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Impact of Short-term, Repeated Water Fasting on the Weight of Mice

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ABSTRACT

Introduction: Caloric restriction is a strategy applied for weight loss. Water fasting is a popular way for obesity treatment. However, little is known about the impact of water fasting on weight. Therefore, this study was conducted to investigate the effect of short-term, repeated water fasting on the weight of mice.

Method: In this study, the physiological effect of short-term, repeated water fasting on the weight of female mice was evaluated. At 6 weeks of age, mice were randomly assigned to either repeated-fasting or control group (fed ad libitum). Each group consisted of twenty mice. As the fasting period started, the repeated-fasting group had access to only water; animals had free access to food and water on non-fasting days. Body weight of each group before, during, and after the fasting period was recorded.

Results: Body weight of the fasting group significantly decreased, unlike the control group. However, the fasting group gained weight rapidly after being re-fed and became significantly heavier than mice in the control group ($P<0.01$). Interestingly, the average body weight of the fasting group increased, compared to that of the control group; in fact, the fasting mice weighed approximately 10% heavier than the control ones.

Conclusion: Repeated water fasting was not only ineffective for weight loss but also increased the body weight of fasting mice.

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Introduction

Fasting and caloric restriction are traditional strategies for treating patients with obesity (1-3). In many cultures, fasting has been accepted as an alternative method for treating psychosomatic disorders (4).

Fasting has been shown to have many positive effects on animals and humans. Moreover, the mean and maximum of rats' life expectancy have been reported to increase via caloric restriction. Fasting can also decrease complications resulting from aging in rats (5-12). Moreover, Sogava et al. reported the beneficial effects of fasting on treating allergies and gastroenteric diseases (13).

Water fasting is a special type of fasting in which consuming foods is prohibited and the practitioner can only drink water. Water fasting is more common in Asian countries. Recent studies have also demonstrated the beneficial effects of water fasting on animals and humans.

Increasing acceptance of complementary medicine has resulted in the application of therapeutic water fasting for various purposes. However, scientific evidence in this field is not sufficient and effects of water fasting have remained unknown (14-17). Therefore, the aim of this study was to clarify the relationship between water fasting and weight loss during fasting periods.

Materials and Method

Mice

In the current study, physiological effect of short-term, repeated water fasting on the

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Figure 1. Mice kept in separate cages

weight of female mice was evaluated. The mice were kept in separate cages (Figure 1) in a room where temperature and humidity were held constant (with a 12/12-hour light-dark cycle).

At 6 weeks of age, the mice were housed in separate metal cages and randomly assigned to either repeated-fasting or control group (fed ad libitum). Each group consisted of 20 mice. The body weight of each group was recorded before, during, and after fasting. For this purpose, the weights of mice were measured on a daily basis during these periods.

Fasting regimen

Fasting was performed for 3 consecutive days, every 2 weeks. As the fasting period started, the fasting mice had access to water, only; animals had free access to food and water on non-fasting days. Control animals were fed ad libitum and the diet for both groups was similar; this regimen continued for ten weeks.

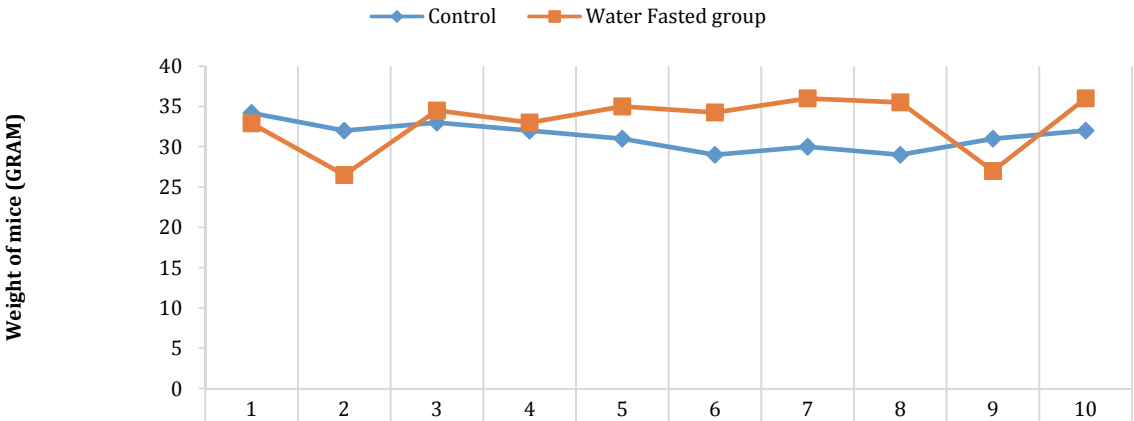
Statistical analysis

Statistical analysis was performed using Student's t-test for parametric data. For all analyses, significance level was considered to be 0.05. Data analysis was performed using SPSS version 11.5.

Results

Prior to the study, body weight (mean ± SD) of the fasting group was not significantly different from that of the control group (33.0±5.8 vs. 34.6±5.2). However, the body weight of the control mice decreased slightly during this period (Figure 2).

Body weight of the fasting mice decreased during the first fasting period (2 weeks), unlike the control group (Figure 2). The fasting group gained weight rapidly after being re-fed and became heavier than the control group (Figure 2). Interestingly, the average body weight of the fasting group became significantly heavier than that of the control group by the end of 10 weeks (36.4 ± 4.4 vs. 32.6 ± 3.5; P<0.01). Weight of the fasting mice was 10% heavier than that of the control group.



	1	2	3	4	5	6	7	8	9	10
Control	34.2	32	33	32	31	29	30	29	31	32
Water Fasted group	32.9	26.5	34.5	33	35	34.25	36	35.5	27	36

Figure 2. Effect of frequent water fasting on the weight of control and fasting groups

Discussion

In the current study, we evaluated the impact of short-term, repeated water fasting on the weight of female mice. According to our findings, water fasting could cause weight loss only during the first period and was not effective in sustainable weight loss (although it prevented weight changes).

When body does not have access to food supplies, it does not immediately rely on body fat stores for energy since there are still some short-lived energy sources such as blood sugar, energy from consumed foods in the digestive system, and muscle and liver glycogen stores. Therefore, it usually takes some hours or days before the short-lived energy stores are all emptied out. Beyond that point, body is forced to switch almost exclusively to burning body fats for survival; this is where true weight loss starts happening (18).

In addition to possible weight loss, water fasting with caloric restriction has been shown to have some positive effects on life expectancy and chronic diseases, e.g., cardiovascular diseases, hypertension, and type 2 diabetes. Fasting has also been shown to decrease cancer rate by reducing cell proliferation (19). In this regard, many trial studies have suggested that medically supervised water fasting is a safe and effective means of moderating metabolic and chronic disorders and may assist health promotion (20).

As other animal studies have indicated, fasting might enhance survival rate and alter biochemical factors associated with life expectancy (21). Valter Longo showed that fasting has a positive impact on insulin-like growth factor-1 (IGF-1) expression, which affects the aging process. According to the aforementioned research, when an individual consumes food, IGF-1 drives cells to reproduce and intrigues the aging process. Therefore, intermittent fasting decreases IGF-1 expression and switches on other DNA repair genes. In this way, intermittent fasting switches the body from “growth mode” to “repair mode”(22).

Many other in-vitro and in-vivo studies have demonstrated the beneficial or adverse effects of fasting on various types of disorders including obesity, diabetes mellitus, and hypertension (23, 24).

Controversially, in our study, we observed weight gain of rats over a long-term period. Therefore, it can be concluded that many other factors may influence body weight, apart from the amount of food consumption. For instance, in one study by Satchidananda Panda et al., mice were given a high-fat, high-calorie diet, which was changed when they were allowed to eat. Despite consuming the same amount of calories, mice with access to food for only eight hours at night (the most active period for mice) remained lean and did not develop any health problems. On the other hand, the all-day access group became obese and was afflicted with health problems including high cholesterol, high blood sugar, fatty liver disease, and metabolic problems (18, 25).

The findings of the mentioned study suggest that body may benefit from the break it receives while fasting, whereas constant eating may lead to metabolic exhaustion and health consequences such as weight gain. The latest studies by researchers show that it is possible to avoid metabolic diseases by periodic fasting or adhering to regular meal schedules rather than eating small meals off and on all day (18).

On the other hand, some studies showed that water and food fasting may increase hematocrit, serum protein, and albumin levels, which can lead to increased viscosity. These fasting-induced changes could deprive vital organs of blood supplies in patients with venous insufficiency (26). In another study, water fasting resulted in reduced heart rate and capacity of physical activity at rest (27). However, several effects of fasting on lipid or adipose formation are still unclear.

Conclusion

Strict caloric restriction such as water fasting could cause weight loss only in the beginning. More interestingly, repeated water fasting was not only ineffective for weight loss but also led to weight gain in fasting mice. Nevertheless, short-term, repeated fasting could prevent weight changes and balance the weight of mice. Further human studies with large populations should be performed in order to demonstrate the possible impact of water fasting on obesity.

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