

# Correlation of Serum Ferritin level and Cardio-Pulmonary Endurance in Young Females

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## ABSTRACT

**Background:** Ferritin is a blood cell protein that holds iron and releases it in controlled intervals. Without enough iron, red blood cells are unable to efficiently supply oxygen. The body's capacity to use oxygen reflects the cardiopulmonary endurance of an individual. Prevalence of iron deficiency has increased in young females and thus the present study is conducted to find association between serum ferritin levels and VO<sub>2</sub>max values aiming to improve their functional capacity.

**Methods:** Ethical clearance and participant consent were taken prior the study. 50 young females aged 18-26 years willingly participated in the study. Their serum ferritin level was measured through laboratory tests and Cardio-pulmonary endurance was measured through VO<sub>2</sub>max value obtained from Rock Port One Mile Walk Test.

**Result:** Spearman test of correlation yielded a value of 0.723 which showed highly significant and strongly positive correlation between the two variables.

**Conclusion:** The present study concludes that reduced serum ferritin levels have a direct impact on reduction of VO<sub>2</sub> max values i.e. Cardio-pulmonary endurance of young females.

**Keywords:** Serum ferritin, VO<sub>2</sub>max, cardiopulmonary Endurance, one mile Walk test

## INTRODUCTION

Iron is an essential mineral; its main tasks are reversibly carrying oxygen in hemoglobin molecules in red blood cells

and in myoglobin in muscle cells. It has other important roles, such as contributing to the electron transport chain, enzymes, DNA synthesis, and energy metabolism [1,2]. Iron is taken up by cells and transported to mitochondria where it can be used to form heme (iron bound to porphyrin), which is the form of iron included in hemoglobin and myoglobin molecules [3]. Iron is transferred in the blood with the transport protein, transferrin and excess iron is stored as ferritin in the liver and the reticuloendothelial system [1,4]. Ferritin is the most used biomarker for iron status [5]. Because of iron's role in biological processes, of carrying oxygen in hemoglobin molecules, a deficiency may cause reactions in the respiratory chain where iron works as a cofactor, thereby reducing oxidative capacity, which again reduces the muscles' ability to use oxygen [1,7]. Symptoms such as fatigue, reduced concentration, and impaired physical performance may occur [6,7]. The oxygen-carrying capability in the blood is reduced because of lower hemoglobin levels. This reduces physical capabilities because of lack of oxygen to all cells in the body, including those of working muscles during exercise [8]. A reduction in VO<sub>2</sub>max and endurance capacity is likely to appear [9,10]. Young females have a varying level of physical activity and might have various kind of nutritional deficiencies, which can affect their physical fitness eventually affecting

their cardio-pulmonary endurance. [11,12] Iron Deficiency is one of the leading nutritional problems especially in the young females and they exhibit a series of symptoms reducing their quality of life. [13,14] The objective of this study is to find the relationship between Serum Ferritin levels and VO<sub>2</sub>max in young females which can help in future interventional studies for anaemic females.

## MATERIALS & METHODS

The research was conducted at various colleges and institutes of Ahmedabad. The study group consisted of 50 young females aged 18-26 years, who were willing to participate. Pregnant females, females with any severe musculoskeletal, cardio-vascular, neurological, gynaecological and psychiatric illness were excluded from the study. Materials used in the study were Treadmill, Pulse Oximeter, Weighing Scale, Stop

watch and a Calculator. Sample size was estimated using sample size estimation formula for correlational study:  $N = [(Z_{\alpha} \text{Total} + Z_{\beta})/C]^2 + 3 = 48$ . After taking Ethical approval for the study from Institutional Research and Ethics Committee, participants were included on the basis of inclusion and exclusion criteria. Verbal and Written consent were taken from all the participants prior the study. Phase 1: Blood tests were conducted for Serum Ferritin level measurement of all the participants. Phase 2: Rockport one mile walk test (submaximal test to measure cardio-pulmonary endurance) was conducted on a motorised treadmill and post-test HR and Time taken to complete one mile (1.6 kms) was documented. VO<sub>2</sub>max value was then calculated using Rockport formula:  $[\text{VO}_{2\text{max}} = 132.853 - (0.0769 \times \text{Weight}) - (0.3877 \times \text{Age}) - (3.2649 \times \text{Time}) - (0.1565 \times \text{Heart rate})]$ .



Fig:1: Participant performing Rockport One Mile Walk Test for VO<sub>2</sub>max value

## STATISTICAL ANALYSIS

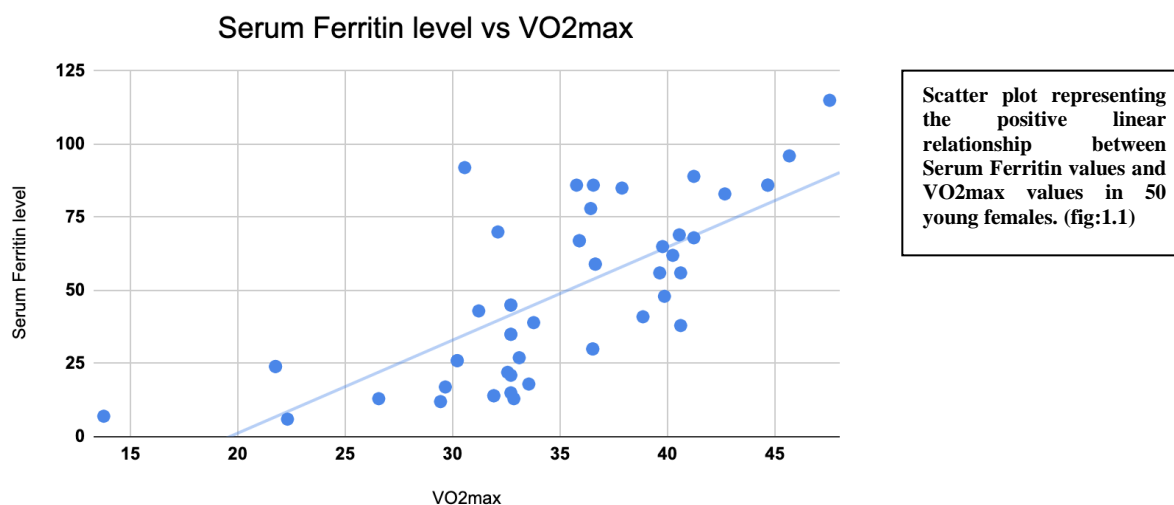
Data was analysed using SPSS version 20.0 and Microsoft Excel 13. The data was screened for Normal distribution using Kolmogorov Smirnov test and Shapiro-Wilk test and it was not normally distributed.

Thus, non-parametric test [Spearman test of Correlation] was applied.

## RESULT

The Serum Ferritin values and VO<sub>2</sub>max values of all 50 young females were then correlated using Spearman test of

Correlation. The results were found to be highly positive and statistically significant ( $r = .724, p < .001$ ).



## DISCUSSION

The present study demonstrates a highly positive correlation between Serum Ferritin level and VO<sub>2</sub>max in young females aged 18-26 years. Studies have illustrated that VO<sub>2</sub>max is determined primarily by the oxygen-carrying capacity of the blood and is thus correlated with the degree of Anaemia. 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. [15,16] Dallman et al suggested that reduced Serum Ferritin limits tissue oxidative function leading to significant decrease in myoglobin and other iron-containing proteins in the skeletal muscle significantly leading to the decline in muscle aerobic capacity [17] A host of detailed animal studies have identified limitations in both oxygen delivery and tissue metabolism as explanations for the deficits in exercise endurance and peak aerobic power in individuals with reduced Serum Ferritin levels.[18]

## CONCLUSION

The present study concludes that Serum Ferritin levels and VO<sub>2</sub>max values have a

highly positive correlation in young females aged 18-26 years. This established relationship can be further studied in depth for females with diagnosed iron-deficiency anaemia and an aerobic exercise protocol can be developed to evaluate impact on their cardio-pulmonary endurance.

### Declaration by Authors

**Ethical Approval:** Approved

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**Conflict of Interest:** The authors declare no conflict of interest.

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