

Lecture 65:

Body Metabolism

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 Metabolism is a series of vital chemical reactions within the body that consists of two components: anabolism (synthesis) and catabolism (breakdown).



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 Basal energy expenditure" (BEE), or basal metabolic rate (BMR) or resting metabolic rate (RMR) is the daily amount of energy expenditure by the body at rest, or it is the minimum calories needed for the body to function properly at rest.

• BMR is <u>approximately 70% of total daily energy</u> <u>expenditure (TDEE)</u> of an average normal person.

Factors that affect BMR:

• 1) Genetics: African – Americans have slower BMR than Asians.

- 2) Gender: men have higher BMR than women due to higher muscle masses.
- 3) Age: BMR reduces by age. After 20 years old, it deceases 2% per decade.
- 4) Weight: Overweight people have lower BMR.

• 5) Body surface area (BSA). Between two people with the same weights, the taller person has a higher BMR than the shorter person due to more BSA.

- 6) Body fat percentage. A high body fat percentage lowers BMR.
- 7) Diet. Proteins increase BMR, while fats have the least impacts on BMR. High – calories and low – fiber diets decrease BMR.

- 8) External temperature. People living in tropical climate have BMR up to 20% higher than that of those living in non topical regions. Also cold weather increases BMR because of shivering.
- 9) Exercise. Any physical activity increases BMR.
- 10) Health status. <u>Kidney disease</u>, liver disease, <u>low function thyroid</u>, <u>depression</u>, <u>and diabetes</u> are the five common medical conditions that decrease BMR.

- 11) Stress. Stress may reduce BMR by increasing the stress hormone, cortisol.
- 12) Medications. The medications that may slow down body metabolism (BMR) are:
- Beta blockers
- Anti-depressants
- Anti histamines
- Sedatives
- Tranquilizers



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Percentage of RMR Used by Different Organs in the Body

Organ	Percentage
Liver	27
Brain	19
Muscle	18
Kidneys	10
Heart	7
Others	19

How to Calculate BMR:

The Harris-Benedict formula has become a standard method to measure BMR:

- Men: BMR = 66 + (13.7 X weight in kg) + (5 X height in cm)
 (6.8 X age in years)
- Women: BMR = 655 + (9.6 X weight in kg) + (1.8 X height in cm) (4.7 X age in years)

Example:

- You are a male.
- You are 45 years old.
- You are 5' 6 " tall (167.6 cm)
- You weigh 160 lbs. (72.4 kilograms)
- Your BMR = 66 + (13.7X72.4) + (5X167.6) (6.8X45)
- Your BMR = 66 + 991.8 + 838 306
- Your BMR = 1589 Calories/day

Despite becoming a common reference to measure BMR, Harris-Benedict formula has important drawbacks:

• 1) It fails to include health status of the person or the medications consumed. For example, if someone has a low function thyroid or someone is taking corticosteroids, they would affect the BMR.

- 2) It fails to include body fat, as it affects the BMR as well. The body mass included in the formula is a non-specific factor.
- For example, if two men have the same weight of 70 kg, but one of them has 12% body fat, and the other one has 20% body fat, this first person will have higher BMR due to having more muscle mass.

Total Daily Energy Expenditure (TDEE):

• TDEE is the total amount of calories that the body consumes in 24 hours, including all activities.

TDEE = BMR X Activity Multiplier

Activity Multiplier:

- Sedentary = BMR X 1.2 (little or no exercise, desk job)
- Lightly active = BMR X 1.375 (light exercise/sports 1-2 days/wk)
- Moderately active = BMR X 1.55 (moderate exercise/sports 3-5 days/wk)
- Very active = BMR X 1.725 (hard exercise/sports 6-7 days/wk)
- Extra Active = BMR X 1.9 (hard daily exercise/sports & physical job or 2X day training, i.e. marathon, contest etc.)

Calorimetry:

It is measuring the heat produced by chemical reactions or physical changes of the body.

Direct Calorimetry:

It serves as the standard interpretation of energy expenditure. However, direct calorimeters are difficult devices to operate. The whole body is placed inside the calorimeter for the measurement: Snellen direct calorimetry chamber.

• Indirect Calorimetry:

It is the preferred method to estimate metabolic energy consumption in the body (BMR).

It measures the exchange of respiratory gases: O2 uptake, and CO2 production, and ventilation.

Thermogenic Effects of Foods on Body Metabolism:

 When a food is consumed, the processes of digestion, absorption, and assimilation of nutrients require tremendous amounts of energy.

The <u>four major</u> dietary factors that affect metabolic rate are:

- portion of the meal.
- 2) macronutrient composition of the meal.
- 3) time passed since previous meal.
- 4) micronutrient status of a person.



 Digestion, absorption, and assimilation of proteins require more energy than those of carbohydrates and fats.

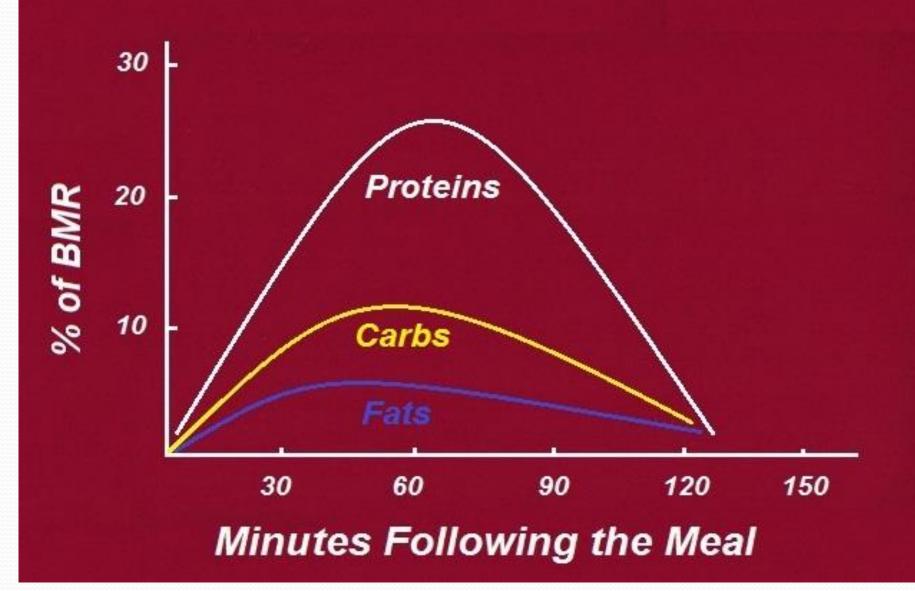
 In other words, proteins increase metabolic rate, while carbohydrates and fats have less effects on

body metabolism.



Among macronutrients, protein has the most impact on BMR (basal metabolic rate). Image: Copyright@Depositphotos.com/Daniel Vincek

Thermogenic Effect of Foods on BMR



• Thermogenic effect of foods usually reaches maximum within 60 minutes after having a meal and then starts declining to reach its minimum impact within 120 minutes.



A high protein meal elicits approximately 25% thermogenic effect. Image: Copyright@Depositphatos.com/Alena Dvarakova

- This is why it is generally recommended to eat a small portion of meal with high content of protein every 2 - 3 hours to stimulate the body metabolism.
- However, the magnitude of thermogenic effect of foods followed by activation of metabolic rate varies among people and depends on <u>the type of</u> <u>food</u>, <u>quantity of food</u>, <u>and health status of the</u> <u>person</u>.

Homework:

• 1) Describe thermogenic effects of foods on body metabolism.

• 2) Describe the factors that affect body metabolism.

