Relation Between Calf Circumference, Thigh Circumference, and Leg Length with Running Speed of 100 Meters

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Abstract. Sprinting involves moving swiftly over distances of 60 meters, 100 meters, 200 meters, and 400 meters. Speed in sprinting relies on the coordinated effort of the body's motion system and muscles, which are limited by a maximum speed threshold. Achieving optimal speed in sprinting requires a combination of muscle strength, agility, and speed, particularly in the lower limbs. Key factors for success include the effectiveness of the starting technique, the sprinting motion, and the technique employed through the finish line, all of which heavily rely on muscle strength, the size of leg muscles, and leg length. This study utilized an observational analytic approach with a cross-sectional design, employing chi-square statistical testing at a 95% confidence level ($P < 0.05$). The sample size consisted of 35 running athletes from Semarang, observed during October to November 2017. Analysis of the data revealed significant correlations: calf circumference with running speed for 100 meters ($p = 0.000$), thigh circumference with running speed for 100 meters ($p = 0.001$), and leg length with running speed for 100 meters ($p = 0.000$). These findings demonstrate a clear relationship between calf circumference, thigh circumference, leg length, and running speed over 100 meters.

Keywords: Calf Circumference, Thigh Circumference, Leg Length, Running Speed.

1. Introduction

Athletics is closely related to daily activities, such as running, jumping, throwing, etc. Athletic activities have an important role in supporting the development of basic movements in sports. Athletics comes from the Greek Athloni which means competition or competition. Athletics began to be competed in the Olympics in 776 BC [1] Athletic competitions are still widely participated in throughout the world, including in Indonesia, for example in running.

Advancements in science and technology have continually shaped the landscape of sports achievements over time. The rapid evolution of sports science encompasses various disciplines such as coaching, sports nutrition, sports physiology, biomechanics, sports

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health, and sports education. Understanding the structure and function of the human body enables insights into how it reacts to stimuli. Through analysis, researchers examine anatomical relationships and the body's structure, elucidating how organs function [2]. Research within the realm of sports performance scrutinizes various factors that contribute to enhancing athletic capabilities.

Indonesia once had several famous runners in the elite number, including Moch Sarengat in 1962, Purnomo in 1984, Mardi Lestar in 1988, the women's class included Irene Truitje Joseph in 1999, then Henny Maspaitella in 1981 [3] However, this proud achievement is currently starting to decline and is difficult for Indonesian athletes to achieve. Various studies have been carried out to find out why the performance of runners in Indonesia is not as good as previously achieved. It is necessary to review again to find techniques and methods to create winning achievements. Studies to improve skills in the field of sports need to continue to be developed, both to create achievements and in their role in the fields of sports and health [3].

Sprinting involves running at maximum speed across distances such as 60 meters, 100 meters, 200 meters, and 400 meters. It relies on the coordinated action of the body's locomotive system and muscle mechanisms to execute movements that are restricted to a specific velocity. Speed is one of the bio motor components that has the most influence on fast running. Speed is the result of the work of a force over a period of time which is measured by the distance per unit of time. Sprinting 100 meters takes a short time of around 10-15 seconds and is a sport whose main source of energy is anaerobic metabolism [4][5].

To optimize speed in running, sprinting necessitates elements such as muscle strength, agility, and velocity, with a predominant focus on the lower limbs. So, it requires strength, frequency of footsteps and speed of movement with a maximum contraction [6][7][8]. Three things need to be considered to achieve this effort, namely good starting technique, sprint movements and technique through the finish line. These three things are closely related to muscle strength, leg muscles size and leg length [9][10][11].

2. Research Methods

The study employs an analytical observational method with a cross-sectional approach. The sample comprises 35 running athletes from Semarang city, selected based on predetermined inclusion and exclusion criteria. The inclusion criteria were running athletes in the city of Semarang. Exclusion criteria were running athletes who had sports injuries during the research, running athletes who were unable to attend the research, running athletes who had respiratory diseases, running athletes who had cardiovascular diseases, running athletes who had neurological diseases, running athletes who had disorders. psychiatry. The sampling technique in this research is total sampling. Data analysis of the relationship between the Chi Square statistical test with $P < 0.05$. This research was conducted after the publication of the statement of ethical feasibility No: 065/KEPK-FKM/UNIMUS/2023.

3. Result

Based on table 1, it can be concluded that all respondents have normal calf circumference (≥27.5cm), namely 35 respondents (100%), the majority of respondents have fat thigh circumference (>50cm), namely 16 respondents (45.7%), Most of the respondents had long leg lengths (96-100cm), namely 20 respondents (57.1%), and most respondents could achieve a fast-running speed (10-15 seconds), namely 26 respondents (74.3%).

Table 2 shows that the results of the bivariate analysis on the calf circumference variable were tested using the Spearman Rank. The calf circumference variable could not be tested using the chi-square test because the data obtained during the research only yielded one category, namely the normal calf circumference category. This means that the calf circumference variable cannot be analyzed categorically, so the researchers used a numerical scale to obtain analysis results from the relationship between the calf circumference variable and running speed of 100 meter.

The Spearman rank correlation coefficient value obtained from the analysis results is 0.000 where $p<0.05$, this means there is a relationship between calf circumference and running speed of 100 meter.

Table 3 shows that statistically the relationship pattern was tested using the chi square analysis test with the result being a significance value of 0.001. The significance value obtained is smaller than the specified significance value, namely $\alpha = 0.05$ ($p<0.05$) so that these results can be interpreted as meaning that there is a relationship between thigh circumference and running speed of 100 meter.

Table 4 shows that statistically the relationship pattern was tested using the chi square analysis test with the result being a significance value of 0.000. The significance value obtained is smaller than the specified significance value, namely $\alpha = 0.05$ ($p<0.05$) so that these results can be interpreted as meaning that there is a relationship between leg length and running speed of 100 meter.

4. Discussion

The hypothesis suggesting a correlation between calf circumference and 100-meter running speed is supported, as indicated by a p-value of 0.000 ($p < 0.05$) and a correlation coefficient (r) of -0.749. This signifies a significant, negative, and robust relationship between the two variables. These findings align with those of Rathore (2016), whose research also observed a significant correlation between calf circumference and running speed [12].

This is in accordance with the literature which states that calf circumference is also a physical element that influences running performance. A large calf circumference allows it to have a larger number of fibers so that the muscles that make it up are stronger. This can provide great muscle strength thereby maximizing the contraction of the muscle. With regard to

strong calf bones and muscles in forming power, it is very possible to form a large calf circumference in anthropometric measurements. Having a large and strong calf circumference can make a big contribution to running.

The hypothesis which states that there is a relationship between thigh circumference and 100 meter running speed is proven to be acceptable. This can be proven by a p value of 0.001 where $p<0.05$ which means that there is a significant relationship between thigh circumference and 100 meter running speed. These results are in accordance with research by Rathore (2016) which reported that there was a significant relationship between thigh circumference and running speed [12].

These results are in accordance with the previous theory stated that a large thigh circumference allows for a larger number of fibers so that the muscles that make up them are stronger. This is possible to produce strong leg power so that it can make a maximum contribution to running speed. With regard to strong thigh bones and muscles in forming power, it is very possible to form a large thigh circumference in anthropometric measurements. Having a large and strong thigh circumference can make it possible to make a significant contribution to running [13].

The hypothesis asserting a relationship between leg length and 100-meter running speed is supported, as evidenced by a p-value of 0.000 ($p < 0.05$), indicating a significant correlation between the two variables. These findings corroborate previous research conducted by prior study, which also found a significant relationship between leg length and 100-meter running speed. This aligns with the notion that individuals with longer strides may move faster than those with shorter strides, provided they maintain the same step frequency, owing to their ability to cover more ground with each step.

Table 1. Distribution of Respondent Variables

Variable	Category	Frequency	Percentage (%)
Calf circumference	≥27,5 cm	35	100%
	<27,5 cm	0	0%
Thigh circumference	≤45 cm	4	11,4%
	46-50 cm	15	42,9%
	>50 cm	16	45,7%
Leg length	96-100 cm	20	57,1%
	90-95 cm	7	20%
	85-90 cm	8	22,9%
Running speed	10-15 second	26	74,3%
	>15 second	9	25,7%
	>20 second	0	0%

Table 2. Relationship between calf circumference and running speed of 100 meter

Variable	Running speed of 100 m	Adjective
	P-value	
Calf circumference	0.000	Significant

Table 3. Relationship between thigh circumference and running speed of 100 meter

Independent Variable		Running Speed of 100 Meter			P Value
		Fast	Medium	Slow	
Thigh Circumference	Thin	0 0%	4 100%	0 0%	0,001
	Normal	11 73%	4 26,7%	0 0%	
	Fat	15 93,8%	1 6,1%	0 0%	

Table 4. Relationship between leg length and running speed of 100 meter

Independent variable		Running speed of 100 meter			P value
		Fast	Medium	Slow	
Leg length	Length	20 100%	0 0%	0 0%	0,000
	Medium	5 71,4%	2 28,6%	0 0%	
	Short	1 12,5%	9 87,5%	0 0%	

5. Conclusion

The study demonstrates relationships between calf circumference, thigh circumference, leg length, and 100-meter running speed. Specifically, there is a significant correlation between calf circumference and 100-meter running speed, as well as between thigh circumference and 100-meter running speed. Furthermore, there exists a significant relationship between leg length and 100-meter running speed.

6. Suggestion

Future research is expected to conduct research with other study designs, a larger population and sample scope, other sampling techniques, and is expected to conduct research at a time that is not close to an event, for example the National Championship, so that not many respondents are excluded.

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