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Effects of iron supplement and exercise intensities on the levels of blood hemoglobin among Jimma University male soccer players

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Abstract

This study was aimed to examine the effects of Iron Supplement and Exercise Intensities on the Levels of Blood Hemoglobin among Jimma University Male Soccer Players. The subjects of this study were twenty male soccer players (ten players in each group) and they were purposively selected and randomly assigned in each group. Anthropometric (age, height, weight and body mass index), physiological (resting heart rate and blood pressure), endurance performance (12 min run and Bruce incremental test) and hematological (hemoglobin and red blood cell tests) variables were tested by digital scale in meter, digital balanced beam scale in kilogram, and body mass index was calculated, Sphygmomanometer, stop watch and humacount hematology analyzer. The analyses were carried out by the descriptive statistical analysis included mean and standard deviation, using SPSS version 16.0 software with a p-value <0.05. 5ml of blood sample were collected before, during and after supplying iron with folic acid in the 12 weeks of the study period. Therefore, both in high and moderate intensity training statistically significant mean difference were observed in RHR, SBP, DBP, Cooper test, HB and RBC at ($p<0.05$) The mean RBC difference of high and moderate intensity group was 0.98 ml/cm^3 (22.99%) and 0.75 ml/cm^3 (17.94%) respectively before and after supplementation and endurance training. The mean HB difference of high and moderate intensity group was 3.35 g/dl (23.29%) and by 2.05 g/dl (14.36%) respectively before and after supplementation and endurance training. This study showed that iron supplementation increased hemoglobin level of soccer players in high intensity and moderate intensity endurance training.

Keywords: Hemoglobin, iron supplement, red blood cell, soccer player.

INTRODUCTION

Good performance in soccer consists of many factors, including excellence in games skills, cognitive abilities to make correct decisions within the game, moderate to high aerobic and anaerobic power (1). Endurance performance at reduced exercise intensities, however, is more closely related to tissue iron concentrations because of the strong association between the ability to maintain prolonged submaximal exercise and the activity of iron-dependent oxidative enzymes.

Several studies have examined the effect of iron supplementation on iron stores and on parameters characterizing changes in aerobic capacity or physical fitness (2,4,7-11,14,16,18,19). As far as individuals with iron deficiency anemia are concerned, there is no question as to the benefit of iron-containing medications, because even mild anemia decreases the capacity for performance of physical exercise substantially (6,20).

In general, a small but significant increase in serum ferritin levels is observed following iron supplementation in most studies enrolling non-anemic athletes. Using the approximation that a 1g/L increase in serum ferritin is equivalent to 8 mg of storage iron (23), iron supplementation added a mean of between 88 to 240 mg of iron to body stores (2,4,7-11,13-16,18,19).

Some investigators also identified objective signs of improved fitness such as increased VO_{2max} (9,10), longer endurance time to exhaustion (9,19), and decreased blood lactate levels (9) and subjective parameters, for example increased training motivation (13,18). However, it is possible that some of the athletes were slightly anemic at study entry and that the positive effects noted in these studies

(9,10,19) were simply caused by the normalization of hemoglobin concentrations.

The physiological roles of minerals are importance to the athletes muscle contraction, normal heart rhythm, nerve impulse conduction, oxygen transport, oxidative phosphorylation, enzyme activation, immune functions, antioxidant activity, bone health, and acid-base balance of the blood (22).

In elite athletes daily iron losses are often increased, but this is usually compensated by enhanced absorption of dietary iron (21). Thus, we hypothesized that iron supplement and exercise intensities could have positive effects on increasing hemoglobin concentration which is the protein in red blood cells that carries oxygen to the working tissues. Therefore, the purpose of this study was to examine the effects of iron supplement and exercise intensities on the levels of blood hemoglobin.

METHODOLOGY

Study Area

The study was conducted in Jimma zone, Jimma University, main campus in Jimma town, located 350 km in south-west of Addis Ababa.

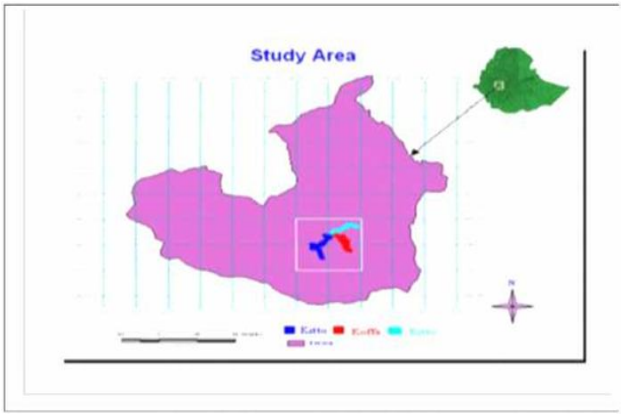

Figure 1. Map of the study area

Study Design

The researcher used longitudinal experimental research design because participants are tested than one test and trained for 12 weeks. Therefore, the data were collected from Jimma University Male Soccer Players.

Subjects

Twenty male intermediate players were purposively selected who took part in national higher governmental institutions sport festival was taken for this study. Then after, the selected subjects were evaluated the baseline iron and randomly and equally categorized in to high and moderate intensity groups before iron supplement and endurance trainings.

Participants were free of risk factors associated with cardiovascular, pulmonary or metabolic disease, deemed safe to begin physical activity, and were not engaged in other regular training program. Other exclusion criteria included medication usage and smoking. The experimental procedures and potential risks were explained prior to the study, and all participants signed written, informed consent.

Supplementation and Exercise Protocol

Both groups were supplied 3mg of iron with folic acid in tablet form three days per week for 12 weeks of the study period. After they supplied iron with folic acid both high and moderate intensity group were perform endurance exercise. The endurance training programs were long aerobic run, speed VO_2 intervals, tempo run and strength efforts.

The exercises were supervised and the intensities were verified by checking the participants' maximum heart rate during training.

The high intensity training group was performed high intensity (70% - 85% HR max) endurance training at Monday, Wednesday and Friday and the moderate intensity training group was also perform moderate intensity (50%-70% HR max) endurance training at Tuesday, Thursday and Saturday. They were perform 6:00 Am to 7:00 Am throughout the study because to minimize the risk of inconvenient time of the players.

Data Quality Control

To ensure the data quality, the researcher and Jimma University specialized hospital certified laboratory technician was conduct all the laboratory test procedures including collection and handling of materials carry out in accordance with standard protocols. The researcher and laboratory technician was check the expired date of all the reagents and keep them from contamination when using and store in favorable temperature. To ensure general safety, disposable gloves were worn out and universal precautions follow at all times. Sample collection was carried out using sterile and disposable materials.

Statistical Analysis

Descriptive statistics included mean and standard deviation was used to analyze the data and

in order to summarize hematological changes and physiological as well as fitness and performance status. Differences in mean values between 2 groups were analyzed using SPSS statistical software version 16.0. A p-value < 0.05 was considered to be statistically significant.

Ethical Issues

The study was conducted under the auspices of Haramaya University rules, policies and code of conduct governing research activities and ethical issues and also obtained approval from the Institutional Research Ethics Review Committee (IRERC) of Haramaya University College of Public Health and Medical Science, stationed at Harar campus.

RESULTS AND DISCUSSION

Hematological Test Results and Discussion

The mean RBC difference of high and moderate intensity group was 0.98 ml/cm^3 (22.99%) and 0.75 ml/cm^3 (17.94%) respectively before and after iron supplementation and endurance training. The mean HB difference of high and moderate intensity group was 3.35 g/dl (23.29%) and by 2.05 g/dl (14.36%) respectively before and after iron supplementation and endurance training. The soccer players showed significant increment of RBC and hemoglobin.

Endurance athletes with normal hemoglobin status who attempt to increase their red blood cells (RBC) and hemoglobin levels may benefit from iron supplementation (12). Iron absorption is the main mechanism through which iron balance is maintained. Iron plays a critical role in oxygen transport as it is necessary for the formation of Hb, the oxygen transport protein that is critical for aerobic capacity.

Physiological and Performance Efficiency Test Result and Discussion

Table 3 showed that significance mean differences in RHR (resting heart rate) within each test between the groups. The mean RHR distribution of high intensity group was decreased by 3.70 b/min (6.07%). However, the mean RHR distribution of moderate intensity group was decreased by 2.80 b/min (4.51%). In this context, high intensity group was revealed better mean RHR decrement.

And as indicated in Table 3 blood pressure (Sbp (systolic blood pressure) and Dbp (diastolic blood pressure)) mean difference was decreased by 7.5 mmHg (6.66%) Sbp and 9 mmHg (12%) Dbp in high intensity group and also at moderate intensity group mean difference was decreased by 3.5 mmHg (3.09%) Sbp and 5.5 mmHg (7.14%) Dbp. Here also high intensity group was revealed better mean decrement in both systolic blood pressure and diastolic blood pressure.

Exercise and/or physical activity is characterized by a substantial increase in oxygen needs. Iron is an essential factor for the formation of Hb, the protein responsible for oxygen transport from the respiratory organs to the peripheral tissues (1). Increases in central O2 delivery (cardiac output) and peripheral O_2 uptake (arteriovenous oxygen difference) contribute to training induced improvements in cardiorespiratory fitness (3).

Table 1. Characteristics of the study subjects (Mean ± SD).

	High Intensity (N=10)		Moderate Intensity (N=10)	
	Before Supplement	After Supplement	Before Supplement	After Supplement
Age (years)	22.1 ± 0.73	22.1 ± 0.73	23 ± 1.24	23 ±1.24
Height (m)	1.78 ± 0.04	1.78 ±0.04	1.74 ± 0.06	1.74 ± 0.06
Weight (Kg)	59.6 ± 5.7	60.4 ± 6.39	62.2 ± 7.88	62.9 ± 7.78
BMI (Kg/m^2)	18.64 ± 1.25	18.71 ± 1.33	20.28 ± 1.36	20.45 ± 1.32

Mean ± SD in the same columns in each parameter are not significantly different ($p<0.05$), BMI (kg/m^2) = Body mass index.

Table 2. Mean value of hematological test of high and moderate intensity group of soccer players before and after iron supplementation.

	High Intensity		Moderate Intensity	
Treatments	RBC	Hb	RBC	Hb
Before supplement	4.28 ± 0.132	14.38 ± 0.209	4.18 ± 0.135	14.27 ± 0.258
After supplement	5.26 ±0.132	17.73 ± 0.377	4.93 ± 0.255	16.32 ± 0.498
Mean diff.	-0.9840*	-3.350*	-0.750*	-2.050*
Sig.	0.000	0.000	0.000	0.000

Means ± in the same column in each parameter with different * superscripts are significantly different ($p<0.05$) RBC = red blood cell and HB = hemoglobin.

Table 3. Mean effects of physiological and performance efficiency test of high and moderate intensity group of the JU soccer players.

Treatments	High Intensity group					Moderate Intensity group				
	RHR	Sbp	Dbp	Cooper	Bruce	RHR	Sbp	Dbp	Cooper	Bruce
Before supplement	60.90±3.54	112.50±5.401	75.00±5.27	2740±134.99	7.20±0.63	62.00±2.82	113.00±4.83	77.00±4.83	2620±187.38	6.80±1.39
After supplement	57.20±3.29	105.00±4.08	66.00±3.94	3320±257.33	9.40±0.84	59.20±3.15	109.50±1.58	71.50±3.37	2860±250.33	8.00±1.33
Mean diff.	3.70*	7.50*	9.00*	-580.00*	-2.20*	2.80*	3.50*	5.50*	-240.00*	-1.20
Sig.	0.021	0.000	0.000	0.000	0.000	0.050	0.032	0.012	0.025	0.058

Mean ± SD in the same columns in each parameter with different * superscripts are significantly different ($p<0.05$), RHR (beat/min) = resting heart rate in beat per minute, Sbp (mmHg) = systolic blood pressure.

And also as indicated in table 3 the mean value of Cooper test in high intensity and moderate intensity group was increased to 580 m (21.16%) and 240 m (9.16%) respectively. This result indicates that effective performance have been observed in high intensity group than moderate intensity group.

The improvement of iron status due to iron supplementation has been accompanied by an improvement in endurance capacity (5,19). However, in Bruce incremental treadmill test no improvements have been observed in moderate intensity group.

High intensity group develop better RBC and Hb level than moderate intensity endurance group of Jimma University soccer players. Iron supplementation to soccer players with high intensity endurance exercise is necessary to RCB and Hb concentration increment. High intensity group highly improved physiological (RHR, Sbp and Dbp) and endurance performance efficiencies than moderate intensity endurance group of JU soccer players. Iron is essential for endurance exercise for the formation of hemoglobin and oxygen carrying capacity.

By considering the major findings and conclusions of the study, it is important to state the following points as a recommendation to investigate more on effects of iron supplementation hematological change, physiological and performance efficiency. It is highly expected from sport nutritionists, sport professionals and related fields to guide and educate on the importance and value of iron supplementation with high intensity endurance exercise on physiological changes and performance efficiency. To be more beneficial in all dimensions (physiological change, performance efficiency and hematological changes) soccer players should use iron supplementation with high intensity endurance exercise additional to their meal. Further research has to be done on the role of iron for the improvement of soccer player's physiological, performance efficiency and hematological changes.

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