

Association of Fasting with Heavy Metals and Minerals: A Review Study

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ARTICLE INFO	ABSTRACT
<p><i>Article type:</i> Review article</p> <hr/> <p><i>Article History:</i> Received: 03 Feb 2018 Accepted: 15 Mar 2018 Published: 03 May 2018</p> <hr/> <p><i>Keywords:</i> Fasting Heavy Metal Minerals Ramadan</p>	<p>Millions of Muslims fast during the month of Ramadan and avoid eating and drinking during this month (1). Fasting is a healthy and non-pharmacological way to improve your health and weight loss (2, 3). During fasting days, nutritional patterns and the amount of food consumed will change (4). It can be concluded that these changes can lead to changes in the metabolism of the human body. The purpose of this review is to investigate the effect of fasting on the rate of secretion and absorption of heavy metals and minerals. According to the former studies during the fasting period, the amount of heavy metal adsorption and disposal and its toxic effects increase. On the other hand, by addition of calcium and phosphorus supplements, it is possible to reduce heavy metal adsorption. Moreover, due to the increase in the absorption of minerals with the empty stomach, individuals with mineral deficiencies can take more of these minerals and trace elements during fasting. Also, Fasting can reduce body mass and release mercury from tissues.</p>
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Introduction

Ramadan is a special month for Muslims in the world. During the month of Ramadan, Muslims avoid eating, drinking and even smoking (5). During Ramadan Muslims have two main meals, the first meal is before dawn and the second one is after sunset and they repeat this style of food for a month (6). In fact, during fasting, normal life, the pattern of sleep and awakening, physical activity, diet, and the amount of water and food intake changes. (7-10). It can be concluded that these changes can lead to changes in the Metabolism and functions of the human body.

As a result, these changes made us investigate the effects of fasting on the amount of minerals and heavy metals present in the body. Because there was no study on these two items at the same time.

Heavy metals are a group of compounds with an atomic density of greater than 4 g/cm³ (11).

These elements are of high density and may exert significant toxicity, even at minimal amounts (12). Heavy metals include lead (Pb), cadmium (Cd), zinc (Zn), mercury (Hg), arsenic (As), silver (Ag), chromium (Cr), copper (Cu), and iron (Fe) (13). According to studies, the most hazardous heavy metals to human health are lead, cadmium, mercury, and arsenic. The acute toxicity caused by heavy metals may cause skin cancer, hyperkeratosis, pigmentation changes, and lung cancer (14).

The purpose of this study was to investigate the effect of fasting on the absorption and disposal of minerals and heavy metals.

Effect of Fasting on Cadmium Toxicity

In a study focusing on cadmium toxicity, mice were administered with 75 mg/kg of cadmium. After 24 hours of fasting, the cadmium intake in the test animals was

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observed to be significantly higher compared to the control group (fed with additional cadmium for 24 hours). Moreover, higher liver damage was denoted in the test group compared to the control group since the liver is considered to be the most sensitive organ to cadmium toxicity (Table 1) (15).

Fasting and Urinary Arsenic Excretion

In low-income areas, arsenic intake through contaminated water is a common health hazard. Consequently, arsenic metabolites, including methylated arsenic, arsenobetaine, dimethylarsinate, arsenite, and arsenate, are among the leading causes of cancer in these areas.

In a study in 2007, urine arsenic concentration was measured in 29 healthy individuals before and after 12 hours of fasting using HPLC and ICP-MS analysis (Table 1). According to the findings, there were no changes in the level of urine arsenic, while the measurement of arsenic metabolites was indicative of the significant increase in the concentration of methyl arsenic. Therefore, it could be concluded that the concentrations of arsenic metabolites may elevate in fasting individuals (16).

Fasting and Absorption of Lead, Calcium, and Phosphorus

In 1983 and 1993, some studies investigated the absorption and excretion rates of lead in humans and mice (Table 1). According to the obtained results, fasting increased the rate of lead excretion in the urine and stool and was associated with higher liver damage. However,

using calcium and phosphorus supplements was reported to reduce the rate of lead absorption (Table 1). Therefore, it could be concluded that these supplements prevent the excessive absorption of lead. Since the absorption rates of calcium and phosphorus increase on an empty stomach, additional dietary minerals were recommended while fasting (17, 18).

Fasting, Body Composition, and Minerals

In the past, long-term fasting was recommended as a treatment for obesity. Reports suggest that fasting individuals could lose 500-1000 grams of body weight per day. If fasting is accompanied by physical activity, the weight loss will be more significant. In a research in this regard, the effects of fasting alone and fasting with physical activity were investigated (Table 1). According to the findings, although fasting with physical activity led to the loss of more protein, fat, and water, it had no significant effects on the levels of mineral in the body.

Other findings in this regard have demonstrated that the intestinal absorption of minerals may decrease in the presence of food in the intestines, which could be due to the association of minerals with foodstuffs, reduced contact with the gastrointestinal wall, and other physical processes (19). Therefore, it could be concluded that fasting individuals could incorporate physical activities into their routine and lose weight without any significant deficiencies in their mineral levels (20).

Fasting and Mercury Concentration

Methylmercury is a neurotoxin, which is

Table 1. Summary of Reviewed Studies

Authors/Year	Title	Results
Shimizu M. and Morita S. (1990)	Effect of Fasting on Cadmium Toxicity	Fasting increased cadmium intake and toxicity.
Brima E.I. and Jenkins R.O. (2007)	Effect of Fasting on the Pattern of Urinary Arsenic Excretion	Fasting increased the urinary excretion of arsenic metabolites.
Hayashi M. and Yamamoto K. (1993)	Effects of Fasting on the Distribution and Excretion of Lead	Fasting increased the excretion of lead in the urine and stool of mice.
Heard M. and Chamberlain A. (1983)	Uptake of Lead by Humans and the Effects of Minerals and Food	Fasting increased the excretion of lead in the urine and stool of humans.
Doluisio J., Tan G., and Billups N. (1969)	Drug Absorption II: Effect of Fasting on Intestinal Drug Absorption	Fasting increased the intestinal absorption of minerals.
Babirak S.P. and Dowell R.T. (1974)	Total Fasting and Total Fasting Plus Exercise: Effects on the Body Composition	Fasting decreased the body mass and had no effects on minerals.
Seewagen C.L. and Cristol D.A. (2017)	Mobilization of Mercury from the Lean Tissues during Simulated Migratory Fasting in a Model Songbird	Fasting increased serum methylmercury.

easily absorbed in the thin tissues of birds and animals due to its high solubility in lipids. This compound is mostly accumulated in the liver, kidneys, and muscles. In 2016, a study assessed the concentration of methylmercury in the tissues and blood of migratory birds. To this end, various doses of methylmercury were administered to fasting birds, and the level of methylmercury was measured in their blood. The results showed that the concentration of methylmercury increased significantly in the test group. In the control group, despite a significant reduction in the body tissues, the level of methylmercury was observed to increase, indicating the release of methylmercury from the tissues during protein catabolism (21).

Conclusion

According to the reviewed studies, fasting is associated with the increased concentrations, absorption, disposal, and toxic effects of heavy metals. Therefore, fasting individuals must pay special attention to adequate water and food intake during the holy month of Ramadan. On the other hand, the addition of calcium and phosphorus supplements could reduce the absorption rate of heavy metals. Considering the higher absorption of heavy metals on an empty stomach, it is recommended that fasting individuals with mineral deficiencies use higher amounts of these supplements in their diet. Findings of the current review indicated that fasting has no effects on the reduction of minerals in the body, while it may decrease the body mass and release mercury from the tissues.

Conflict of interest

The authors of this paper declare no conflicts of interest.

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