

Exploring the Effects of Fasting on Metabolism

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ABSTRACT

Fasting is a common way to lose weight and might also help with health issues like type 2 diabetes. Many people are curious about how intermittent fasting affects health, aging, and the chances of developing diseases. This paper examines how fasting influences human metabolism, including how the body uses fats, sugars, proteins, and hormones. It also explains the metabolic changes that occur during fasting and discusses how fasting can impact mental health, the connection between mood and blood sugar levels, and the positive effects fasting can have on emotions.

Keywords: Hormones, Nutrition, Fasting, Metabolism, and Testosterone

Introduction

Fasting is when people eat less solid food. People all over the world practice different kinds of fasting based on their traditions, culture, or religion. In the past, doctors like Hippocrates used fasting to help people feel better. Later, many European doctors also suggested fasting to treat both short-term and long-term health issues. Today, most people eat several times a day, which means they have

long eating periods and short fasting periods (Johnstone et al., 2007). Eating too much high-calorie food and not getting enough physical activity can slow down the body's metabolism and increase the risk of diseases like obesity, diabetes, heart disease, stroke, and dementia. Because of this, scientists are studying different fasting methods to improve health and help with weight management.

Fasting can be divided into short-term methods, like intermittent fasting (IF), and longer periods of fasting that last more than 8 days. Intermittent fasting is a new way to manage when and what to eat. During fasting periods, people don't eat any food that contains calories. The word "intermittent" means alternating between fasting and eating (Harvie et al., 2017). There are different types of intermittent fasting, such as alternate-day fasting, time-restricted feeding, whole-day fasting, and modified fasting.

On fasting days, people eat about 25% of their usual daily calorie intake, which is around 2090 kilojoules (Pellegrini et al., 2020). You can choose the times that fit your schedule. Common options include fasting for 16 hours and eating for 8 hours, fasting for 18 hours and eating for 6 hours, or fasting for 20 hours and eating for 4 hours.

On those days, people eat about 1672 to 2508 kilojoules and eat normally on other days. Examples include the 5:2 methods, where people eat very little on two days, and the 4:3 method, where they eat less on three days. Ramadan fasting is a special kind of time-restricted eating. During Ramadan, people don't eat, drink, smoke, or take medicine during the day, but they can eat and drink from sunset until dawn. Compared to the Mediterranean diet or continuous calorie restriction, intermittent fasting doesn't control how much people eat during eating times, which makes it easier to follow and more comfortable. This article explains how fasting affects human metabolism and mental health (Patterson et al., 2015).

The Effect of Fasting on Human Lipid Metabolism

Studies show that when people fast every other day for 8 to 12 weeks, their bad cholesterol (LDL) levels can decrease by 20 to 25 percent, and their triglyceride levels can drop by 15 to 30 percent. Also, during this time, the size of the LDL particles tends to increase. Similar results occur when people practice fasting every other day for 3 to 12 weeks. These studies find that total cholesterol decreases by 10

to 21 percent and triglycerides go down by 14 to 42 percent in people who are of normal weight, overweight, or obese. Total cholesterol decreases by 5 to 20 percent and triglycerides fall by 17 to 50 percent.

All these studies together suggest that intermittent fasting can help lower blood fats. When the body uses up all the stored glycogen in the liver, which usually happens 12 to 36 hours after fasting starts, it switches from making and storing fat to breaking down fat for energy. This process causes more free fatty acids to be released into the blood (Kowaltowski et al., 2020). The liver and other tissues use these fatty acids to make ketones, which act as an energy source, especially when food isn't available.

Also, all types of intermittent fasting can help the body burn more calories through a process called thermogenesis. This happens when white fat turns into brown fat, which is better at burning calories. Brown fat uses a protein called UCP1 to release energy as heat, helping the body burn more calories and reduce high levels of fat in the blood caused by eating too much fat (Nedergaard et al., 2018).

The Effect of Fasting on Human Glucose Metabolism

Adults who were overweight and followed an 8-week plan where they fasted every other day saw a significant drop in their blood sugar levels, and their insulin levels also went down, though not by much. In another study, people who ate only between 10:00 a.m. and 6:00 p.m. for 12 weeks and then fasted for the rest of the time did not see much change in their blood sugar, but their insulin levels and a measure called HOMA-IR went down slightly (Singh et al., 2013). Another study showed that when people followed a 2-day very strict diet and then ate normally for 12 weeks, those with type 2 diabetes and obesity had better control over their blood sugar and lower HOMA-IR levels. A separate study found that when people ate all their meals within a 6-hour window, with dinner before 3:00 p.m., for 5 weeks, their bodies became more sensitive to insulin, and their beta cells, which help make insulin, started working better.

All these studies show that different types of intermittent fasting can have varying effects on how the body handles sugar in overweight people, and the results depend on how long they fast, how often they do it, and how healthy they were to begin with (You et al., 2010).

The Effect of Fasting on Human Protein Metabolism

During fasting, the body uses protein to generate energy. Proteins are composed of amino acids, which are essential for the body and perform specific functions. They are a crucial part of the diet. Fasting can alter the levels and types of amino acids in the body, leading to confusion and frustration. The duration of the fast influences these changes. Palou and others studied rats that fasted for 24 hours and examined their blood (Palou et al., 2008). They found that after 3 hours of fasting, levels of lactic acid, total amino acids, and essential amino acids decreased significantly. At the same time, other substances like glycerol, free fatty acids, beta-hydroxybutyric acid, and acetoacetic acid increased. Some amino acids, such as arginine, alanine, serine, threonine, aspartic acid, and proline, also decreased. A few other amino acids showed little change. Lysine, leucine, isoleucine, and taurine had levels that initially dropped and then slightly increased after 12 hours of fasting. The amount of essential amino acids decreased more than non-essential amino acids. Another study found that when urea levels were low during fasting, ammonia levels also decreased, but overall nitrogen levels remained the same (Veeneman et al., 2004).

The Reason for the Different Outcomes among the Above Studies

There are many reasons why different studies show different results. One reason is that having strong religious beliefs can be good for a person's health, both physically and mentally. For people who deeply care about their faith, fasting can feel easy and even enjoyable. But for those who do not believe in religion, fasting might make them feel bad or stressed. Another reason is that fasting involves self-control. It takes a lot of mental strength to resist the urge to eat and to stick with fasting for several days. However, when someone successfully completes a fast, they might feel more in control of themselves.

Also, the tools used to measure mental states can give different results. For example, in a study about Ramadan fasting in Germany, researchers used the Visual Analogue Scale (VAS) and the Fatigue Severity Scale (FSS) to assess fatigue (Anic et al., 2022). The VAS showed that fatigue first increased and then decreased, but the FSS showed that fatigue kept dropping throughout Ramadan.

Past experience with fasting can also influence the outcome. A study found that people who had fasted before felt less stressed, had fewer negative emotions, and had

more energy than those who had never fasted. Lastly, how someone feels at the start of fasting can have a big impact. In a Ramadan study, the group that started with normal moods did not change much in terms of depression, anxiety, or stress before and after Ramadan. But the group that started with depression, anxiety, and stress showed lower levels of these issues by the end of the month. This suggests that Ramadan might help people with mental health problems such as depression, anxiety, and stress (Elsahoryi et al., 2025).

Intermittent Fasting and Fat Derived Hormones

Leptin is a hormone that tells the brain when you're full by connecting to receptors in the hypothalamus. This sends a series of messages in the brain, including substances that can make you feel less or more hungry. Leptin also works with the brain's dopamine system, which affects how enjoyable eating is. It also activates part of the brainstem that helps signal when you're full. Adiponectin is a hormone made by fat cells and helps control different body functions, such as improving insulin sensitivity and lowering inflammation. In healthy people, leptin helps the pancreas make less insulin, and insulin, in turn, helps fat cells release more leptin. Leptin also helps the liver make glucose and supports muscles and the heart in using glucose. If the body doesn't respond well to leptin, the brain doesn't get the right signal, which can cause high blood sugar and higher insulin levels. A study looking at fasting during Ramadan found that leptin levels go down, while adiponectin levels stay about the same (Al-Rawi et al., 2020).

Leptin is mostly released when insulin changes how fat cells work. When people eat less food, lower insulin levels can affect leptin levels. Also, when people eat at different times, it can change when leptin is released during the day. Another study found that fasting and eating less can lower leptin levels. Adiponectin levels can go up when food intake is less than half of usual. Adiponectin is beneficial because it helps reduce inflammation and protects against problems with blood vessels. It is also connected to body fat and how well insulin works. The balance between adiponectin and leptin may be a better way to check for insulin resistance than looking at either hormone alone. As metabolic syndrome gets worse, this balance tends to drop, which can help identify if someone has metabolic syndrome. Overall, fasting can improve how the body uses glucose by lowering leptin levels

and raising adiponectin levels, depending on how much food is eaten (Opie et al., 2007).

Fasting and Circadian Rhythms

Time-restricted eating appears to influence the natural rhythms of genes within the body's internal clock. To adapt to changes in the timing of food availability, the body's energy system begins to align with a daily cycle. This occurs because the body's internal clocks rely on a system where certain proteins activate genes, while others deactivate them. Proteins like BMAL1, CLOCK, NPAS2, and ROR activate genes, whereas PER, CRY, and REV-ERB deactivate them, creating a 24-hour cycle of gene activity. Eating and fasting also impact proteins such as AMPK, CREB, and AKT, which regulate various metabolic processes (Schultze et al., 2012). There is a strong link between the body's clock system and these proteins, leading to coordinated changes in gene activity and enhanced function in critical areas of the body, such as the brain, communication signals, and energy metabolism. When the body's clock becomes disrupted, it can lead to health issues like obesity and diabetes. Thus, maintaining a regular schedule for eating and fasting might be important for supporting good metabolic health. Interestingly, time-restricted eating has also been found to alter the timing of testosterone release throughout the day. Eating has been shown to rapidly lower testosterone levels, which can affect when this hormone naturally appears in the body (Anderson et al., 1985).

Conclusion

A long time ago, people practiced fasting for religious reasons and didn't realize it could also be good for their health. Now, intermittent fasting is being studied extensively and has become a popular health trend. However, we still don't know everything about how fasting affects the body, nor which methods are best for getting the most benefits. When you fast, it changes several things inside your body, such as sex hormones, hormones that help break down fat, growth hormone, insulin, and the bacteria in your gut. Fasting makes your body break down fat and send it into the blood while also storing some of it in your muscles. Insulin levels go down, so your muscles store less sugar. Even though fasting might lower testosterone directly, it can also raise it indirectly by reducing the activity of an enzyme that turns estrogen into testosterone. Higher testosterone helps your body use glucose

more effectively. Fasting also increases growth hormone, which helps your liver make more glucose and release it into your blood. It also helps break down fat and release more free fatty acids. Fasting lowers leptin and raises adiponectin, which makes your liver produce less glucose and makes your body more responsive to insulin.

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