شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

HANAA ALY

Serum Hepcidin Concentration in Relation to Iron Deficiency in Ain Shams Athletes

Thesis
Submitted for Partial Fulfillment of Master Degree in Clinical Nutrition

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Serum Hepcidin Concentration in Relation to Iron Deficiency in Ain Shams Athletes

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Abstract:

Background: Iron deficiency is a frequent and multifactorial disorder in the career of athletes. Exercise-induced disturbances in iron homeostasis produce deleterious effects on performance and adaptation to training. Thus, the identification of strategies that restore or maintain iron homeostasis in athletes is required

Aim of study: To determine the relation between regular physical activity, iron level and hepcidin level as well as inflammatory markers among a sample of medical Ain Shams University students.

Subjects and Methods: The current study is a descritptive study of 54 students from 200 students that follow regular physical activity among 1220 Ain Shams medical students. Our study group was divided into two groups. Group 1 included 23 students with reduced serum iron level. Group 2 included 31 students with reduced serum iron level

Results: There was no significant difference observed between studied groups regarding BMI, waist circumference, hip circumference and waist hip ratio and the hemoglobin level. However serum ferritin and hepcidin were significantly lower in reduced serum iron group than normal serum iron group. CRP was significantly higher in reduced serum iron group than normal serum iron group and shows positive correlation between with BMI in reduced serum iron whereas hepcidin show significant positive correlation between serum hepcidin and waist circumference in reduced serum iron group as well as significant negative correlation with BMI in control group.

Conclusion: the timing of sampling post exercise may show the induction of hepcidin response to exercise which may show guiding information on exact timing with iron therapy in athletes.

Keywords: Iron, Hepcidin, Nutrition, CRP, Athletes.

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List of abbreviations

BMI	Body mass index
BMP	Bone morphogenetic protein
BMPR	Bone morphogenetic protein receptors
CRP	C Reactive Protein
Cp	Ceruloplasmin
DMT1	Divalent metal transporter 1
ELISA	Enzyme Linked Immunosorbent Assay
FPN1	Ferroportin1
HCP1	Heme-carrier protein
HO-1	Heme oxygenase-1
HP	Hephaestin
IL-6	Interleukin 6
NAMS/ASU	Nutritional Assessment of Medical Students of Ain Shams University
sTfR	Soluble form of the TfR
TfR	Transferrin receptor
TNFα	Tumor necrosis factor-α
WC	Waist circumference
WHr	Waist hip ratio

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Introduction

Iron deficiency is one of the most prevalent nutritional disturbances in the world. It is a frequent event in the life of athletes ***(Domínguez et al., 2018)***. In fact, the prevalence of iron deficiency is higher in physically active individuals and athletes, in comparison to the sedentary population, moreover, exercise itself has been shown to play a regulative role in iron metabolism ***(Woolf et al., 2009)***.

Iron is an essential component of hemoglobin and myoglobin, which ensures oxygen supply to the skeletal muscle ***(Lukaski, 2004)***. In the myocyte, iron is a component of several mitochondrial proteins that are integral parts of the electron transport chain, and facilitate the activation of oxidative phosphorylation. Hence, the deficiency of this mineral may compromise the energy metabolism system by increasing the contribution of glycolysis ***(Hinton, 2014)***, reducing energy efficiency, performance and adaptations to training ***(DellaValle and haas, 2014).***

Due to the significant role of iron in optimal physical performance and health, the evaluation of iron status in athletes is of great importance in order to prevent iron deficiency **(*Worwood, 2004).***

Iron deficiency progresses in three stages: in the first stage iron stores in bone marrow, liver, and spleen are depleted; in the second stage, erythropoiesis decreases; in the

final stage haemoglobin production falls resulting in anemia ***(Heinrich, 1968).***

The mechanisms relating to iron deficiency in athletes have been increasingly investigated, with a shift in focus from the more traditionally accepted avenues of exercise-induced iron loss such as hemolysis, sweating and gastrointestinal bleeding to the influence of the iron regulatory peptide hormone, produced mainly by hepatocytes, known as hepcidin ***(Peeling et al., 2009a).***

The main function of hepcidin is related to immunity since iron is essential for the survival of invading pathogens. Hepcidin regulates iron by hindering its absorption. Thus, it seems that both iron deficiency and iron overload are influenced to a large extent by an individual's hepcidin response **(*Domínguez et al., 2014).*** Recently, factors that may affect the activity of this hormone such as training frequency, exercise modality and nutritional practices have been established ***(Peeling et al., 2014).***

Furthermore, some types of physical activity are accompanied by inflammation-like reactions that can induce an acute phase response and increase ferritin level which is an acute phase reactant. In case of exercise-induced inflammation, normal ferritin levels could be deceptive, reflecting rather an acute phase response than the true deficiency of athletes iron stores. Estimation of iron status depends on the determination of all iron parameters ***(Hallberg and Hulthen, 2003).***

Aim of the work

To determine the relation between regular physical activity, iron level and hepcidin level as well as inflammatory markers among a sample of medical Ain Shams University students.

Review of Literature

Iron

Iron is a mineral that is naturally present in many foods, added to some food products, and available as a dietary supplement. Dietary iron has two main forms: heme and non heme. Plants and iron-fortified foods contain non heme iron only, whereas meat, seafood, and poultry contain both heme and non heme iron. Heme iron is formed when iron combines with protoporphyrin IX and it contributes about 10% to 15% of total iron intakes in western populations ***(Powers et al., 2019)***.

A- <u>Iron stores:</u>

The total amount of iron in a 70 kg man is about 3500–4000 mg, corresponding to an average concentrationof 50–60 mg of iron per kg of body weight. The vast majority (2300 mg, 65%) of iron in the body is found in the haemoglobin of erythrocytes. About a tenth of total iron (350 mg) is present in the myoglobin of muscle, enzymes, and cytochromes of other tissues. Of the remainder, approximately 500 mg is found in macrophages of the reticuloendothelial system; about 200–1000 mg is stored in hepatocytes in the form of ferritin, while 150 mg of iron is found in the bone marrow.

Transferrin is the main protein in blood that binds iron and transports it throughout the body. Humans typically lose only small amounts of iron in urine, feces, the gastrointestinal tract, and skin. Losses are greater in menstruating women ***(Yiannikourides and Latunde-Dada, 2019).***

B- Iron absorption:

The duodenum plays a significant role in dietary iron absorption. The absorbed iron can be stored in the enterocytes or enter the circulation and be transported around the body bound to the liver-derived plasma protein transferrin. It is then taken up by tissues and utilized for many processes, such as erythropoiesis in the bone marrow, myoglobin synthesis in muscle, and oxidative metabolism in all respiring cells. Splenic, hepatic and bone marrow macrophages, which belong to the reticuloendothelial system, have the task of recycling iron from erythrocytes ***(Munoz et al., 2011).***

Over the past decade, the findings of several important molecules involved in iron homeostasis, including divalent metal transporter 1 (DMT1), ferroportin1 (FPN1), heme-carrier protein 1 (HCP1), hephaestin (HP) and ceruloplasmin (Cp), have helped to illucidate the mechanism of decreased iron absorption in athletes (figure 1). Intestinal iron