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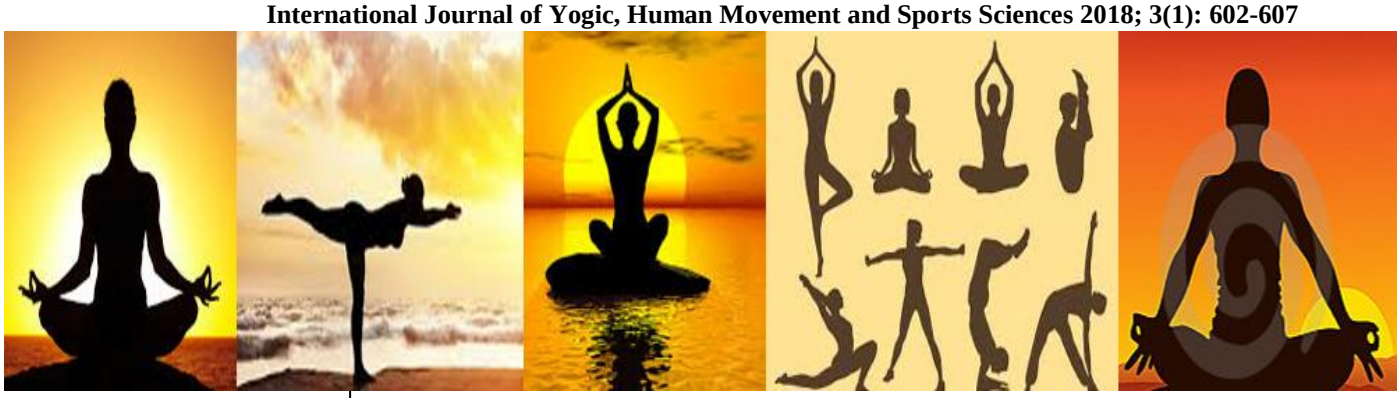

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Dr. P. Samraj
Principal, Sri Renugambal College of Physical Education, Polur, Tamil Nadu, India

Correspondence
Dr. P. Samraj
Principal, Sri Renugambal College of Physical Education, Polur, Tamil Nadu, India

Efficacy of varied pace running and iron supplementation on hematocrit, ferritin and transferrin saturation among college women students

Dr. P Samraj

Abstract
To achieve the purpose of the study the investigator randomly selected 60 women students of GSS Jain College for Women, Chennai in the age group of 18 to 23 years. The independent variables used in the present study were two experimental variables namely varied pace running and iron supplementation. The dependent variables selected were three biochemical variables related to iron namely hematocrit, ferritin and transferrin saturation and they were estimated by adopting standard method in reputed laboratory during before and after training. The chosen 60 subjects were divided into three equal groups consisting of 20 each on random basis. For group I, varied pace running was given for 12 weeks, for group II in addition to same varied pace running iron supplementation was given. Based on the advise of a doctor the required level of eight mg to eleven mg iron capsule of Livogen was given for five days a week for 12 weeks. Placebo capsule was given to group I. Control group was kept idle. The study was formulated as a randomized double – blind placebo 3x2 factorial design. The Analysis of Covariance (ANCOVA) was computed for the data collected form three grops during pre and post tests. Further Scheffe's test was used as a Post Hoc test. It was concluded that the varied pace running with iron supplementation has improved hematocrit significantly, the varied pace running with iron supplementation has improved ferritin significantly and the transferrin saturation has improved significantly due to varied pace running with iron supplementation.

Keywords: Varied pace running, iron supplementation, hematocrit, ferritin transferrin saturation

Introduction
Sports training is a programme of exercise designed to improve the skills and increase energy capacities of athlete for a particular event. These basic training procures will serve better when utilized with modifications suited to individuals or a group dealt with. The training programme should look into improving the performance of athletes.

In varied pace running the spots men run continuously but with changing pace. The change of pace is done according to a plan already prepared. For example the pace can be varied from slow jogging to sprinting After periods of running at high speed, the periods of slow running follow. The intensity varies from slow to maximum that is 140-180 beats/min. The duration of the activity can be 20 minutes to 90 minutes or even more. The pace can be changed in terms of time, distance or surface as is suitable. The varied pace method primarily improves the aerobic capacity that is vo2 max, muscle glycogen, oxidative enzyme etc. As the pace is not constant and it varies from slow to fast and it has a better positive effect on the heart. The phase of faster pace also tend to increase the lactic acid production in the muscles there by resulting the improvement of anaerobic capacity also. The type of varied pace activity determine to what extent the aerobic or anaerobic capacity will be improved (Hardyal Singh, 1984) [7].

In humans iron is an essential component of protein involved in oxygen transport. It is also essential for the regulation of cell growth and differentiation. A deficiency of iron limits oxygen delivery to cells, resulting of fatigue, poor work performance and decreased immunity. On the other hand excess amount of iron can result in toxicity and even death. There are two forms of dietary iron namely heme and nonheme. Heme iron is derived from hemoglobin the protein in red blood cells that delivers oxygen to cell and it is found in animal foods that

originally contained hemoglobin, such as red meats, fish and poultry. Iron in plant foods like lentils and beans is arranged in a chemical structure called nonheme iron. Heme iron is absorbed better than nonheme iron and most dietary iron is nonheme iron. Healthy audults absorption is influenced by several factors (Behm & Sale, 1993) [3].

Iron deficiency develops when iron intake does not meet the daily need for dietary iron. Iron deficiency anaemia is an advanced stage of iron depletion in which blood hemoglobin levels are below normal level. Women of child bearing age, pregnant women, teenage girls etc are at greatest risk of developing iron deficiency. Many men and women who engage in regular intense exercise like competitive swimming, cycling etc. have marginal or inadequate iron status. The need for iron may be 30% greater in those who engage in regular intense exercise. Three groups of athletes are at greater risk of iron depletion and deficiency: female athletes, distance runners and vegetarian athletes.

Iron supplementation is indicated when diet alone cannot restore deficiency iron levels to normal within an acceptable time frame. The goal of providing oral iron supplements is to supply sufficient iron to restore normal storage levels of iron and to replenish hemoglobin deficits. A serum ferritin level less than or equal to 15 micrograms per liter confirms iron deficiency anaemia and suggests a possible need for iron supplementation. Supplemental iron is available in two forms namely ferrous and ferric. Ferrous iron salts (ferrous fumarate, ferrous sulphate and ferrous gluconate) are the best absorbed forms of iron supplements. The amount of iron absorbed decreases with increasing does. For this reason it is recommended that most people take their prescribed daily iron supplement in two or three equally spaced does. Physicians evaluate each person individually and prescribe according to individual needs. Starting with half the recommended does and gradually increasing to the full does will help to avoid or minimize side effects. Hemoglobin usually increases within 2 to 3 weeks starting iron supplementation (Sale, 1988) [11].

The hematocrit is the volume percentage of red blood cells in blood. It is normally about 45% for men and 40% for women. It is considered an integral part of a person's complete blood count results, along with hemoglobin and platelet count. Serum ferritin is the ferritin that is in a person's blood stream. Ferritin is a protein that stores iron and allows the body to use iron. Transferrin saturation is abbreviated as TSAT and measured as a percentage in a medical laboratory value. It is the ratio of serum iron and total iron binding capacity multiplied by 100. Of the trasferrin that is available to bind iron, this value tells a clinician how much serum iron is actually bound. (Behm & Sale, 1993) [3].

Methodology

To achieve the purpose of the study the investigator randomly selected 60 women students studied in GSS Jain College for Women Vepery, Chennai in the age group of 18 to 23 years. The subjects selected were divided into three equal groups consisting of 20 each on random basis. The groups were designated as a) varied pace running group, b) varied pace running with iron supplementation group and c) control group. The investigator explained the purpose of research work, nature of varied pace running, iron supplementation and blood required for testing the variables. Prior to commencement of the study the investigator received the individual consent separately from each volunteer subjects. The independent variables used in the present study were two experimental variables namely varied pace running and iron supplementation. The dependent variables selected were three biochemical variables related to iron such as hematocrit, ferritin and transferrin saturation.

Experimental Protocols

For experimental group I varied pace running was given for twelve weeks and for group II in addition to same training, iron supplementation was given. Training was given three days a week during alternative days as the subjects are female and new to this type of training. The varied pace running training programme was scheduled for one session per day during morning between 6.30 and 7.30 am. During every session the workout lasted approximately for 45 to 60 minutes inclusive of warming up, training and limbering down process. By considering the Subjects the training load was increased once in three weeks by changing the distance, duration and repetition and which is given in table I. The control group did not participated in any of the training. All the three variables were tested for both experimental groups and control group prior and after training period. As precautionary methods were followed throughout the training period, none of the subject was not injured.

Table 1: Varied Pace Running Training Schedule

Week/ Day	Distance	Duration	Repetition	Recovery
I, II & III Weeks				
Monday	60 mts 140 mts	8 sec 20 sec	5 3	1 min 4 min
Wednesday	80 mts 140 mts	12 sec 20 sec	4 3	3 min 4 min
Friday	180 mts	30 sec	5	4 min
IV, V & VI Weeks				
Monday	60 mts 140 mts	7 sec 18 sec	6 4	1 min 4 min
Wednesday	80 mts	11.5 sec	5	3 min
Friday	140 mts 180 mts	18 sec 29 sec	4 6	4 min 4 min
VII, VIII & IX Weeks				
Monday	60 mts 140 mts	6.8 sec 17 sec	6 4	1 min 4 min
Wednesday	80 mts 140 mts	11 sec 17 sec	6 5	3 min 4 min
Friday	180 mts 60 mts	27 sec 8 sec	7 4	4 min 1 min
X, XI & XII Weeks				
Monday	60 mts 140 mts	6.5 sec 16.5 sec	8 5	1 min 4 min
Wednesday	80 mts 140 mts	10.5 sec 16.5 sec	6 6	3 min 4 min
Friday	180 mts 60 mts	26 sec 8 sec	7 6	4 min 1 min

Iron Supplementation

Before the commencement of training, the iron deficiency of subjects were tested under the supervision of a qualified and experienced medical doctor. Based on the test report doctor advised to give eight mg to eleven mg of iron capsule of Livogen to the subjects per day. Five days a week that is Monday to Friday placebo capsule was given to experimental group I for 12 weeks to avoid psychological feeling. Further, based on the advise of a doctor the required level of eight mg to eleven mg iron capsule of Livogen was given to experimental group in addition to varied pace training for 12 weeks.

Collection of blood samples
Five ml of venous blood was collected from the subjects of all the three groups during pre and post tests through venupuncture by using standard disposable syringes by the technician. The serum was separated by 300 rpm for 10 minutes and stored in a deep freeze at 20 degree celsious.

Assay of Hematocrit
The heparinised blood was centrifuged in a capillary tube at 10000 rpm for five minutes. This separate the blood into layers and Automated Pulse Height Detection method was followed. The volume of packed red blood cells divided by the total volume of the blood sample gives hematocrit. As a tube is used this can be calculated by measuring the lengths of the layers. The results were expressed in percentage.

Assay of ferritin and transferrin saturation
The ferritin was measured by Eclia method by using serum and the result is expressed in ng/ml. The transferrin saturation was measured by Automated method by using serum and it is measured as a percentage.
Trasferrin saturation = Iron / Trasferrinx100

Experimental design and statistical techniques
The study was formulated as a randomized double - blind placebo 3x2 factorial design. The first factor indicates 3 groups and the second factor denotes 2 testing periods. With regard to statistics, Analysis of Covariance (ANCOVA) was computed for the data collected from three groups during pre and post tests separately for each variables. Since three groups were involved, whenever the 'F' ratio was found to be significant, Scheffe's test was used as a Post-Hoc test to determine which of the paired mean differ significantly (Clarke, 1972) [5] The level of significance was fixed as 0.05.

Analysis of Hematocrit
The statistical analysis of hematocrit is given in table II.
Table II shows that the pre-test mean score of hematocrit for varied pace running group is 36.89, varied pace running with iron supplementation group is 36.92 and control group is 35.89. The Post - test mean values are 37.33, 38.92 and 36.37 respectively.
The obtained 'F' value on pre - test score 1.26 is less than the required 'F' value of 3.16 to be significant at 0.05 level. This proved that there is no significant difference among the groups before the experimentation.
The post-test score analysis proved that there is significant difference between the groups at 0.05 level as the obtained 'F' value 12.51 is greater than the required 'F' value of 3.16. The adjusted post – test mean also significant at 0.05 level

Table 2: Computation of Analysis of Covariance on Hematocrit

Testing period	Varied pace Running Group	Varied pace Running with Iron Supplementation Group	Control Group	Source of variance	Sum of Squares	df	Mean Squares	'F' Ratio	Level of Significance
Pre–test Mean	36.89	36.92	35.89	between	13.68	2.00	6.84	1.26	Not significant
SD	1.56	2.64	2.62	within	308.52	57.00	5.41		
Post–test Mean	37.33	38.92	36.37	between	66.39	2.00	33.20	12.51	0.05
SD	1.48	2.21	2.62	within	151.24	57.00	2.65		
Adjusted Post-test	37.19	38.77	36.66	between	47.21	2.00	23.60	14.03	0.05
				within	94.24	56.00	1.68		
Mean gain	-0.44	-2.01	-0.48						

The tabulated 'F' ratio for df 2 & 57 and 2 & 56 at 0.05 level are 3.16 and 3.15 respectively

Table 3: The results of Scheffe's test is given in table III.

Varied pace running group	Varied pace running with iron supplementation group	Control Group	Mean Difference	CD at 5% Level
37.28		36.48	0.80	0.90
	38.86	36.48	2.38*	0.90
37.28	38.86		1.58*	0.90

*Significance at.05 level of confidence

Table III shows that there is significant differences between the adjusted means of varied pace running with iron supplementation group and control group; varied pace running group and varied pace running with iron supplementation group. It is observed that hematocrit has improved significantly for varied pace running with iron supplementation group. There is no significant improvement for rest of the groups.
The results of the hematocrit is graphically illustrated in figure1.

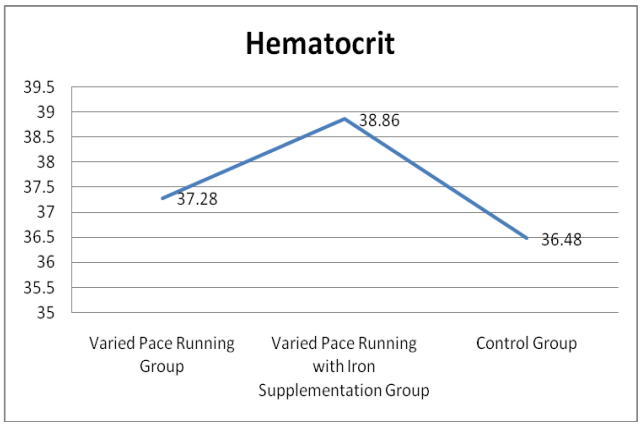

Fig 1: Line Graph for the Ordered Means of Hematocrit

Analysis of Ferritin

The statistical analysis of ferritin is given table IV.

Table 4: Computation of Analysis of Covariance of Ferritin

Testing period	Varied Pace Running Group	Varied Pace Running with Iron Supplementation Group	Control Group	Source of variance	Sum of Squares	df	Mean Squares	'F' Ratio	Level of Significance
Pre –test Mean	46.27	46.49	37.90	between	958.49	2.00	479.25	2.86	Not significant
SD	17.72	17.84	6.80	within	9550.66	57.00	167.56		
Post –test Mean	48.27	71.29	37.87	between	11697.54	2.00	5848.77	27.29	0.05
SD	17.07	17.37	6.80	within	12214.35	57.00	214.29		
Adjusted Post-test	46.35	69.21	41.86	between	8281.05	2.00	4140.53	31.12	0.05
				within	7450.26	56.00	133.04		
Mean gain	-2.00	-24.80	0.04						

The tabulated 'F' ratio for df 2 & 57 and 2 & 56 at 0.05 level are 3.16 and 3.15 respectively

Table IV shows that the pre-test mean score of ferritin for varied pace running group is 46.27, varied pace running with iron supplementation group is 46.49 and control group is 37.90. The post test means are 48.27,71.29 and 37.87 respectively.

The obtained 'F' value on pre-test score 2.86 is less than the required 'F' value of 3.16 to be significant at 0.05 level. Thus proved that there is no significant difference among the groups before experimentation.

The post-test score analysis proved that there is significant difference between the groups, as the obtained 'F' value 27.29 is greater than the required 'F' value of 3.16. The adjusted post-test also significant at 0.05 level.

The results of Scheffe's test is given in table V.

Table 5: Scheffe's confidence interval test scores on ferritin

Varied Pace Running Group	Varied Pace Running with Iron Supplementation Group	Control Group	Mean Difference	CD at 5% Level
46.35		41.86	4.49	9.16
	69.21	41.86	27.35*	9.16
46.35	69.21		22.86*	9.16

*Significant at.05 level of confidence

Table V shows that there is significant differences between the adjusted means of varied pace running with iron supplementation group and control group; varied pace running group and varied pace running with iron supplementation group. It is observed that ferritin has improved significantly for varied pace running with iron supplementation group. There is no significant improvement for rest of the groups.

The results of ferritin is graphically illustrated in figure 2.

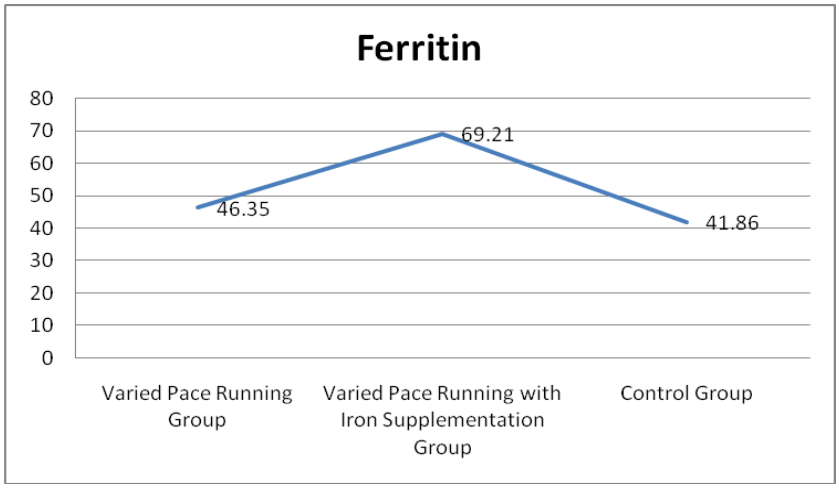

Fig 2: Line Graph for the Ordered Means of Ferritin

Ananlysis of trasferrin saturation

The statistical analysis of transferrin saturation is presented in table VI.

Table VI shows that the pre-test mean score of transferrin saturation for varied pace running group is 29.32, varied pace running with iro supplementation group is 30.45 and control group is 30.56. The post-test mean for these groups are 30.32, 36.82 and 30.41 respectively.

The obtained 'F' value on pre-test score 2.24 is less than the required 'F' value of 3.16 to be significant at 0.05 level. This proved that there is no significant difference among the groups before experimentation.

The post-test score analysis proved that there is significant difference between the groups, as the obtained 'F' value 14.69 is greater than the required 'F' value 3.16. The adjusted post-test also significant at 0.05 level.

Table 6: Computation of Analysis of Covariance on Transferring Saturation

Testing period	Varied Pace Running Group	Varied Pace Running with Iron Supplementation Group	Control Group	Source of variance	Sum of Squares	df	Mean Squares	'F' Ratio	Level of Significance
Pre –test Mean	29.32	30.45	30.56	between	18.78	2.00	9.39	2.24	Not significant
SD	5.25	4.41	4.03	within	1200.47	57.00	21.06		
Post –test Mean	30.31	36.82	30.41	between	557.38	2.00	278.69	14.69	0.05
SD	5.63	3.38	4.03	within	1081.17	57.00	18.97		
Adjusted Post-test	30.95	36.55	30.04	between	496.27	2.00	248.13	48.38	0.05
				within	287.22	56.00	5.13		
Mean gain	-0.99	-6.37	0.16						

The tabulated 'F' ratio for df 2 & 57 and 2 & 56 at 0.05 level are 3.16 and 3.15 respectively

The results of Scheffe's test is given in table VII.

Table 7: Scheffe's Confidence Interval Scores on Transferrin Saturation

Control Group	Varied pace Running with Iron Supplementation Group	Varied pace Running Group	Mean Difference	CD at 5% Level
30.04	30.95		0.91	1.80
30.04		36.55	6.51*	1.80
	30.95	36.55	5.60*	1.80

***** Significant at.05 level of confidence

Table VII shows that there is significant difference between the adjusted means of varied pace running with iron supplementation group and control group; varied pace running group and varied pace running with iron supplementation group. It reveals that transferrin saturation has improved significantly for varied pace running with iron supplementation group. There is no significant improvement for rest of the groups

The results of transferrin saturation is graphically illustrated in figure 3.

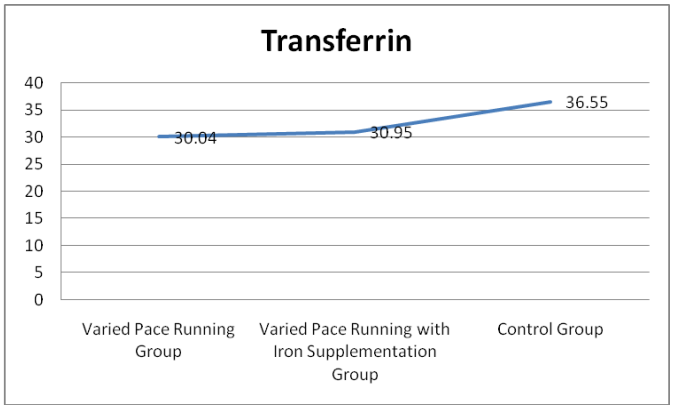

Fig 3: Line Graph for the Ordered Means of Trasferrin Saturation

Discussion on findings

The results of the present study reveals that the varied pace running with iron supplementation has improved hematocrit significantly. These results are in conformity with the findings of the studies organized by The research conducted by using elite and sub-elite teams shows that oral iron supplementation has increased the hematocrit level during training period. Sinclair and Hinton (2005) [12] determined the prevalence of iron deficiency, health status, biochemical variables and sports performance. It was observed that iron supplementation leads to improvement on hematocrit.

The results of the presents study reveals that the varied pace running with iron supplementation has improved ferritin significantly. These results are in conformity with the findings of the studies conducted by. It is documented that iron deficiency is probably the most common nutrient deficiency in the western world. Athletes are a special group with additional reasons for iron loss. Female athletes have yet another source of blood loss that is menstruation and Suedekum Dimeff (2005) [13] documented that iron is an important mineral necessary for biological pathways.

It is found in the present study that trasferrin saturation has improved significantly due to varied pace running with iron supplementation. The results of the study is in line with the findings of Sinclair and Hinton (2005) [12]. They examined the iron status and nutrient intake in highly active female athletes from Southern Spain. It was observed at iron supplementation has increased the transferrin saturation level among athletes.

It is concluded that

1. The varied pace running with iron supplementation has improved hematocrit significantly.
2. The varied pace running with iron supplementation has improved ferritin significantly.
3. The transferrin saturation has improved significantly due to varied pace running with iron supplementation.

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