  - Malnutrition / starvation → reduces BMR by 20-30% due to a reduction in tissue metabolism
- Climate → BMR is 10%-20% higher for individuals living in arctic regions compared to the tropics
- Pathology → BMR increases by ~14% per degree of fever. Trauma, burns and malignancy also increase BMR

Measurement of BMR utilizes calorimetry:

- DIRECT →
  - Subject placed in an Atwater-Benedict chamber, which measures quantity of heat liberated from a subject. Complicated and difficult to perform.
- INDIRECT →
  - Uses oxygen consumption to calculate metabolic rate
  - The utilization of 1L O<sub>2</sub> is equal to the production of 4.82kcal of energy
  - Utilizes a Benedict-Roth spirometer, Douglas bag or Max Planck spirometer to measure oxygen use