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Energy Expenditure and Weight Management

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Introduction

Your body needs energy to function. Energy (also known as calories) comes from the macronutrients in the food we eat and beverages we drink. The macronutrients include carbohydrates, protein and fat. Alcohol also contains calories. Energy requirements or calorie needs vary from one individual to the next, depending on age, if you're male or female, body composition (the amount of muscle versus fat in your body) and your physical activity level (how much you exercise) [1].

Nutrient	Calories Per Gram
Carbohydrate	4
Protein	4
Fat	9
Alcohol	7

When more food is eaten than is needed over days or weeks, excess fat can accumulate in the body's fat tissue where it is stored. When energy supplies run low, this stored fat is used to provide our body with energy.

Overview of Energy Expenditure

Daily energy expenditure (EE) is the total amount of calories we use throughout the day (24 hours) [1]. The three main parts of daily energy expenditure are 1) basal metabolic rate (BMR), 2) thermic effect of food (TEF), and 3) activity energy expenditure (AEE).

Basal metabolic rate (BMR) is the rate at which a person uses energy to maintain the basic functions of the body – breathing, keeping warm, keeping the heart beating – when at complete rest [1]. BMR varies from person to person. Men tend to have a higher BMR than women since they tend to have more muscle mass, which burns more calories than our other tissues. Older adults usually have a lower BMR compared to younger people since muscle mass tends to decrease with age [1]. The BMR accounts on average for about 60 to 65 percent of an individual's energy needs [2].

Thermic effect of food (TEF) represents between 5 and 15 percent of daily energy expenditure. TEF is the energy required to digest and absorb the food we eat [2]. Studies have shown that increasing protein intake and decreasing carbohydrate intake can increase TEF by up to 10 percent in both adults and children, which demonstrates that what we eat can help with managing our weight [4].

The third component of daily energy expenditure is activity energy expenditure (AEE) or the calories burned due to exercise and physical activity. AEE is considered the most variable component of EE and represents between 20 to 35 percent daily energy expenditure [5,6].

Measuring Energy Expenditure

There are several ways to measure energy expenditure. Indirect calorimetry is calculated by measuring the amount of oxygen consumed and the amount of carbon dioxide produced by the body [3]. Direct calorimetry is the second technique used to measure EE and measures the rate of heat lost by the body [3]. Noncalorimetric techniques use physiological observations, such as heart rate and body water excreted in urine [3]. The doubly labeled water (DLW) method is one of the most accurate ways to measure energy expenditure. However, due to cost and complex machinery required for analysis, this method is not typically used outside of a research laboratory [4].

How Many Calories Do You Need Each Day?

The above calculations of energy expenditure can only be made in a medical or laboratory setting. However, you don't need fancy machinery or methods to estimate your daily energy expenditure. You can estimate your daily energy needs by using the following on-line tools:

https://www.supertracker.usda.gov/bwp/index.html

https://tdeecalculator.net

http://faculty.mccneb.edu/CVanRiper/Unit%201/Calculating%20BMI%20and%20EER.pdf

The table below can also provide you with an estimate of calories needed per day based on age, gender and physical activity level [10].*

The Role of Energy Expenditure and Weight Management

In order to maintain body weight, energy intake (calories we eat) must equal energy expenditure (calories we burn/use). Failure to maintain energy balance will result in weight change. Energy balance can be maintained by regulating energy intake (through the diet), energy expenditure (adjusting physical activity level to match intake) or a combination of both. Failure to compensate for an increase in energy intake with an increase in expenditure will result in weight gain (positive energy balance); conversely, a reduction in energy intake, which isn't matched by a reduction in physical activity levels, will result in weight loss (negative energy balance) [1,2].

Increasing Energy Expenditure in our Daily Lives

Energy expenditure can be increased by adopting simple lifestyle changes, such as parking the car out a little further from your destination and walking, eating more mindfully, cooking at home with less fat and sugar instead of getting takeout and finding fun physical hobbies such as walking, biking or dancing [5]. Within the workplace, there are some opportunities for increasing activity levels, such as taking the stairs instead of taking the elevator, walking around the building during breaks and walking to speak to colleagues rather than using the phone or e-mail [1].

	Activity Level					
Age (Years)	Male Sedentary	Male Moderately Active	Male Active	Female Sedentary	Female Moderately Active	Female Active
19-20	2,600	2,800	3,000	2,000	2,200	2,400
21-25	2,400	2,800	3,000	2,000	2,200	2,400
26-30	2,400	2,600	3,000	1,800	2,000	2,400
31-35	2,400	2,600	3,000	1,800	2,000	2,200
36-40	2,400	2,600	2,800	1,800	2,000	2,200
41-45	2,200	2,600	2,800	1,800	2,000	2,200
46-50	2,200	2,400	2,800	1,800	2,000	2,200
51-55	2,200	2,400	2,800	1,600	1,800	2,200
56-60	2,200	2,400	2,600	1,600	1,800	2,200
61-65	2,000	2,400	2,600	1,600	1,800	2,000
66-70	2,000	2,200	2,600	1,600	1,800	2,000
71-75	2,000	2,200	2,600	1,600	1,800	2,000
76+	2,000	2,200	2,400	1,600	1,800	2,000

*Reference man is 5 feet 10 inches tall and weights 154 pounds. Reference woman is 5 feet 4 inches and weighs 126 pounds. Estimates do not include women who are pregnant or breastfeeding.

Are There Foods That Can Increase Energy Expenditure?

As mentioned above, thermic effect of food (TEF) represents between 5 and 15 percent of daily energy expenditure. TEF is the energy required to digest and absorb the food we eat [2].

Certain foods have been shown in research studies to increase TEF more than others. For example, meals higher in protein increase energy expenditure compared to meals higher in carbohydrates or fat [6-8]. This is true for both adults and children. In addition, there is some evidence that capsaicin, the component of peppers that makes them spicy, has been shown to increase energy expenditure and fat oxidation [9]. However, the supplements used in these studies are not currently available for sale, and there are mixed results in scientific studies.

What Should You Eat For a Healthy Weight?

Following a healthy eating pattern recommended by the Dietary Guidelines for Americans 2015 [10] can help you achieve and maintain a healthy body weight, get the right amount of nutrients you need and reduce the risk of chronic disease.

To follow a healthy eating pattern, make half your plate fruits and vegetables. Choose a variety of vegetables including those that are dark green, red and orange; beans and peas; and some starchy vegetables like potatoes, winter squash and corn. Nonstarchy vegetables are low in calories and help you feel full, so choose them often. Choose whole fruits instead of juice. Choose whole grains most of the time; fat-free or low-fat dairy foods; a variety of protein foods including seafood, lean meats and poultry, eggs, nuts and seeds; and healthy oils. Limit added sugars and alcohol. Be mindful of portion sizes.

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