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Correlation of Hemoglobin Content with 6 Minute Walking Distance and VO_2max, Among Young Healthy Male Individuals

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Abstract

Introduction: VO_2max is an index of one's cardio respiratory fitness. The maximal oxygen consumption (VO_2max) acts as an indicator of aerobic work capacity. It is affected by hemoglobin concentration. 6 Minute Walk Test (6MWT) has been widely used to assess the cardio-respiratory activity. This also accurately estimates VO_2max.

Objective: To correlate between hemoglobin concentration, VO_2max and 6 Minute Walking Distance (6MWD) in untrained healthy young male individuals.

Materials and Methods: 123 randomly seleted clinically stable, male individuals of age 19-21 years were included in the study. After analyzing their hematological parameters 121 subjects having hemoglobin content more than or equal to 13gm% underwent 6MWT according to ATS guidelines. The total distance covered was noted down. VO_{2max} was calculated.

Results: The mean hemoglobin was 15.08 ± 1.01gm% in subjects with mean age18.87 ± 1yr and their mean 6MWD was 350.02 ± 49.67mtrs. There was no significant correlation between the hemoglobin and 6MWD in young healthy male individuals.

Conclusion: Hemoglobin content has insignificant role in determining 6MWD and VO2max among healthy individuals.

Keywords: Hemoglobin, 6MWT, VO_{2max}, 6MWD

Introduction

Maximal Oxygen Consumption (VO_2max) is defined as the highest attainable rate of anaerobic metabolism during the performance of dynamic work that exhausts the subject within 5-10 min and is internationally accepted as an index of one's cardio respiratory fitness[1] . The maximal oxygen consumption (VO_2max) acts as an indicator of aerobic work capacity. Its decrease in the anemic individuals leads to reduction in oxygen-transport capacity of blood during heavy work[2,3]. Maximal oxygen uptake (VO_2max) plays an important role in the evaluation of cardio-respiratory fitness[4,5]. Studies show that it increases when

hemoglobin concentration increases and it decreases when hemoglobin concentration decreases[6]. Recently, it has also been assessed by a research that, 6 Minute Walking Test accurately estimates VO_2max[7] .

This study aimed to note the relationship between Hemoglobin content and 6MWD and VO2 max achieved in healthy male individuals. By assessing the correlation between hemoglobin concentration, VO_2max, and 6 Minute walking Distance (6MWD) we can devise a simple self-assessment tool to check the prognosis of anemia by the improvement in 6MWD in anemic individuals on treatment.

Objectives

To correlate between hemoglobin concentration, VO_2max and 6 Minute Walking Distance in untrained healthy young male individuals.

Materials and methods

The study was conducted in Karwar Institute Of Medical Sciences, Karwar, Karnataka, India in the Department of Physiology after seeking Institutional Ethical Committee Approval (IEC/KRIMS/O/56/2019-20). The study group was randomly selected clinically from general population. The purpose of study was explained to the subjects and informed written consent was taken.

Study Design: Cross-sectional Study

Sample size

- The sample size for this study was calculated after setting significance at 0.05, power at 0.8 and effective size at 0.3.
- The standard normal deviate for $\alpha = Z_\alpha = 1.960$
- The standard normal deviate for $\beta = Z_\beta = 0.842$

$C = 0.5 * \ln[(1+r)/(1-r)] = 0.310$

Total sample size $= N = [\frac{(Z_\alpha + Z_\alpha)}{C}]^2 + 3 = 85$

Sample Selection: the participants were selected based on the following criteria

Inclusion criteria

- Untrained male individuals aged between 19-21 years who have given consent to participate in this research.
- Subjects with hemoglobin content more than 13g%[8].
- Subjects presenting clinical stability, defined as absence of any acute disease during 6 weeks preceding the study.

Method

Females were excluded to avoid the variations caused by menstrual cycle[9]. History of previous illnesses in the recent past which may interfere with the ability to perform physical exercise science was elicited in the participants. Apparently healthy selected participants underwent general physical and systemic examination to assess their clinical stability. Then, their hematological parameters were assessed. Later, a 6 Minute Walking Test was performed to assess $Vo_{2max.}$

Parameters assessed are as follows:

1) Hematological parameters: It was assessed in the selected subjects using biotech HL3125PLUS fully automated hematological analyzer.
2) 6 Minute Walking Test (6MWT): After obtaining the Hematological report, on the same day, the subject was asked to walk briskly back and forth for 6 minutes in the 30 m path bounded by two cones. The total distance covered(6MWD) was noted. 6MWT was conducted according to the guidelines mentioned by revised American Thoracic Society[10,11].

3) VO_{2max} was calculated from 6MWD using the following formula[7]:

Mean Peak VO_{2max} (ml/kg/min) = 4.948+0.023*Mean 6 MWD (meters)(SEE 1.1 ml/kg/min)

The data of the hematological profile, 6MWD and VO_{2max} was compiled in Microsoft Excel sheet and appropriate statistical methods like mean, Standard Deviation, Pearson's correlation etc. were applied to analyze the data.

Results

About 123 subjects showed interest in participation. Their Complete Blood Count was done and the reports were analyzed. Two subjects were excluded since their hemoglobin content was less than 13gm%. 6 Minute Walk Test (6MWT) was conducted only on the subjects satisfying the inclusion criteria.

Table 1: The mean values of age, hemoglobin content, and 6 MWD.

Sn.	Mean Values (n=121)	
1	Age	18.87 ± 1 yr
2	Hemoglobin content	15.08 ± 1.01 gm%
3	6MWD	350.02 ± 49.67 mtrs

The subjects were grouped into two categories based on Hemoglobin content for analysis:

1) Group 1: subjects with hemoglobin content ranging from 13 to 15g/dl.
2) Group 2: subjects with hemoglobin content more than 15g/dl.

Then the 6MWD between Group1 and Group2 were compared.

Table 2: Comparison of 6MWD between the two groups done based on Hb content

Sn.	Parameter	Group 1 (n=60)	Group 2 (n=61)	Unpaired 't' test
1	Hemoglobin (in gm %)	14.3±0.59	15.87±0.67	--
2	6MWD (in m)	353.86±52.96	346.12±46.21	p=0.2

There is an insignificant difference in 6MWD between the two groups.

Table 3. Correlation between parameters of age, hemoglobin and 6MWD

Sn.	Parameters	Pearson's Correlation (r value)
1	Age v/s Hemoglobin	0.11
2	Age v/s 6MWD	-0.05
3	Hemoglobin v/s 6MWD	-0.04

n=121

There was no significant correlation between Age and Hemoglobin and 6MWD parameters in the study group.

Discussion

6MWD is useful parameter in calculating VO2 max to assess the cardio respiratory fitness of an individual. There are various factors that can affect 6MWD. An earlier study conducted by Vaish H et al has shown that the parameters-age, height, weight, BMI, leg length, resting heart rate, resting systolic blood pressure and resting diastolic blood pressure have significant impact on 6MWD[12]. It is also affected by hemoglobin concentration[6]. This study aimed at deriving a correlation between hemoglobin and 6MWD in young healthy male individuals having hemoglobin content within normal range. The mean hemoglobin content was 15.08 ± 1.01gm% in subjects with mean age 18.87 ± 1yr and their mean 6MWD was 350.02 ± 49.67mtrs.

Various studies have shown relation of 6MWD and hemoglobin. Hemodynamics, cardiovascular function, pulmonary function, and episodes of acute lung injury seem to impact the 6MWD in adults with Sickle Cell Anaemia. A significant correlation ($P < 0.001$) was found between 6MWD and hemoglobin (Hb) level[13].

In the study conducted by Hugo Nivaldo Melo et al., it was concluded that there was no significant difference in the 6-minute walk test but patients with sickle cell anemia had a lower physical activity level compared to healthy controls[14]. Also Ferrari et al. in their study showed that anemic patients with COPD had lesser 6MWD than COPD patients without anemia. It was

found that 6MWD has a prognostic value in relation with hemoglobin content in anemic patients in the same study[15]. The study done by Anthi A et al supports the use of 6MWD as an index of Pulmonary Hypertension and cardiopulmonary function in patients of sickle cell disease with pulmonary hypertension [16].

In another study done by H J Jin et al although anemic patients with chronic airway disease had significantly lower 6MWD, it was found that there is no significant correlation of hemoglobin concentration and 6MWD[17]. The present study conducted on young healthy untrained male individuals has found no significant correlation of hemoglobin concentration and 6MWD. The results are similar to study conducted by H J Jin et al though our study is done on healthy individuals. Adding to this, the studies conducted by Ferrari et al[15] and Anthi A et al[16] emphasise on the fact that 6MWD has a prognostic value in anemia patients on treatment.

6MWD works as an index to measure the prognosis in anemic individuals and has no significant relation with hemoglobin in healthy individuals. The strongest indication for the 6MWT is for measuring the response to medical interventions in patients with moderate to severe heart or lung disease[10]. The 6MWT has also been used as a one-time measure of functional status of patients, as well as a predictor of morbidity and mortality[10]. In the present study the subjects were healthy males with hemoglobin within normal range. Only hemoglobin was included as a parameter for correlating with 6MWD and the results show that Hemoglobin content has very minimal role to play in determining 6MWD in healthy male individuals.

Limitations: Until now not many studies have been conducted on the young healthy male individuals to relate hemoglobin with 6MWD and this is the first study of its kind. Also the study was conducted only on male individuals aged between 19-21 years on smaller population. Conducting such study on significantly larger population including other age groups and other sex would be more meaningful to arrive at much accurate conclusions.

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