The relationship between body height and weight toward blood hemoglobin level in the teen athletes

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ABSTRACT

Background: Performance sports are carried out with high intensity and require excellent physical preparedness. This study aims to determine the relationship between height, weight, and athlete's blood hemoglobin level.

Methods: This research was an analytic observational type with a *cross-sectional study design* among 49 male and female athletes enrolled with the total sampling technique. Data were analyzed with a descriptive test, and normality test, and *multiple correlations*. A significance value of $p \leq 0.05$ and research data was analyzed using *software* SPSS version 20 for Windows.

Results: Most respondents in both genders were normal in BMI (85.72%). However, anemia status tends to be higher in males (23.33%) than females (10.52%). The multiple correlation tests showed a moderate level of correlation with a value of r=0.408 The significance analysis of the value of p=0.015 indicates that there is a significant correlation between Height, Weight, and Blood Hemoglobin (Hb) level ($p < 0.05$).

Conclusion: There is a significant moderate positive correlation between height and weight to blood hemoglobin level.

Keywords: Body Height, Weight, Hemoglobin

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INTRODUCTION

Sports is a structured physical activity and schedule carried out with repetitive movements to improve physical fitness.[1] Maximum physical activity can trigger an imbalance between free radicals' production and the body's antioxidant defense system, known as oxidative stress. High-intensity exercise produces free radicals.[1] Sports activities that affect biological function can be positive effects that repair and negatively damage body cells. Continuous physical activity with maximum intensity will cause physical fatigue. The body must be able to adapt by involving various body systems.[1,2] And exercise can be seen as a burden or stress on the mechanism of homeostasis in the body.[2,3]

The physical components related to the athlete's biometric aspects are height and weight. Both of these physical components can be observed directly by shaving the athlete directly.[4] Athlete coaching programs are also related to nutrition issues where diet can influence the body's adaptation path to exercise training—a balance between intake and requirements.[5] The balance between the intake and nutritional requirements of athletes will impact the athlete's physical growth and development.[5] The teen phase is characterized by physiological maturities, such as the enlargement of body tissue. The growth and physical development of boys and girls are different.[6] That the peak of girls' growth is very fast occurring around the age of 12 years and the boy's growth is very fast occurring at the age of 14 years. Adolescence is the age of growth of children toward the maturity process of adult humans.[6] Some components of physical growth that are often used as a benchmark in assessing the growth and development of athletes are height, weight, and blood hemoglobin levels as a parameter of assessment of athletes' physical status.

Height is the distance from the footwear to the highest point on the head when standing upright.[7] Height is part of anthropometry, which describes the state of skeletal growth from the sole to the tip of the head. Under normal circumstances. Biological aspects in the form of structure and body posture as well as height are one of the determinants of support for achieving peak performance. Height is a vertical direction from the floor to the upper head.[7] Height is an important factor in various sports. Weight is the most easily measured growth parameter. Weight is the most important measure used in every assessment of a child's physical growth—bodyweight results from an increase in all bone, muscle, fat, body fluid, etc.[7] Weight is an anthropometric measure and very closely related to several sports.[7]

Hemoglobin is an essential element for the human body because it plays a role in the supply of oxygen throughout the body or hemoglobin is a significant determinant of VO_2Max ability.[8] Hemoglobin has two important transportation functions in the human body that are the transport of oxygen from the respiratory tissue to oxygen and carbon dioxide transport.[9] That is the ability of one hemoglobin molecule can bind four oxygen molecules. Hemoglobin plays a very important role in

sports activities related to oxygen demand.[9] In heavy exercise, oxygen consumption can increase by 10-20 times compared to oxygen requirements at rest.[8,9]

Hemoglobin (Hb) is a parameter that is widely used to determine the incidence of anemia and also hemoglobin is also used as a parameter to assess the physical condition of an athlete whether it is suitable to compete or not. Anemia has an impact on the process of growth, development, and immunity.[10] Hemoglobin functions as an oxygen-rich oxygen carrier in red blood cells and oxygen are carried from the lungs into the tissues.[9] Muscle cells and are dependent on hemoglobin levels.[11] Lack of hemoglobin causes anemia, characterized by fatigue, shortness of breath, pale, and dizziness. Factors affecting hemoglobin and red blood cell levels are food, age, sex, physical activity.[9] Low hemoglobin levels are very influential in O_2 transport function, which is needed a lot in the body's metabolism reaction when moving or exercising. Normal hemoglobin levels in men are 13gram/dL and in women 12 gram/dL and it is called anemia when Hb<12g/dL.[12] Low hemoglobin levels will have an impact on fatigue and decrease work capacity.[12] If the athlete's Hb level is low, it will impact the general decline in ability and achievement.

This study aims to determine the correlation between height, weight, and athlete's blood hemoglobin level. This study's results can add insight into sports science, especially in the correlations between physical development and growth of athletes related to height, weight, and blood Hb levels as a parameter to determine the level of development and growth of athletes undergoing a long-term training program. And provide scientific data for trainers on athlete development, knowledge of distractions, and complaints that can hinder athletic performance improvement.

METHODS

This study was an analytic observational study with a *cross-sectional study design.* The population in this study were male and female teenage athletes fostered by PPLP Bali, with 49 people. They consisted of 19 female athletes and 30 male athletes. The age range of the sample is 13 years up to 18 years. Determination of the research sample using the total sampling method so that the total number of research samples was taken from a population of 49 people. Research data taken include height, weight, and blood hemoglobin (Hb). This study's research instrument was the Microtoise One Med brand, height

measuring by scale TANITA HD-380 and the Hemoglobin Easy Touch GcHb brand. Research data were collected directly with direct measurements on the study sample.

The study's data analysis included: Descriptive Statistics Test to analyze variants of age, height, weight, and blood hemoglobin levels. Normality Test with *Kolmogorov-Smirnov test* to find out the distribution of research data with p-value≥0.05. And the multiple correlation test to determine the correlation between height, weight, and blood hemoglobin with a significance value of p ≤ 0.05. Data were analyzed using SPSS version 20 for Windows.

RESULTS

To determine the nutritional status of research subjects, the Body Mass Index (BMI) for the study subjects was calculated, as shown in Table 1. The recent findings suggest that most respondents have Normal BMI status in both females (93.34%) and males (73.68%) (Table 1).

Levels Blood hemoglobin levels by gender of the study subjects are presented in Table 2. A recent study found that anemia status tends to be higher in the male (23.33%) compared with the female (10.52%) (Table 2). Based on the Pearson correlation test, this study found a moderate positive correlation between height, weight, and hemoglobin levels (r=0.408; p=0.015) (Table 3).

DISCUSSION

The age range of the sample was 13 years up to 18 years who still in a period of growth and development. This is following World Health Organization (WHO) limits adolescence is the age range between 10 to 19 years old.[13] At this age, there are still chances that are still unstable. Also due to the behavior of athletes both on diet or rest patterns that can affect the level of physical development such as height, weight, and blood hemoglobin levels which are greatly influenced by the lightweight of the exercise program carried out and nutritional intake and athlete's diet in line with the results of the Shah and Asna research in which 20% of students with anemia had a risk of eating disorders.[14]

Based on the research results on male and female teen athletes fostered by PPLP

Table 1.   Distribution of respondents based on Body Mass Index (BMI)

Variable	Gender (N=49)		Total	
	Female (N=30)	Male (N=19)	n	%
BMI (kg/m²), n (%)				
Underweight	1 (3.33)	5 (26.32)	6	12.24
Normal	28 (93.34)	14 (73.68)	42	85.72
Overweight	1 (3.33)	0 (0.00)	1	2.04

Table 2.   Frequency distribution of Blood Hemoglobin Levels (Hb) based on Gender

Variable	Hemoglobin Level (N=49)		Total	
	Anemia (N=9)	Normal (N=40)	n	%
Gender, n (%)				
Male	7 (23.33)	23 (76.67)	30	61.22
Female	2 (10.52)	17 (89.48)	19	38.78

Table 3.   Results of Correlation Test of Height, Body Weight with Levels Hemoglobin (Hb)

Variable	r	p
Height	0.408	0.015
Weight		
Hemoglobin Levels (Hb)		

Bali with a total sample of 49 people. Consisting of 19 female athletes and 30 male athletes. The results of the multiple correlation test showed a moderate level of correlation with a value of r=0.408 and a value of p=0.015 indicates that there were significant correlations between Height, Weight, and Blood Hemoglobin Level (Hb) with a value of p <0.05. This study is in line with the research was conducted by Acharya with the results of research on height with significant hemoglobin with a value of p=0.008 and significant bodyweight with a value of p=0.001.[15]

CONCLUSION

There is a correlation between height, weight, and blood hemoglobin level. The level of moderate category correlations with positive direction, which is signed between height, weight, and blood hemoglobin level in PPLP athletes in Bali province.

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CONFLICT OF INTEREST

The authors declare that there is no competing interest regarding the manuscript.

ETHICS CONSIDERATION

This article has followed the ICMJE and COPE regulations and has already been approved by the Ethics Committee of Universitas Dhyana Pura (UNDHIRA), Bali, Indonesia.

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AUTHORS CONTRIBUTION

All of the authors equally contribute to the study from the conceptual framework, data gathering, and data analysis until reporting the study results through publication.

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