



Correlation Between Hemoglobin Level And Functional Capacity In Young Adult Population

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ABSTRACT

Introduction. Functional capacity defines as an individual's ability to do activities of daily living and is assessed by VO₂ max as a basic indicator of physical fitness. The more sufficient hemoglobin levels, the more oxygen can be transported, so the body will be more optimal to produce energy. This study aimed to determine the relationship between hemoglobin levels and the functional capacity of the body in young adults. **Methods** This was an analytic observational study with a cross-sectional approach. A total 34 healthy young adults who met the inclusion and exclusion criteria were recruited as subjects in this study. Functional capacity was assessed by six minutes walking test, and hemoglobin level was measured using the strip test method. Data analysis was performed using the Spearman correlation test in SPSS version 25 with a significance level of $p < 0.05$. **Results.** The average value of hemoglobin levels in respondents was 16.0 mg/dl. The mean functional capacity based on the predicted VO₂ max is 20.3 kg/m² and 530m based on the distance. Spearman's test results showed that there was a significant correlation between hemoglobin levels and predicted VO₂ max ($p=0.001$). **Conclusion.** Our study concluded a significant correlation between hemoglobin level and functional capacity assessed by predicted VO₂ max. Therefore, hemoglobin level should be considered as a factor in enhancing functional capacity.

1. Introduction

Functional capacity is defined as the ability to perform Activities Daily Living (ADL). Functional capacity in an individual is the ability to perform work aerobically and can be expressed in the maximum amount of oxygen absorption or VO₂max as a basic indicator of physical fitness.¹ VO₂max is defined as the maximum amount of oxygen delivered through the lungs to the muscles on a millimeter scale or in minutes per kilogram of body weight. VO₂ max is influenced by various anthropometric factors, one of which is body weight. Individuals who have good endurance or stamina will also have a good VO₂max value. Good functional capacity can certainly reduce the risk non communicable disease.²

Hemoglobin or Hb is defined as a protein pigment complex containing iron which functions to bind oxygen in the process of blood transportation. Normal hemoglobin levels in adult men are between 13.5 – 18 g/dl and in women 11.5 – 16.5 g/dl.³ There were significant differences in blood hemoglobin levels in the groups with high VO₂max or fitter and less fit. The more adequate the hemoglobin level, the more oxygen can be transported, so that the body will be more optimal to produce energy.⁴ The prevalence of anemia in the age group of 15-34 years

in Indonesia is 48.9%, the incidence of anemia is still quite high and is still a health problem throughout the world, especially in developing countries.⁵

Research on hemoglobin and functional capacity that has been done before, the results are still contradictory. In a study conducted by Wati et al. proves that an athlete who has high hemoglobin levels has good endurance or VO₂max.⁶ However, based on a study conducted by Eastwood, A et al. showed that the hemoglobin level did not affect the VO₂max value. In his research on untrained adults, hemoglobin levels remained stable, but there was a 10% increase in VO₂max after 40 days of routine training or certain physical activities.⁷ Based on these varying result, researchers are very interested in conducting further research on the relationship between hemoglobin levels and functional capacity in young adults.

2. Methods

The study design in this study is observational analytic with a cross-sectional approach. The target population in this study is the young adult age group in Penaruban Village, Kec. Kaligondang, Kab. Purbalingga, Central Java. With an age range of 26-35 years who met the inclusion and exclusion criteria, there were 34 samples. The sampling technique in

this study used the cluster method and simple random sampling. The data used is primary data. Data collection was carried out by assessing functional capacity as assessed by VO₂max estimation and measuring the distance in meters that can be traveled for 6 minutes and measuring hemoglobin levels in the sample using the Easy Touch GCHb Hb meter. Measurements are carried out together at one time. After the data is collected, the data is processed using the Statistical Package for Social Science (SPSS) program. A normality test was performed with the Shapiro-Wilk test on each data and a correlative test was carried out between the independent variables and the dependent variable using the Spearman correlation test with a p-value or a significance level of p <0.05.

3. Results

Our study results the median of hemoglobin in all respondents was 16.0 mg/dl, with the median value being higher in men (16.7 mg/dl). The mean functional capacity based on the predicted VO₂ max is 20.3 kg/m², with the mean value for men being higher than for women. The average distance of 6 min walking test in all respondents is 530 meters, which is in the normal category based on age.

Our study resulted significant positive moderate correlation between hemoglobin levels and predicted VO₂ max. Meanwhile, the correlation between hemoglobin level and 6-minute walking test distance was insignificant.

Table 1. Sociodemographic distribution data (n=34)

Sociodemographic Distribution	Frequency	Percentage
Gender		
Men	16	47,1%
Woman	18	52,9%
Age (y.o)		
26 – 27	13	38,2%
28 – 29	4	11,8%
30 – 31	3	8,8%
32 – 33	3	8,8%
34 – 35	11	32,4%

Table 2. Baseline data (n=34)

Variable	Median (min-max)	SE
Hemoglobin (mg/dl)		
Men	16,7 (15,8-18,7)	0,18
Woman	14,8 (11,5-18,6)	0,50
Total	16,0 (11,5-18,7)	0,33
Predicted VO ₂ max (ml/kg/min)		
Men	23,8 (19,9-27,1)	0,65
Woman	18,7 (12,2-21,1)	0,60
Total	20,3 (12,2-27,1)	0,66
6 min walking test (meters)		
Men	532 (510-576)	4,97
Woman	509 (424-575)	10,59
Total	530 (424-576)	6,49

Table 3. Correlation of hemoglobin and functional capacity

Functional Capacity Aspect	Spearman Correlation	
	p	r
Predicted VO ₂ max	0,001*	0,52
6 min walking test	0,064	0,32

*statistically significant, p<0.05

4. Discussion

This section discusses the main findings of the study, novel findings, and the results of the study in general. Authors may compare their findings to existing literature and previous studies, providing a logically sound explanation why the findings are similar to or different from existing data.

In this section, authors need to explain the strengths and limitations of the study. This may help future research to be developed and conducted in the needed direction, in accordance with existing literature and the current findings.

Normal hemoglobin levels in men are 13.5 – 18 g/dL and in women 11.5 – 16.5 g/dL. In this study, the number of polycythemia in all respondents was 11.8% of, where the majority of these incidents were found in women. Polycythemia or erythrocytosis is defined as an increase in the number of circulating red blood cells or a condition in which the hemoglobin level and hematocrit are more than normal limits.³ The causative factors can be comorbid or comorbid diseases, drugs that are routinely used, lifestyle, and family history. According to the 2019 Medical Hematology Oncology Study at Cipto Mangunkusumo Hospital, the incidence of polycythemia is still challenging to know at this time. It is estimated that half of polycythemia cases are secondary to non-hematological disorders.⁸

In 2016, globally, 28% of all people over 18 y.o were not physically inactive. Physical inactivity is also a problem in Indonesia, involving around 26.1% of the population.⁹ Exercise status or physical activity can change an individual's VO₂ max by 20%, depending on the person's lifestyle and fitness status.¹⁰ A decrease in physical activity will affect a person's cardiorespiratory endurance (VO₂max) when carrying out daily activities.¹¹ Indonesian Basic Health Research conducted by the Ministry of Health in 2018 reported in the young adults group (25-34 y.o) the prevalence of physical inactivity is 25.4%.¹² Our study reported a higher prevalence, with 100% of the participant physically inactive and having functional capacity below normal.

In this study, the 6-minute walk test result in healthy young adults ranges from 400 – 700 m. However, age, height, gender, track distance, impaired cognition, and the need for continuous oxygen supplementation can affect the 6-minute walk test in respondents.¹³ According to a study conducted on students 19-21 years in Semarang, walking speed is also influenced by height and leg length, which will determine the distance of one walking cycle.¹⁴

In this study, a significant correlation was found between hemoglobin levels and predicted VO₂ max ($p = 0.001$ ($p < 0.05$)), and the correlation coefficient value was 0.52, which

indicates a positive correlation between the two with moderate correlation strength. This result is in line with research conducted previously by Wati et al. VO₂max is the maximum volume of oxygen (O₂) that an individual can consume per minute and is usually related to body mass. Therefore, the unit of measurement for VO₂max is ml/kg/minute. There are four things that can affect VO₂max: the respiratory system, cardiovascular system, oxygen (O₂) transport, and tissue biochemical systems.⁶

There is research that analyzes the relationship between lung vital capacity and VO₂max by carrying out a 6-minute walk test or test, and it is found that when the hemoglobin level is below normal, the oxygen level in the blood is also lower, and vice versa.¹⁴ hemoglobin levels, the more optimal the process of transporting oxygen (O₂) into the tissues. In a study previously conducted by Wati et al. states that there is a relationship between hemoglobin levels and VO₂max, with evidence that an athlete who has high hemoglobin levels has good endurance or VO₂max.⁶

Our study showed there was no significant relationship between hemoglobin levels and mileage ($p = 0.064$ ($p > 0.05$)) and a correlation coefficient of 0.32 indicated that both correlations were positive with a weak correlation strength. According to the American Thoracic Society (ATS), the 6-Minute Walk Test (TJ6M) is a valid, reliable, and responsive test for measuring lung functional capacity. Many studies say that the distance traveled is also influenced by the length of the path. ATS recommends that the length of the track used on the TJ6M is 30 m long.¹⁵ In reality, not all TJ6M use a 30 m track due to various factors, one of which is limited land. This research uses a straight and flat trajectory along 15 m. But until now there has been no agreement for the length of the track used.

A study in Jakarta has analyzed the effect of a 6-minute rehabilitation walk on increasing hemoglobin levels in the blood in patients with acute coronary syndrome. This study obtained significant results or relationships.¹⁶ In this study, no significant relationship was found between hemoglobin levels and distance traveled on the 6-Minute Walk Test (TJ6M). The absence of a significant relationship can occur because the study in Jakarta lasted for five weeks and the 6-minute walking test was carried out intensely 8 times, whereas in this study the data on hemoglobin levels and distance traveled were taken only once at a time.

We suggest conducting further research by calculating other factors that can affect hemoglobin levels such as diet, co-morbidities, habits, and so on so as to get better results. And by considering other factors that can affect functional capacity based on VO₂max values such as the respiratory system and

tissue biochemical systems. And based on mileage like, foot length.

5. Conclusion

Our study concluded that the average hemoglobin level in participants is included in the normal category (16.0 g/dL). Functional capacity in the young adult group based on predicted VO₂max showed that the average result was included in the less category (20.3 ml/kg/min). Based on the distance traveled, the average results are included in the good category (530 m). There is a significant relationship between hemoglobin levels and functional capacity based on predicted VO₂max with a value of $p = 0.001$ and a correlation coefficient (r) = 0.523. There is no significant relationship between hemoglobin levels and functional capacity based on distance traveled with a value of $p = 0.064$ and a correlation coefficient (r) = 0.321

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7. References

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