

Choose the right word/phrase and complete the passages:

3. Energy Metabolism

Key messages

• Energy balance in the body is the balance between how much energy is _____ and how much is expended. _____ is when intake exceeds expenditure and is associated with increases in body energy stores (weight gain). During _____, as in periods of starvation, body energy stores are depleted.

1. Positive balance
2. negative balance
3. consumed

• Energy _____ corresponds to the energy _____ of macronutrients in foods. Carbohydrate provides 16.8 kJ/g, protein also 16.8 kJ/g, and fat 37.8 kJ/g. In addition, alcohol _____ 29.4 kJ/g.

1. content
2. intake
3. provides

• Total energy _____ constitutes approximately two-thirds of the energy expended by the body to maintain basic physiological functions plus the thermic effect of a meal and energy expended during _____. The basic physiological functions include heart beat, muscle function, and respiration (resting or basal metabolic rate). The _____ of a meal is about 10% of the caloric value of the meal needed to digest, metabolize, and store ingested macronutrients. The energy expended during physical activity is energy expended when skeletal muscles are used for any type of _____. In infants and children, the cost of growth is added.

1. functions
2. thermic effect
3. physical movement
4. expenditure

• Energy requirement is the amount of food energy needed to _____ energy expenditure in order to maintain body size, body composition, and level of physical activity, consistent with long term good health. This includes the _____ for optimal growth and development in children, and the needs of pregnancy and _____ (deposition of tissue and secretion of milk).

1. lactation
2. balance
3. energy needs

• Body mass index (BMI) classifies weight _____ to height squared and is the most accepted and widely used crude index of _____. A BMI of 18-24.9 kg/m² is _____ as normal for adults, between 25 and 29.9 kg/m² as overweight, and >30 kg/m² as obese.

1. obesity
2. relative
3. regarded

• Energy expenditure can be measured by direct methods (calorimetry) or indirect methods, in which oxygen _____ and carbon dioxide production are used to calculate energy expenditure. However, the modern gold standard is _____ by doubly labeled water, which is a noninvasive method used to measure total energy expenditure over periods of 7-14 days while _____ are living in their usual environments.

1. measurement
2. subjects
3. consumption

• Hunger is the physiological need to eat and results in actions to attempt to obtain food for consumption. Appetite is a psychological _____ to eat and is related to the pleasant sensations that are often _____ with food. Thus, hunger is more of an intrinsic instinct, whereas appetite is often a _____.

1. associated
2. desire
3. learned response

Choose the best heading for each passage:

This chapter explains how the body is able to achieve this state of energy balance through control of energy intake and energy expenditure. In addition, the various ways that body energy stores can be measured and some examples of conditions in which energy balance may be disrupted are summarized. Particular emphasis is placed on obesity, which is the end-result of a positive energy balance and is now considered one of the major nutritional disorders.

1. Energy expenditure
2. Introduction
3. Energy balance in various conditions

The internal factors that regulate the overall feeling of hunger and satiety include the central nervous system (primarily the hypothalamus and the vagus nerve), the major digestive organs such as the stomach and liver, and various hormones. In addition, environmental factors (e.g., meal pattern and composition, food availability, smell and sight of foods, climate), emotional factors (e.g., stress), and some diseased states (e.g., anorexia, trauma, infection) may influence the feelings of both hunger and appetite. The factors that influence appetite include factors external to the individual (e.g., climate, weather), specific appetite cravings, specific learned dislikes or avoidance (e.g., alcohol), intrinsic properties of food (e.g., taste, palatability, texture), cultural practices or preferences, specific effects of some drugs and diseases, and metabolic factors such as hormones and neurotransmitters. Some of these factors are described in further detail below.

1. Energy intake
2. Obesity
3. Introduction

Lavoisier's device was the first calorimeter that was used to measure heat production. This approach is termed direct calorimetry because heat production is measured directly. Direct calorimeters have been designed for measuring heat production in humans, but this approach is technically demanding, especially in human studies, and is now infrequently used. Indirect calorimetry measures energy production via respiratory gas analysis. This approach is based on oxygen consumption and carbon dioxide production that occurs during the combustion (or oxidation) of protein, carbohydrate, fat, and alcohol, as shown in the example of glucose combustion.

1. Factors than influence energy expenditure
2. Energy expenditure
3. Energy balance in various conditions

Although fat mass is generally thought to be metabolically inert, it significantly contributes to variations in RMR. This is likely explained, at least in part, by neurobiological effects (e.g., changes in sympathetic nervous system activity) resulting from variations in fat mass which affect the metabolism of other tissues. RMR is also influenced by fat mass, even though fat mass is generally thought to be metabolically inert.

1. Introduction
2. Perspectives of the future
3. Factors that influence energy expenditure

However, since the relationship between RMR and total energy expenditure is highly variable because of differences in physical activity, the estimation of energy needs from knowledge of RMR is not that accurate and requires a crude estimate of physical activity level. Nevertheless, reasonable estimates can be made to estimate daily energy budgets for individuals (Table 3.4).

1. Energy intake
2. Energy expenditure
3. Energy requirements

In the elderly, two different problems related to energy balance can be recognized. In one segment of the elderly population there is a decline in food intake that is associated with dynamic changes in body composition where there is a tendency to lose FFM, which leads to loss in functionality. In others there is a tendency to gain fat mass, which increases the risk for obesity, cardiovascular disease, and noninsulindependent diabetes.

1. Obesity
2. Energy balance in various conditions
3. Introduction

Traditionally, the waist-to-hip ratio has been used as a marker of upper versus lower body-fat distribution. More recent studies suggest that waist circumference alone provides the best index of central body-fat pattern and increased risk of obesity-related conditions. The recommended location for the measurement of waist circumference is at the midpoint between the lowest point of the rib cage and the iliac crest.

1. Obesity
2. Perspectives on the future
3. Energy intake

There is a need to develop more cost-effective methods that can be used in field studies and to determine the energy cost of specific activities of people throughout the life cycle in developing countries. Obesity has recently been defined as a disease by the World Health Organization. The growing problem of obesity worldwide, and in children and in people who were previously food insecure and malnourished, needs to be addressed with better information about the behavioral and cultural factors that influence energy balance. This demands a more holistic, integrated approach to the study of obesity in the future.

1. Energy expenditure
2. Factors that influence energy expenditure
3. Perspectives on the future