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## Are Three Meals A Day Sufficient?

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### ABSTRACT

A meal aids in the intake of nutrients through food. In a meal, food is taken either in the raw form or in the processed form. Each food largely differs in terms of the amount and type of nutrients present. Additionally, the required nutrient intake varies according to age and sex. For this reason, people must consume a combination of various foods. For many years, it has been customary for Japanese people to eat three meals a day. However, in recent years, there has been an increase in the number of people who cannot or do not eat three meals owing to busy work and calorie intake. This study provides insights into and basic information on whether three meals a day are needed.



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## INTRODUCTION

It is well-known that meal aids are in the intake of nutrients through food. Nutrients are essential for supporting human life<sup>1,2</sup>). In a meal, foods are ingested either in processed form or in raw form. There are five major nutrients: sugars (carbohydrates), lipids, proteins, minerals (inorganic substances), and vitamins. The first three are the three major nutrients, which contribute to energy production, and the last two are mainly involved in the regulation of metabolism in the body<sup>3</sup>). The number of nutrients varies greatly in each food item, and the required intake of nutrients varies depending on age, sex, and intensity of exercise<sup>4</sup>). For this reason, it is necessary to consume the required nutrients through various foods<sup>3</sup>). Approximately 60% of the energy requirement is derived from basal metabolism (the amount of energy required without exercising), nearly 10% is derived from diet-induced heat production (the amount of energy obtained when the body temperature increases when eating), and approximately 30% is derived from physical activity (the amount of energy required for exercise)<sup>4</sup>). The basal metabolic rate accounts for a large proportion of the energy requirement<sup>5</sup>), but it also depends on sex, age, and physique (Table 1). Individual differences are also observed based on the amount of physical activity.

In Japan, it has long been customary to eat three meals a day: in the morning, noon, and evening<sup>6</sup>). However, in recent years, owing to changes such as busy work and working in shifts in the center of activity hours in the evening and night, an increasing number of people do not necessarily (or cannot) eat three meals a day<sup>7</sup>). Is it necessary to eat three meals a day? Or is it better to increase or decrease the number of meals? Furthermore, does the optimal number of meals vary from person to person? This study provides insights into and basic information on whether three meals a day are needed.

### ***Why do people have to eat?***

Our body has certain involuntary functions, such as maintaining circulation (heart), initiating thought processes (brain), and regulating body temperature (skin). However, our body also performs voluntary actions, such as moving the limbs. All of these actions require energy, and nutrients are involved in producing the required energy<sup>3</sup>). Nutrients are required regardless of whether voluntary actions are being performed. This is because the components that constitute the body are constantly being replaced by dietary substances, i.e., nutrients. This process is known as metabolism. Both bones and blood components have a limited

lifespan and undergo bone remodeling and hematopoiesis, respectively, wherein the old ones are replaced with the new ones. Nutrients play an important role in these regeneration processes. Therefore, people must consume proper food.

However, the human body maintains homeostasis<sup>3)</sup>. Glucose, which is mainly used to produce energy, is a typical example of sugar and is a component of table sugar (sucrose), which is often used for seasoning (sweetener) in meals. Sucrose is enzymatically metabolized in the gastrointestinal tract to glucose and fructose, which are then absorbed from the intestine into the body. When absorbed into the body, the blood glucose concentration temporarily increases, but eventually, it remains at a constant level. The amount of glucose absorbed and the amount used in each cell may vary depending on the situation. Enzymes such as insulin and glucagon act in a cyclic manner such that the residual glucose concentration reaches an almost-constant value, and the substance is temporarily replaced with another substance, or the converse occurs<sup>3)</sup>. Alternatively, excess material is excreted outside the body without being used. Considering these processes, the nutrients necessary for everyday activities are prepared in the body, and, to some extent, the excess is stored and can be used when needed, even if nutrients are not constantly supplied through the diet. This can be observed from the fact that you do not have to keep eating all the time when you are awake. As expected, the amount of stored food is limited; hence, it is desirable to supplement approximately the same amount of nutrients through the diet according to the amount consumed. Considering the sleep-wake cycle, it is often possible to consider the consumption and supply of nutrients on a daily (24-hour) basis. Therefore, it is better to eat at least once a day to supplement the essential nutrients.

Food contains one or more nutrients, but unfortunately, no food contains all the nutrients required by the human body in a well-balanced manner<sup>8)</sup>. Therefore, it is necessary to understand the ingredients or characteristics of each food and supplement it according to the required amount of nutrients. It is also necessary to consume food in a combination. However, the food consumption of each person varies according to their preferences. In other words, it is natural and important to have a balanced diet overall. There are controversial opinions regarding whether a meal should be considered for each time of the day, considered as a whole for each day (multiple meals of the day), or considered for each week. Currently, the mainstream practice is to eat meals in a balanced manner. It is suggested that a person

should consider at least every meal a day. This is because meals may also be involved in adjusting the circadian rhythm (a clock-like rhythm in the body).

### ***Historical background of three meals a day***

The concept of three meals a day is now commonplace, but hundreds of years ago, the Japanese consumed only two meals a day<sup>6)</sup>. This means that they did not eat outside, eat food only in the morning and evening at home, and go to work. Many years ago, people did not rely on light and went to sleep only when it became dark; hence, it was not a major problem. A diet pattern of three meals a day was recommended in the Showa period (around 1950), but the Japanese began eating three meals a day only in the Edo period (around 1740)<sup>6)</sup>. When there were many fires, many carpenters and craftsmen were gathered by the shogunate (like the government at that time) for reconstruction, and the work was done all day long. For manual workers, the morning and evening meals alone did not provide sufficient physical strength, and it is believed that they began to eat additional meals, which corresponds to the current lunch that originated in Japan. It was also actively used only when it was bright, but this may be because oil for lighting was gradually used. By using light at night, the activity time of the day becomes longer, and they began to think that two meals a day were not enough. This thought has consequently changed to a life of three meals a day<sup>6)</sup>.

In the West, a diet pattern of two meals a day was once the mainstream, but it is said that it became three meals a day owing to the influence of the famous inventor Edison<sup>6)</sup>. In an interview with the media, he replied, “Eat three meals a day,” when asked, “How can people be as smart as you?” This influence spread widely across society. At that time, everyone wanted to be as smart as Edison; hence, this statement may have had a huge impact on people’s thoughts. It is believed that this influence has also changed the eating habits of people in developed countries, further affecting those of Japan, which eventually became a habit of eating three meals a day.

### ***Why should people eat multiple meals a day?***

In the previous section, we mentioned that several meals are needed every day to consider the intake of nutrients daily. The most common practice in Japan is to eat three times a day. In addition, some people consume snacks and eat more frequently, whereas others skip one meal and eat two meals.

Let us assume that you consume one meal a day. There is an idea that if you consume a higher amount of time, then the excess nutrients will not be used and will accumulate in the body, leading to obesity. Sumo wrestlers sometimes eat this way because they want to gain more weight for their purpose<sup>9)</sup>. There is also an idea that the proportion of unused substances in the body increases and many of them may be excreted. Before that, it may be practically difficult for women, in particular, to consume many foods at a time. Therefore, if an athlete or the like forcibly eats a large amount, then it may be possible to consume a large number of nutrients with a meal once a day. In other cases, obtaining sufficient nutrition may be difficult. To solve this problem, it is preferable to reduce the amount of food consumed at one time and take the required amount multiple times a day. In addition, excessive hunger may increase food intake. Apart from the amount required by the body, the desire to achieve a feeling of fullness by eating becomes stronger. It is well known that eating only once a day makes it favorable to ingest a large number of nutrients rather than eating it multiple times. It takes a certain amount of time to achieve fullness, and this is particularly likely to happen if you eat faster than you do. This is a comparison of the amount taken in one meal with the amount taken in multiple meals, and this does not necessarily mean that you will eat enough to exceed the daily requirement (especially if you stop eating at the same time as you are full). To avoid this, it may be desirable to utilize more time eating slowly or divide one meal into multiple meals. However, if you think about each meal properly, the intake and calories tend to increase for each meal. This is particularly true if one is aware of the amount and balance of nutrients in each meal. If you ensure to eat three meals properly, then it is important to stop before achieving fullness; however, continuous eating until reaching fullness can lead to over nourishment.

### ***Number of meals as a medical remedy***

The idea of eating one meal a day is to break away from the habitual meal and to eat what the body needs according to the requirement<sup>10)</sup>. The biggest advantage of eating one meal a day is that one can eat what one likes without worrying about the calorie intake. The process of digesting dietary substances in the stomach and absorbing them through the intestine takes a certain amount of time. If you eat less often, then your stomach will be empty and you will have more time to be hungry, which is referred to as the gastrointestinal rest time<sup>7)</sup>. By reducing the number of meals, you will be less likely to become drowsy after eating, thereby

enhancing blood flow to the brain. Many people have reported that their body becomes lighter in such a scenario.

Conversely, increasing the number of meals with an intent toward weight loss is also popular<sup>10)</sup>. Considering the consumption of calories and the production of meal-induced heat, there is an increase in the frequency of metabolism and body temperature elevation per day. If nutrients are continuously replenished, then the brain is signaled to accept the excess nutrients in the body, and it becomes difficult to store fat. This is reported to be the mechanism underlying weight loss caused by increasing the number of meals. A diet pattern of four meals a day is recommended for people who are busy with work and tend to have late dinner. Moreover, it is advisable to have a meal in the morning, noon, evening (a light meal), and night. Eating a low-calorie, low-carbohydrate meal prevents overdose late at night. For five meals a day, it is recommended to add two snacks to three meals, each in the morning, day, and night. According to Western studies, people who consume five meals a day have a lower body fat percentage than those who consume three meals. Five meals a day is a diet pattern for people with diabetes, and because it does not achieve sudden fullness from hunger, the increase in the blood glucose level becomes moderate. It is essential to consider the amount of intake properly when choosing to eat multiple meals a day, and notably, excessive overdrinking and eating are not effective at all<sup>7)</sup>. Increasing the number of meals will increase the upper limit of nutrient intake, but it will be necessary to consume only the prescribed amount, even if fullness is not achieved (such as a restricted diet during hospitalization).

If you eat three meals a day, then it will be ideal to eat three meals with the same amount of food regularly. For example, if you are an adult, it is recommended to divide the required 2000 kcal into three proportions and consume 600-700 kcal every 5-6 hours. This well-balanced diet is easy to practice in terms of both quality and quantity and is suitable for many people. Table 2 summarizes the advantages and disadvantages of eating three meals a day, but this is generally true even if it is replaced with one to five or more meals a day.

### ***Significance of eating breakfast***

This section describes the significance of eating breakfast only, not the number of meals. Many people do not eat breakfast because they are busy with work, have no appetite in the morning, and wish to sleep for more hours in the morning. Not eating breakfast can have

various adverse effects on the body<sup>6)</sup>. In particular, the brain enters an energy-deficient state for a long period; therefore, the blood flow to the brain may decrease during the morning, thereby impacting work efficiency. People who do not eat breakfast are more likely to experience hypothermia, which may cause a decrease in immune function and physical discomfort<sup>6)</sup>. Skipping breakfast can maintain low blood glucose levels (below normal) for a long time. To compensate for this, excess eating at the next meal increases the absorption rate of nutrients drastically, and the blood glucose level may increase sharply. A spike in blood glucose levels causes excessive insulin secretion in an attempt to lower the excessive blood glucose level. The insulin acts to counterbalance the lowered blood glucose level and the cycle of a rapid increase in the blood glucose level occurs even during the next meal, which causes the risk of diabetes and obesity<sup>6)</sup>.

Nutrients also have the effect of increasing blood flow to the brain, thereby alleviating drowsiness<sup>9)</sup>. It is necessary to eat breakfast before beginning the daily activities to supplement the water consumed while sleeping and awakening. (In routine, a person sleeps at night and stays awake in the daytime; energy consumption per unit time is low at night, but for a long period; hence, it is thought that some amount of energy is required.) If snacks are not consumed, then a separate meal may be needed to supplement the energy consumed after the morning. There are multiple ways of thinking about whether the meal after breakfast is two meals, day and night, or once in the evening (Eating little by little over 3 times has the advantage that the calorie intake is less likely to be excessive)<sup>9)</sup>. However, considering that there is not much extent of activity after dinner, it is recommended to avoid late dinner and a large amount because it may tend to be excessive.

## CONCLUSION

Since the recommendation of three meals a day, the working population in Japan has changed and lifestyles have diversified. College students who engage in sports and office workers in their 40s, who mainly work at desks, have different quantities and qualities of food (in terms of personal desires and necessary foods). As long as there is no extreme excess or deficiency in the total daily calorie intake, it seems acceptable to set the number of meals as you like. It is also important to create time to become hungry. It may be a good idea to remove the limit of three meals per day and determine the number of meals suitable for each person. It is recommended to eat only when being hungry<sup>10)</sup>.



The human body has various functions, which drive and sustains life. If the various functions of the body are utilized to the fullest, then it may be necessary to create various conditions daily, such as being hungry/full and active/inactive, and to create opportunities for your body to adjust to them<sup>7)</sup>. Additionally, meals not only create satisfaction<sup>11)</sup> but may also be useful for relieving stress; therefore, it is necessary to enjoy a meal rather than just focusing on nutrient consumption.

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**Table no 1: Basal metabolic rate by age and sex**

| Age   | Basal metabolic rate (kcal) |        | Reference weight for male/female(kg) |
|-------|-----------------------------|--------|--------------------------------------|
|       | Male                        | Female |                                      |
| 1-2   | 730                         | 660    | 11.5/11.0                            |
| 3-5   | 920                         | 840    | 16.5/16.1                            |
| 6-7   | 1020                        | 910    | 22.2/21.9                            |
| 8-9   | 1140                        | 1040   | 28.0/27.4                            |
| 10-11 | 1330                        | 1240   | 35.6/36.3                            |
| 12-14 | 1550                        | 1350   | 49.0/47.5                            |
| 15-17 | 1570                        | 1270   | 59.7/51.9                            |
| 18-29 | 1520                        | 1180   | 64.5/50.3                            |
| 30-49 | 1520                        | 1140   | 68.1/53.0                            |
| 50-69 | 1380                        | 1100   | 66.5/53.0                            |
| ≥70   | 1230                        | 1030   | 59.6/48.8                            |

Because it is calculated based on the reference body weight, it is considered that the number of metabolism changes depending on the increase or decrease in body weight.

Based on reference 4).

**Table no 2: Advantages and disadvantages of eating three meals a day**

|         | Contents   | Supplementary explanation   |
|---------|--|---|
| Merit   | The blood sugar level is easy to stabilize                   | Your blood sugar level increases with your diet. If the quantity of one meal is lowered and the number of times is divided, then the increase in the blood glucose level is alleviated. Even with only one meal a day, the blood glucose level increases only once a day and does not elevate at other times. |
|         | Easy to balance nutrition                                    | To maintain a nutritional balance, it is necessary to eat various kinds of foods. It is easier to do this with multiple meals. However, it is meaningless unless the nutritional balance and meal quality are taken into consideration.   |
|         | Various meals (varying in quality and quantity) can be eaten | If you eat one meal a day, the amount of food you can eat in a day will decrease (you cannot eat three times as much). As the number of times increases, you will have the opportunity to eat various kinds of food.  |
| Demerit | Less time available  | Not only do you sleep less when you eat more, but you also take more time to prepare your meals. Eating requires energy and time. The energy required for digestion and absorption is enormous.   |
|         | Do not feel like moving after eating                         | The body gets tired because it takes a huge amount of energy to digest and absorb. After eating, you feel sleepy and your body tends to become heavy.   |
|         | Increased likelihood of becoming obese                       | It is difficult to become fat with one meal a day, but three meals a day can be too much.   |
|         | Taste becomes insensitive                                    | Longer waiting time to get hungry makes you more sensitive to taste, and vegetables and water feel delicious.   |
|         | Immunity weakens   | When calorie restriction is applied, autophagy (decomposing waste products accumulated in the cells) beings to work to clean the inside of the cells.   |
|         | Concentration is reduced                                     | Drowsiness, dullness, and the amount of time spent with each meal make it difficult to stay focused.  |

Based on reference 12).