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THE RELATIONSHIP BETWEEN WAIST-HIP RATIO AND 60-METER RUNNING SPEED STUDIES ON STUDENTS OF THE FACULTY OF MEDICINE, DIPONEGORO UNIVERSITY

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ABSTRACT

Background : It is imperative to improve Indonesia's achievement in sprint category using an indicator according to talent scouting. The running speed of those with excessive body fat is slower. The distribution of body fat, especially in the area of abdomen and hip, could be measured using the waist hip ratio indicator. **Aims :** This study is aimed at determining the relationship between waist-hip ratio and 60-m running speed. **Methods :** This was a cross-sectional study. The subjects were chosen using simple random sampling. **Results :** There were 32 medical students of Diponegoro University. The subjects were measured for their waist circumference, hip circumference, leg length, and 60-m running speed. The mean of waist hip ratio was 0.88 ± 0.07; the mean of leg length was 80.24 ± 3.75 cm; the mean of 60-m running speed was 5.49 ± 0.69 m/ s. Pearson correlation test between waist-hip ratio and 60-m running speed of Diponegoro University's medical students showed a significant negative correlation (r= -0.515; p= 0.003). According to multiple linear regression analysis, it was found that waist-hip ratio affected 60-m running speed as much as 26.6%. (R^2= 0.266). **Conclusions :** Thus, there is a significant negative correlation between waist-hip ratio and 60-m running speed.
Keywords: *waist-hip ratio, 60-m running speed*

INTRODUCTION

Athletics is the oldest sport that has existed for several centuries, for the movements in athletics consist of walking, running, throwing and jumping, typically done in everyday life. One of the athletic numbers that are competed is running, ranging from the regional, national, to international levels.[1] Running numbers consist of sprinting, medium-distance running, long-distance running and marathon.[2] Sprints is one prestigious branch of sport often competed, both at regional and international level.[3] In 2018, one of the Indonesian sprinters, Lalu Muhammad Zohri, was able to win a gold medal at the U-20 World Athletics Championship in Finland. However, in 2019, Indonesia failed to win gold in the Asian Athletics Championships in Doha. It is necessary to put various efforts to improve Indonesia's achievements in sprint numbers, one of which is by using certain anthropometric indicators in terms of talent scouting.[4]

Short-distance running (sprint) is running between 50 meters to 400 meters. It takes mastery of techniques in starting, running, and crossing the finish line in order to achieve maximum results.[5] Speed is the most important aspect of running.[6] An athlete who has talent, potential, and high motivation will not put out optimal results without systematic training.[7] There are several factors affecting running speed, e.g. leg muscle strength, leg muscle explosive power, and leg muscle flexibility, length, width, size, and body weight.[8]

Acceleration is the change in speed per time unit. Based on Newton's Second Law, the acceleration of an object's motion will be inversely proportional to the object's mass.[9] With the increase of time sprinters increase their speed, but if there is excess weight, given the equal power, the acceleration will decrease. The comparison of body weight and squared height produces an anthropometric index called the body mass index (BMI), which is commonly used to determine obesity when the value surpasses its normal limit. Obesity can occur due to an energy imbalance, where energy intake exceeds energy expenditure.[10] In addition, lack of physical activity, especially sports can also lead to obesity.[11]

There are several studies on the relationship between BMI and running speed. In 2014, a study was conducted by collecting data on BMI, weight, and height of world running athletes with the top 100 rankings in each running branch. It implied that BMI, weight, and height were important parameters in speed, but the two most important indicators are BMI and body weight.[12] Furthermore, research in 2019 on

30 male students of fifth grade students of an elementary school in Batang Central Java also showed a relationship between BMI and the 60-m running speed.[13]

Thus it is suggested that there is a relationship between increased body fat components and running speed. However, there has been no research on the relationship between waist-hip ratio, which is an anthropometric index to determine the distribution of body fat, especially the abdomen and pelvis, and running speed. It is essential to conduct a study on the relationship between waist-hip ratio and 60-meter running speed.

METHODS

This research is a correlational study with a cross-sectional study design. The study was conducted in August 2020 at the Diponegoro IV Military Command Shooting Field with 32 students from Faculty of Medicine Diponegoro University. The inclusion criteria in this study were: consented to be a respondent, male, BMI ranging from18.5 kg/m^2 –35 kg/m^2 , and aged 18–21 years. The exclusion criteria in this study were: experiencing an injury, a history of fractures, receiving therapy for muscle, bone or tendon injuries, pain during the study period, athletes, consuming protein to increase muscle mass, doing sports more than 3 times a week, and smoking. Simple random sampling was applied to select the subjects.

The independent variable in this study was waist-hip ratio. The waist-hip ratio was calculated by measuring the waist and hip circumference. Hip and waist circumference were measured by standing upright and calm. When measuring, the clothes should be removed, only light clothing or underwear was allowed. The measuring tape should be parallel to the floor and not pressing against the skin. The measurement of waist circumference was performed in the area between the twelveth rib and the iliac crest which has the smallest circumference in the abdominal area. The measurements were taken during normal expiration. For the hip circumference, the measuring tape was wrapped around the top of the *symphysis pubis* and the maximum part of the gluteus region. After obtaining the waist circumference and the hip circumference in centimeters (accuracy value 0.1 cm), the comparison between the two was calculated. The dependent variable in this study was 60-m running speed. To determine the running speed, distance and time measurements were taken from start to finish. Then the ratio was calculated between the covered distance and the acquired time. The unit of speed was m/s or meters per second (digital stop-watch accuracy value is 0.01 seconds). The confounding variable in this study was the leg length. The leg length was measured in centimeters from the major *trochanter* to the lateral *malleolus* using the anthropometric stick (accuracy value 0.1 cm).

Pearson was used as the correlation test based on the normally distributed data by Saphiro Wilk. Multivariate analysis of multiple linear regression was chosen to determine the relationship between variables by removing the confounding variable.

This research had been approved by the Ethics Commission of The Faculty of Medicine, Diponegoro University with the serial number 90/EC/KEPK/FK-UNDIP/VI/2020 dated June 3rd 2020.

RESULT

This research was conducted in August 2020 at the Diponegoro Military Commands IV Shooting Field. The study was conducted by measuring waist circumference, hip circumference, leg length, and 60-m running speed on 32 subjects. The characteristics of the subjects are shown in Table 1.

Table 1. Characteristics of Research Subjects (n = 32)

Characteristics	Mean ± SB (min - max)
Age (years)	19.94 ± 1.05 (18-21)
Body mass index (kg/m ^{2})	24.04 ± 3.45 (18.7-30.1)

SB = Standard Intersection; min = minimal; max = maximum

In this study, the majority of subjects were at the age of 21 years (13 people). The subjects with normal BMI (18.5 to 25 kg/m^2) were 20 people, with overweight (25 to 29.9 kg/m^2) were 11 people, and one subject was categorized as obese (more than 30 kg/m^2). The measurements of waist-hip ratio, leg length, and 60-m running speed are shown in Table 2.

Table 2. Measurement Results of Waist-hip ratio, Leg Length, and 60-m running speed

Variable	Mean ± SB (min - max)
Waist-hip ratio	0.88 ± 0.07 (0.74 - 1.02)
Leg Length (cm)	80.24 ± 3.75 (72.1 - 87.9)
60-m running speed (m / s)	5.49 ± 0.69 (3.60-6.79)

SB= Standard Intersection; min= minimal; max= maximum

In this study, 11 subjects had normal waist-hip ratio (= 0,9), one with central obesity (>0.9), while those included in the peripheral obesity category (<0.9) are 20 people. The value of the leg length of the research subjects who were above the mean value (>80, 24 cm) were 18 people, while 14 people had a leg length below the mean value (<80.24 cm). Subjects with 60-m running speed faster than the mean value (<5, 49 m/s) were 12 people, while 20 people were slower than the average (>5.49 m/s).

The relationship between waist-hip ratio and 60-m running speed using the Pearson correlation test are shown in Table 3.

Table 3. Analysis of the Relationship between Waist-hip ratio and 60-m running speed

		60-m running speed
Waist-hip ratio	r	-0.515
	p	0.003
	n	32

r= degree of correlation; p= meaningfulness; n= number of samples

The waist-hip ratio and 60-m running speed showed r= -0.515 and p= 0.003. These results indicate that waist-hip ratio has a negative correlation to the 60-m running speed and statistically shows a significant correlation. The correlation strength is moderate.

Multiple linear regression test of the relationship between the waist-hip ratio as the independent variable and leg length as a confounding variable and the 60-m running speed using multiple linear regression tests are shown in Table 4.

Table 4. Results of Multiple Linear Regression Analysis

Variable	**Co-efficient**	**Sig**	**Conf sig**
Waist-hip ratio	-5,050	0.003	Signi-ficant
R^2 = 26.6%			
Constant = 9,929			
Y = 9,929 - 5,050 (WHR)			

In the multivariate analysis of multiple linear regression using the backward method, the best model for the independent variable is waist-hip ratio while 60-m running speed is the dependent variable. The leg length was excluded from this model.

The above-mentioned multiple linear regression equation informs that with an increase in the value of the waist-hip ratio, there is decrease in the 60-m running speed by 5.050. The p value= 0.003 indicates a significant relationship.

The value of R^2 indicates that the waist-hip ratio had 26.6% effect on the 60-m running speed, while the remaining 73.4% are influenced by other variables not included in the study.

DISCUSSION

Analysis of the relationship between waist-hip ratio and 60-m running speed meters was done using Pearson test. The relationship between waist-hip ratio and 60-m running speed showed r=-0.515. This result indicates a negative correlation where the higher the waist-hip ratio, the slower the 60-m running speed. The correlation strength is moderate, as 0.515 is within 0.4 and 0.6. The p value of 0.003 indicates a significant relationship between waist-hip ratio and 60-m running speed. This result agrees with the initial hypothesis that there is a relationship between waist-hip ratio and 60-m running speed.

Previous research showed a significant relationship between BMI and 60-m running speed.[13] Individuals with a BMI above the normal value can be classified as overweight if it is between 25 and 29.9 kg/m^2 and classified as obese if over 30 kg/m^2. In addition to using BMI, to determine the distribution of fat in the body, especially the abdominal and pelvic area, waist-hip ratio can be used.[14-16] According to the WHO (World Health Organization), men with a waist-hip ratio> 0.9 are considered as having central obesity.[15,17] In central obesity, there is excess fat storage in the waist and abdomen.[18]

Barandun, et al. stated that in runners with excess fat tissues, more efforts from muscles are required to produce energy and the energy exerted is theoritically greater even though the resulting speed is equal.[19] People who are either obese or overweight have more fat tissue than muscle tissue. The formation of energy occurs directly in muscles, thus obese and overweight people have lower ability to generate energy.[20] The higher the value of waist-hip ratio, the lower the 60-m running speed due to a decrease in the ability to generate energy.

Analysis of the relationship between waist-hip ratio, leg length, and 60-m running speed was done using multivariate analysis of multiple linear regression with the backward method. The best model is obtained from waist-hip ratio as the independent variable and 60-m running speed as the

dependent variable. The leg length as a confounding variable was excluded from the research model because it was not significant.

Based on the multiple linear regression equation, the waist-hip ratio variable coefficient is -5.050, which indicates that if the value of the waist-hip ratio increases by one point, the 60-m running speed will decrease by 5.050 and vice versa. The p value of 0.003 means that the relationship between waist-hip ratio and 60-m running speed in this study is significant. These results indicate that the higher the waist-hip ratio, the lower the 60-m running speed. This is in accordance with the initial hypothesis where there is a relationship between waist-hip ratio and 60-m running speed.

Multivariate analysis on the relationship between waist-hip ratio and the 60-m running speed showed $R^2 = 0.266$. This value indicates that the independent variable in the form of waist-hip ratio affects the 60-m running speed by 26.6%. The other 73.4% are influenced by other variables not included in the study i.e. leg muscle strength, flexibility, and leg muscle explosive power. Some of these variables are related to the stance phase while running. Running speed can be improved if the stance phase is done swiftly, where *m. soleus* and *m. gastrocnemius* contract for a short period of time. In addition, running speed also increases with stronger repulsion during the stance phase, so that the resulting steps are further due to the body being in the air longer.[21]

This research was conducted outdoor, not on a standard track and field due to the health protocols applied during the pandemic. In addition, differences in shoes used while running, such as differences in shoe materials, can be a confounding factor for running speed.

CONCLUSION AND SUGGESTION

There is a significant negative correlation between waist-hip ratio and 60-m running speed. It is recommended to observe the relationship between waist-hip ratio and 60-m running speed on female subjects. Further research should also be conducted to determine the relationship between waist-hip ratio and factors contributing to running speed i.e. strength, explosive power, and flexibility of leg muscles.

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