

A Study on Work Efficiency of Anemic and Non-Anemic Subjects of Rural Area

Vikhe BB*, Badwe AN**, Latti RG***

Abstract

VO₂ was studied in 102 subjects in the 17-19 year age group consisting of two groups as 47 anemic (male-21, females=26) and 55 non anemic (males = 26, females=29) respectively. The hemoglobin concentration in anemic and nonanemic females was 9.21 ± 1.21 gm/dl and 11.68± 0.98 gm/dl and in males it was 11.12± 0.37 gm/dl and 12.86± 0.8 gm/dl. VO₂max was determined by recording pulse rate and mechanical work done on bicycle ergo graph for 5 minutes. The mean value of VO in anemic and non-anemic males was 2.28± 0.44 (L/min) and 3.98 ± 1.12 (L/min) and in females, it was 2.78 ± 1.06 (L/min) and 3.24± 1.13 (L/min) respectively. VO₂ value was found to be less in anemic females as compared to anemic males. However VO₂ max value showed significant difference between anemic and non-anemic subjects in both sexes.

Key Words: VO₂max , Anemia, Work efficiency

Introduction

Maximum oxygen uptake or VO₂max of any individual is considered as an indicator of maximal work capacity or physical activity.[1] Value of VO₂max is dependent on the efficiency of the circulatory, respiratory and muscular systems. Adequate Hb level indicates adequate O₂ delivering capacity of blood at the tissue level, and more so during strenuous physical activity, indicating high VO₂max values.[2] In anemic individuals it is observed that oxygen delivering capacity and VO₂max is significantly affected.[3] Various scientific studies report that iron deficiency anemia remains a major concern in many developing countries and severe anemia caused by it, affects work capacity proportional to decrease in hemoglobin levels.[4,5] In Pravara Rural Hospital, Loni, Taluka Rahata, District Ahmednagar, many cases of anemia are reported routinely. Present study is an attempt to find a correlation between anemia and VO₂ max, Red blood cell indices (Hb, HCT, MCV, MCH), and anthropometric parameters (height, weight, BMI).

Material and methods

The study was carried out in 250 subjects in the age group of 17 - 19 years over a span of one year. All subjects were from rural area and out of these only 103 were included in the study. The protocol of study was explained to all subjects and study was conducted after their consent. Prior to study, thorough clinical examination of all subjects was conducted. Subjects with history of chronic ailments were excluded from the study, except anemic individuals. Subjects with features of malnutrition assessed by age, height proportion and those with body mass index (BMI) less than 15 were not included in the study. Hemoglobin concentration (gm/dl) in all subjects was determined by Sahli's method.[6] Subjects with Hb concentration less than 12 gm/dl were considered as anemic and those with Hb concentration more than 12 gm/dl were considered as non anemic and formed control group. Anemic group included 21 males and 26 females (total 47) and the non-anemic group included 26 males and 29 females (total 55). Height in meters and weight in kilogram was recorded for all subjects to determine BMI. Packed cell volume was estimated by Wintrobe method.[7] ESR, Total red cell count, mean blood corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) was determined.[8] To determine

* Asst. Professor, ** Assoc. Professor, ***Professor & Head

Department of Physiology

Corresponding author

Mr. Vikhe Balasaheb B.

Dept of Physiology, Rural Medical College, Pravara Institute of Medical Sciences, Loni, Dist- Ahmednagar, Maharashtra,

VO₂max, all subjects were called to the laboratory with prior appointments in morning hours (09.00 am 11.00 am). On their arrival, they were made to rest for 30 minutes after which, they were made to perform mechanical work on Martinet's bicycle ergograph for 5 minutes against workload of 3 Kg for males and 2 Kg for females. Immediately after completion of given task, pulse rate was determined for one complete minute. VO₂max was determined by using method described by I. Astrand.[9]

Results

Table: I

The mean age, height, weight, BMI for anemic males was 18.22 ± 1.10 years, 171.66 ± 4.63 cm, 58.23 ± 10.70 Kg, 15.4 ± 0.30 Kg/m² respectively and for nonanemic males it was 18.20 ± 1.12 years, 171.58 ± 5.37 cm, 64.42 ± 11.37 Kg, 15.6 ± 0.6 Kg / respectively. Similarly in anemic females age, height, weight, BMI was 18.54 ± 1.15 years, 168.53 ± 6.07 cm, 49.92 ± 9.97 Kg, 15.4 ± 0.39 Kg/m² and for nonanemic females it was 18.74 ± 1.12 years, 168.58 ± 5.37 cm, 62.42 ± 11.37 Kg, 16.5 ± 0.56 Kg/m²

Table I : Anthropometric data in males and females

Sn	Parameter	Males		Females	
		Control	Anaemic	Control	Anaemic
1.	Age (years)	18.20 ± 1.12	18.27 ± 1.10	18.74 ± 1.12	18.54 ± 1.15
2.	Height (cm)	171.58 ± 5.37	171.66 ± 4.62	168.58 ± 5.37	168.54 ± 1.15
3.	Weight (kg)	64.42 ± 11.37	58.23 ± 10.70	62.42 ± 11.37	49.92 ± 9.97
4.	BMI (Kg/m ²)	15.6 ± 0.6	15.4 ± 0.30	16.5 ± 0.56	15.4 ± 0.39

Sn	Value	Males		Females	
		Control	Anaemic	Control	Anaemic
1.	Hb (g%)	12.86 ± 0.80	11.12 ± 0.37	11.68 ± 0.98	9.21 ± 1.21
2.	HCT (%)	34.0 ± 0.04	32.0 ± 0.016	36.0 ± 0.05	32.0 ± 0.03
3.	MCV (cu.micron)	85.7 ± 0.5	76.5 ± 10.4	89.9 ± 7.75	85.2 ± 8.99
4.	MCH (pg)	31.0 ± 2.6	24.4 ± 4.29	30.0 ± 3.24	27.7 ± 3.5
5.	MCHC (%)	36.34 ± 6.32	34.75 ± 0.11	32.44 ± 0.34	28.78 ± 0.21

Table: II

The value of Hb concentration, hematocrit value, MCV, MCH, MCHC in anemic males was recorded as 11.12 ± 0.37 (g/dl), 32 ± 0.06 (g/dl), 76.5 ± 1.04 (cu micron), 24.4 ± 4.39 (pg), 34.75 ± 0.11 (%) and for non-anemic males these values were 12.86 ± 0.08 (g%), 36.0 ± 0.04 (%), 85.7 ± 5.0 (cu micron), 31.0 ± 0.26 (pg), 36.34 ± 0.32 (%). In anemic females the Hb concentration, hematocrit value, MCV, MCH, MCHC was 9.21 ± 1.21 (g/dl), 32.0 ± 0.32 (%), 85.2 ± 8.99 (cu micron), 27.7 ± 3.5 (pg), 28.78 ± 0.21 (%) and for non-anemic females this value was 11.68 ± 0.98 (g / dl), 36.0 ± 0.5 (%), 89.9 ± 7.75 (cu micron), 30.0 ± 3.20 (pg), 32.44 ± 0.34 (%).

Table: III

Predicted maximum oxygen consumption (VO₂max) was determined by method described by Bijlani¹. Predicted value of VO₂max (L/min) in anemic males was 2.5 L /min and in non-anemic males was 3.2 L/min (approximately). The actual value of VO₂max determined by bicycle ergograph in anemic males recorded as 2.78 ± 1.06 L / min and in non-anemic males as 3.24 ± 1.13 L / min. Predicted VO₂max (L/ min) value in anemic females was 2.7 L / min. and in nonanemic females it was 2.6 L / min (approximately). However the actual value of VO₂max (L / min) recorded in anemic females was 2.28 ± 0.44 L / min and nonanemic females it was 3.98 ± 1.12 L/min.

TABLE-III : VO₂max (L/min) in male and females.

SN	PARAMETER	MALES		FEMALES	
		CONTROL	ANEMIC	CONTROL	ANEMIC
1.	VO ₂ max (L/min) Predicted	3.2	2.5	2.6	2.7
2.	VO ₂ max (L/min) Actual	3.24 ±1.13	2.78 ± 1.06	3.98 ±1.12	2.28 ± 0.44

Discussion

Body Mass Index (BMI) in anemic males and females were lower than their non-anemic counterparts. This finding was related to lesser body weight and dietary habits in the anemic groups. Blood indices also showed lower values in both anemic groups as compared to non-anemic groups. Decrease in Hb concentration may be due to dietary deficiency of iron, folic acid, genetic disorders causing hemolytic anemia, sickle cell disease, thalesemmia, infections including malaria and increased loss of blood caused by parasites like hook worms. However, iron deficiency is the largest single cause of anemia in India.[10] MCV and MCHC values were less in both anemic groups indicative of hypochromic microcytic anaemia. Anemia in the participants may be due to iron deficiency.[10] Value of VO₂max, in the anemic group was found to be significantly less in both groups as compared to the non-anemic group. Our study recorded lesser VO₂max, values in anemic females. Iron deficiency anemias lowers physical capacity by reducing availability of oxygen to tissues which in turn lowers cardiac output which may result in heart failure and death in severe cases.[11]

Conclusions

It is concluded that anemia is a significant deterrent in reducing physical work capacity and VO₂max. To improve the anemic status it is suggested that oral iron supplements be administered which will help conserve energy, enhance physical work capacity, and improve oxygen availability to the tissues.

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