



## Research Article

# Exploring the Impact of Nutrition and Physical Activity on Human Metabolism

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## ARTICLE INFO

## ABSTRACT

### Keywords:

Nutritious diet  
Reasonable  
Physical activity  
Metabolism

### Article History:

Received: 25-02-2024  
Accepted: 01-04-2024  
Published: 08-04-2024

**Background:** The human body acquires energy substances through diet and consumes them through exercise, completing the metabolism process. This article aims to analyze the impact of metabolism concerning diet and scientific exercise to emphasize the importance of these factors in promoting physical health. **Methods:** The research delves into the effects of diet and exercise on energy metabolism, focusing on energy balance, nutrient oxidation, and metabolic flexibility. Various methodologies are employed to measure energy intake and expenditure accurately, crucial for understanding energy homeostasis and developing effective interventions. **Findings:** Exercise and Diet Influence Metabolism: Physical exercise and dietary interventions play a significant role in influencing energy metabolism, improving metabolic flexibility, and managing cardiometabolic diseases like obesity and diabetes. Energy Metabolism Measurement: Current methodologies for measuring energy intake and expenditure provide valuable insights into energy homeostasis regulation. These methods help researchers conduct high-quality obesity research by assessing various aspects of energy metabolism. Impact of Exercise on Metabolism: Studies suggest that extreme exercise combined with calorie restriction may not lead to sustainable weight loss due to metabolic adaptations like reduced resting metabolic rates. Muscle loss during rapid weight loss can contribute to lower metabolic rates. Dietary Carbohydrates and Exercise: Research highlights the interplay between dietary carbohydrate intake, exercise, appetite regulation, and energy intake. Low-carbohydrate diets combined with exercise show promising effects on body mass reduction and improved fat and carbohydrate metabolism. **Conclusion:** The analysis underscores the critical role of diet and exercise in human metabolism. By understanding how these factors impact energy balance, nutrient oxidation, and metabolic flexibility, individuals can make informed choices to enhance their physical health through scientific and reasonable lifestyle modifications.

### Cite this article:

Hazim, H., Zalmi, M. R., & Bahir, H. (2024). Exploring the Impact of Nutrition and Physical Activity on Human Metabolism. *Sprin Journal of Arts, Humanities and Social Sciences*, 3(4), 39–42. <https://doi.org/10.55559/sjahss.v3i4.284>

## 1. Introduction

The rate of human metabolism determines the development rate of the body and even the living body, and diet and physical exercise are important means to maintain human body functions. In daily life, on the one hand, the human body becomes the source of energy for metabolism by ingesting various nutrients in food; on the other hand, it consumes energy through various activities of the body to complete the body's material metabolism process. Therefore, this article will analyze in detail the impact on metabolism from the two aspects of reasonable diet and physical exercise (Bahir et al., 2023).

## 2. Significance of Research

Research on the effects of diet and exercise on human metabolism is crucial due to the rising incidence of metabolic syndrome (MS), a cluster of metabolic risk factors like abdominal

obesity, dyslipidemia, hypertension, type 2 diabetes, and non-alcoholic fatty liver disease. Understanding the biochemical and molecular links between metabolic changes and lifestyle interventions is essential to combat these health issues

## 3. Objectives of Research

**Investigate the Impact of Exercise:** Studies have shown that exercise, especially resistance and endurance training, can reverse obesity-related metabolic effects, improve insulin sensitivity, reduce adiposity, and ameliorate glycemic control.

**Explore Dietary Interventions:** Various "healthy diets" like the Mediterranean diet have been found to reduce the risk of developing MS by improving whole-body metabolism. Research aims to understand how dietary interventions impact metabolism independently or in conjunction with exercise.

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<https://doi.org/10.55559/sjahss.v3i4.284>

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**Understand Metabolic Adaptations:** Recent studies have revealed surprising insights into human metabolism over the lifespan. For instance, infants are born with high metabolic rates that increase significantly during the first year of life. Understanding these metabolic changes at different life stages is crucial for developing effective interventions

#### 4. The impact of a reasonable nutritious diet on human metabolism

Metabolism is the exchange of matter and energy between the organism and the environment and the self-renewal process of matter and energy within the organism. It includes anabolism (anabolism) and catabolism (dissimilation). After the human body ingests external food, it recombines nutrients through digestion and absorption to form organic matter and store energy. The process of metabolic assimilation, while at the same time, the process of decomposing part of its own substances and releasing energy is metabolic assimilation (Ajmiri & Bahir, 2023).

chemical process. The nutrients that the human body obtains from food include six categories: protein, lipids, carbohydrates, vitamins, minerals and dietary fiber. Since these six categories of nutrients have different production capacities and metabolic rates during metabolism, it is necessary to use food rich Containing different nutrients, a reasonable combination can regulate metabolism.

##### 4.1 A reasonable combination of three major macronutrients regulates metabolism

The three major macronutrients refer to protein, lipids and carbohydrates. First of all, the main component of protein is amino acids. When the body consumes protein-based foods, it takes longer and more calories are burned during the decomposition process. Studies have shown that consuming enough protein can increase the body's metabolism and cause the body to burn 150-200 more calories per day. Therefore, in order to improve the metabolic level, the three major nutrients in the diet should be appropriately matched (Bahir & Huanghe, 2021a).

When increasing the protein ratio. The main sources of protein in food are meat, fish, eggs, poultry, milk and soybeans (Bahir & Huanghe, 2021b).

This kind of food contains a complete range of amino acids, sufficient quantity and excellent amino acid combinations. They are all high-quality proteins that can meet the needs of human body function development. But excessive protein intake will also put a burden on the kidneys. Therefore, in a reasonable dietary mix, it should be appropriately ensured that 10%-25% of the total daily caloric intake comes from protein (Bahir et al., 2023).

Secondly, fat is the main energy supply substance for aerobic metabolism. Its main component is fatty acids, of which omega-3 fatty acids are very important for the body's metabolism. Studies have proven that omega-3 fatty acids contribute to the metabolism of fats in the body and blood circulation metabolism. Therefore, consuming foods rich in omega-3 fatty acids (such as nuts, cold water fish such as salmon, herring, mackerel and sardines) will help improve metabolism. However, since 1 g of fat can produce 9 kilocalories and fat consumption is mainly aerobic metabolism, excessive fat intake is more likely to cause obesity due to excess calories. Therefore, in a reasonable dietary mix, it should be appropriately ensured that 10-15% of the total daily caloric intake comes from fat (Bahir et al., 2023).

Thirdly, carbohydrates are the most economical and important energy supply material for the human body. According to the post-meal glycemic index (GI), foods with a GI >70 are considered high GI foods, and foods with a GI <55 are considered low GI foods. High GI foods are consumed and absorbed faster after entering the intestine, causing higher insulin levels, promoting the storage of fat in the body, and reducing the body's metabolic rate. Low-GI foods are more likely to produce a feeling of fullness, causing lower insulin levels to help burn fat, reduce fat storage, and increase the body's metabolism. Therefore, in a reasonable dietary mix, it should be appropriately ensured that 50-65% of the total daily caloric intake comes from carbohydrates. Among them, low GI foods should be mostly composed of various vegetables, fruits and whole wheat cereals (Edwards, 2006).

##### 4.2 Minerals regulate metabolism

Iron has the function of transporting oxygen to cells. Therefore, if the iron intake is insufficient, the body cannot transport sufficient oxygen to cells, thus reducing the metabolism level. Adults should supplement 18 mg of iron daily. Through a reasonable diet, you can consume iron-rich foods such as lean meat, animal offal and whole animal blood. Potassium increases metabolism by regulating fluid balance. To ensure that the body is in normal metabolism, the daily demand for potassium should reach 1,200 mg. A cup of milk can provide 370 mg of potassium in the diet, an orange can provide 250 mg of potassium, and a banana can provide 450 mg of potassium. It can be seen that reasonable dietary adjustments can be made to meet the body's demand for certain types of minerals, thereby improving metabolism (Yu & Wu, 2023).

##### 4.3 Dietary fiber regulates metabolism

Dietary fiber is a type of food nutrient that is not easily digested. It can promote intestinal peristalsis, help the excretion of harmful substances and absorb fat in the intestine, improve intestinal flora, thereby reducing the body's absorption of fat (Ayers et al., 2023). Dietary fiber foods are mainly represented by fruits and vegetables. High-fiber cereals (such as oats, buckwheat, brown rice) are rich in water-soluble dietary fiber, which can regulate blood sugar and promote metabolism by lowering cholesterol. A large number of fruits and vegetables can speed up gastrointestinal motility and improve gastrointestinal metabolism efficiency.

#### 5. The impact of reasonable physical exercise on human metabolism

##### 5.1 Moderate Exercise and Glucose Metabolism

As we all know, the main function of sugar is to provide energy for human life activities (Baeza et al., 2016). Most foods will be converted into sugar after entering the human body. They will be decomposed and absorbed by the blood to form various glycogens, such as glycogen that exists inside the liver. Hepatic glycogen, the glycogen that exists inside the muscles is muscle glycogen. Experiments have proven that more than 70% of the energy required by the human body comes from sugar supply. Reasonable physical activity involves the exercise and selection of personal endurance, sports, etc. As far as endurance training is concerned, as training time and training intensity continue to increase, the oxidative ability of muscles is also constantly improving. Especially when performing high-load exercise, the oxidative ability of human muscle usually reaches the optimal level, fatty acids, glycogen, etc. The oxidation rate is increased, and at the same time, the rate of muscle glycogen utilization is also

affected. If you perform high-intensity exercise, the decomposition rate of muscle glycogen will increase as the exercise intensity increases, providing power for the body's output.

**Table.1 Muscle glycogen reserves and exhaustive exercise time**

Meal category	Muscle glycogen (100g wet muscle)	Time to exhaustion (min)
mixed meal	1.77	115.8
High fat, high protein	0.69	57.1
High sugar meals	3.85	167.4

The degree of influence on muscle contraction is different, and the utilization rate of muscle glycogen is also different. Take the exercise methods of running and cycling as an example. Under the same conditions, the degree of fatty acid oxidation in cycling is higher than that in running.

Reasonable physical activity will improve glucose metabolism and provide energy for the body. Research shows that a mixed meal can provide 1.77g of muscle glycogen per 100g of wet muscle, which can sustain exercise for 115.8 minutes; while a high-sugar meal can provide 3.85g of muscle glycogen per 100g of wet muscle, which can sustain exercise for 167.4 minutes. It is enough to prove that high-sugar meals can significantly extend exercise time. We will find that the synergistic effect of a reasonable diet and physical activity will improve the body's exercise capacity, thus accelerating metabolism.

### 5.2 The impact of reasonable physical exercise on fat metabolism

The functions of fat include supplying energy to the body, maintaining normal body temperature, effectively reducing friction during exercise to protect internal organs from damage, increasing satiety, and promoting the absorption of fat-soluble vitamins (Ayers et al., 2023). Among them, the most important function is to provide energy for the human body. provide energy. Endurance training is the best way to promote human metabolism. It can directly affect human body fat metabolism, including plasma fat metabolism. At the same time, skeletal muscle can also oxidize fatty acids and other substances. Data surveys show that people with higher exercise endurance levels will increase the proportion of fatty acid function when performing load training. During endurance training, the utilization rate and intake of plasma free fatty acids are relatively large. At this time, the consumption of sugar is reduced, and exercise endurance is improved.

The provision of fat function through physical exercise is reflected in the following ways: first, the catecholamines released by exercise increase the activity of fatty acids through the action of lipase (Desheng, 2019); secondly, reasonable physical exercise causes the proliferation and increase of the skeletal muscle capillary network, and the lipid content in its cells increases. Protein lipase increases plasma glyceride capacity; thirdly, long-term exercise increases the number, volume and volume of mitochondria in muscle cells, thereby increasing the activity of enzymes within the mitochondria; the increase in glyceride content during endurance training is proportional to the mitochondrial volume Increase, visible in sports, it can be seen that physical exercise, especially endurance exercise, will increase the metabolism of fat.

### 5.3 The impact of reasonable physical exercise on blood lipid metabolism

Clinical medicine usually regards cholesterol content as the standard for blood lipid testing. Blood lipids and cholesterol generally exist in two environments, one is deposited on the inner wall of blood vessels in a low-protein environment, and the other is attached to the arterial wall in a high-protein environment. The two are antagonistic to each other, but both can remove other substances deposited on the blood vessel walls. When cholesterol levels rise in the human body, protein levels also increase in low-protein environments. At this time, the protein content in the low-protein environment and the high-protein environment can easily become imbalanced. If things go on like this, the probability of the human body suffering from cardiovascular diseases such as atherosclerosis will increase significantly. Proper aerobic exercise can promote cholesterol metabolism. When performing low-intensity exercise, fat oxidation plays a major role in this process. It can not only provide about 70% of the energy for human exercise, but also stimulate protease activity and accelerate other Decomposition of lipids. After high-intensity exercise, plasma triglycerides in the human body will continue to decrease. It can be seen that high-intensity exercise also has a direct impact on blood lipid content. For example, after a marathon, the plasma triglyceride content in a participant's body will be about 10% lower than before the competition. A large number of experimental studies have proven that the higher the HDL content, the lower the probability of suffering from coronary heart disease. This is because HDL does not accumulate in large amounts on the arterial walls and can assume certain metabolic functions for the human body. promptly remove lipoproteins accumulated on arterial blood vessel walls, and reduce the prevalence of cardiovascular disease. Compared with high-density lipoprotein, low-density lipoprotein has larger molecules, has adsorption effect on the arterial blood vessel wall, and has no automatic clearance ability (Edwards, 2006). Therefore, the higher the content of low-density lipoprotein, the more protein content accumulates on the arterial blood vessel wall.

### 5.4 The impact of reasonable physical exercise on protein metabolism

The so-called reasonable sports refer to persisting in exercise for a long time and planning exercise time and sports according to one's own situation.

	Synthesis rate	Decomposition rate
Quiet	33.2±1.8	26.3±2.6
before exercise	27.6±1.5	40.8±2.7
after exercise	41.7±1.9	36.5±1.4

Protein is one of the three major functional substances in the human body. The rate of protein decomposition and synthesis affects the continuous energy supply capacity of muscles. As can be seen from Table 2, the protein in the human body in different states

Conversion rates vary. Before and after exercise, the protein conversion rate is greatly affected [8].

If you do not exercise for a long time and suddenly continue to exercise for a long time, the protein content of skeletal muscle and the protein content of the heart muscle will drop significantly. Through experimental studies on other animals, it has been found that the synthesis rate of liver protein decreases by one-fifth when sudden and continuous running occurs, and the highest decrease rate can reach more than 60%. However, with continued low-



intensity exercise, the decrease in liver protein synthesis rate is not obvious. As time goes by and exercise intensity increases, the synthesis decreases rate increases. For example, if a classmate does not exercise for a long time and suddenly swims for 1 hour, the liver protein synthesis rate will drop by about 20%. If he performs treadmill training for 1 hour, it will drop by 30% or more. When the running time continues to increase, he will approach the physical limit. The decline rate of liver protein synthesis will exceed 60%, seriously affecting human metabolism and health (Głuszek et al., 2020). Therefore, the importance of reasonable exercise needs to be repeatedly emphasized before exercise.

### 5.5 Reasonable physical exercise stimulates human metabolism

In physical education, sports are divided into different types of exercise according to different classification standards. For example, according to the amount of oxygen supplied to the human body during exercise, it is divided into aerobic exercise and anaerobic exercise [9]; according to the level of exercise load, it is divided into strenuous exercise. and low-load exercise, etc. These types of sports are relatively common in physical education, but not all sports are beneficial to the human body and can promote metabolism. Only by choosing a reasonable exercise method and formulating a scientific exercise plan can we truly achieve the purpose of promoting metabolism. As mentioned earlier, proper aerobic exercise or endurance training can affect human metabolism. In the actual application process, it can be found that even if they are both aerobic exercises and exercise methods are different, the metabolic rate will be different. Among these types of exercise, aerobic exercise is the one closest to students' lives and has the greatest impact on human metabolism. Changes in metabolic rate promote the formation and development of muscles. Proper exercise is beneficial to maintaining the activity of metabolic hormones in the human body, increasing the elasticity of arterial blood vessel walls, and promoting blood circulation in the body. It promotes the decomposition of cells in the body and ultimately maintains the acid-base balance and protein balance within the human body. However, aerobic exercise is usually gentle and is not suitable for students who want to build muscles or body strength (Głuszek et al., 2020). Compared with aerobic exercise, anaerobic exercise consumes more energy on the human body, but is beneficial to body shaping and strength training. Therefore, different types of exercise have different pros and cons, and a reasonable combination can achieve the best training effect.

## 6. Conclusion

To sum up, human metabolism is an important part of maintaining life. Through a reasonable nutritious diet and the selection of a reasonable exercise plan, the body's internal fat, cholesterol, protein and other contents can be adjusted to varying degrees, which is conducive to creating a good physical environment for metabolism. It is hoped that through the explanation of this article, people can realize the important role of diet and exercise on human metabolism, so that they can use scientific and reasonable diet and exercise arrangements in daily life to promote healthy development of the body.

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