

Measurement of Tibial Bone Length and Body Weight as Factors That Determine the Running Speed of 5th Grade Elementary School Students

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ABSTRAK

Pendahuluan: Peningkatan kualitas sumber daya manusia di bidang olahraga perlu dilakukan dengan cara pembinaan sejak dini. Salah satu hal yang bisa dilakukan adalah dengan mencari dan mengidentifikasi bakat yang dimiliki oleh siswa sekolah dasar untuk mengetahui potensi olahraga yang sesuai dengan bakat anak. Lari merupakan cabang olahraga yang penting dalam perkembangan awal sekolah. Pada cabang sprint 100 meter, pelari berusaha untuk mencapai kecepatan maksimal yang salah satunya dipengaruhi oleh struktur tubuh. Semakin panjang kakinya, semakin cepat pula larinya. Sebaliknya dengan berat badan anak, semakin besar beratnya justru cenderung semakin lambat. Penelitian ini bertujuan untuk mengetahui pengaruh panjang tulang tibia dan berat badan terhadap kecepatan lari.

Metode: Kegiatan dilaksanakan di Sekolah Dasar Negeri 15 Mangkubumen Lor Surakarta. Kelas V. Ada sebanyak 33 siswa yang dilibatkan dalam pengukuran panjang kaki dan berat badan ini. Data yang didapatkan dianalisis dengan menggunakan regresi linier ganda. Hasil analisis digunakan sebagai bahan edukasi dan masukan kepada guru olahraga di Sekolah tersebut.

Hasil dan Pembahasan: Panjang kaki rata-rata adalah 30,51 cm dan Berat badan rata-rata sebesar 36,33 Kg. Sedangkan rerata kecepatan lari 4,74 m/s. Uji statistik koefisien regresi menunjukkan bahwa panjang kaki ($\beta = 0,424$; $p = 0,018$) dan berat badan ($\beta = -0,488$; $p = 0,007$) artinya kedua komponen tersebut berpengaruh terhadap kecepatan lari.

Kesimpulan: Panjang kaki berpengaruh positif sedangkan berat badan berpengaruh negatif terhadap kecepatan berlari.

Kata Kunci: berat badan; kecepatan lari; panjang kaki

ABSTRACT

Introduction: Improving the quality of human resources in the field of sports needs to be done by coaching from an early age. One of the things that can be done is to find and identify the talents possessed by elementary school students to find out the potential for sports that are following the child's talents. Running is an important sport in early school development. In the 100 meter sprint, runners try to achieve maximum speed, one of which is influenced by body structure. The longer the legs, the faster they run. On the other hand, with a child's weight, the greater the weight, the slower it tends to be. This research aims to determine the effect of tibia bone length and body weight on running speed.

Methods: The activity was carried out at the State Elementary School 15 Mangkubumen Lor Surakarta. Class V. There were 33 students involved in the measurement of the foot length and weight. The data obtained were analyzed using multiple linear regression. The results of the analysis are used as educational material and input for sports teachers at the school.

Results and discussions: The average leg length was 30.51 cm and the average weight was 36.33 Kg. While the average running speed is 4.74 m/s. Statistical test of the regression coefficient showed that leg length ($\beta = 0.424$; $p = 0.018$) and body weight ($\beta = -0.488$; $p = 0.007$) means that these two components have an effect on running speed.

Conclusion: Leg length has a positive effect while weight has a negative effect on running speed.

Keywords: leg length; body weight; running speed

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INTRODUCTION

The role of sport in Indonesia in its development and growth is given to schools starting from kindergarten, elementary school, junior high school, high school, and even college and society in general. Every level of education, sports lessons are always given, so that every student has physical fitness.¹

Indonesia's sports achievements from year to year experience many setbacks when compared to other countries. The decline in this achievement can be seen from the results in multi-event events at the Southeast Asian and Asian level such as the Sea Games and the ASEAN Games.²

If professional efforts are not immediately carried out in dealing with it, the sports achievements in Indonesia will be increasingly left behind from sports achievements in other countries. One of the most basic strategies to realize the improvement of Indonesia's human resources, especially in the field of sports, is to focus attention and orientation on sports development as early as possible, namely by coaching and developing sports for the younger generation from an early age.³

The talent identification process is carried out to determine potential children in one of the sports, according to their talents. The fact is, many children pursue a sport that is not based on talent identification. They pursue one sport only based on the influence of the surrounding environment, the influence of their playmates, the encouragement of their parents.²

Athletics is a combination of several types of sports. Broadly speaking, the types of sports in athletics can be grouped into running, throwing, and jumping. Athletics is one of the subjects of Physical Education that must be given to students starting from the elementary school level to the senior high school level, following the Decree of the Minister of Education and Culture No. 0413/U/87.⁴

Running is very important because it is part of early sports development in physical education in schools. In athletics, running numbers are divided into short distance running (sprint), middle distance running, long-distance running also called long-distance, relay running, and obstacle running. Most of these athletic numbers are programmed in the physical education curriculum from elementary to high school level.^{5,6,7}

As already stated, one of the most dominant body parts in sprinting is the legs (legs). In general, the longer the legs of a person, it can be estimated that the longer the stride of the person, this causes the higher the speed produced when the person runs. In addition, bodyweight which is often considered to slow a person's movement turns out to have a positive relationship with muscle strength, especially leg muscles, causing someone with excess body weight to tend to have sluggish movements.^{8,9}

Currently, research that is more focused on the length of the tibia bone is still rare and has never been done. The researcher decided to formulate a research problem, namely the effect of tibia bone length and body weight on running speed.

METHODS

The activity was carried out at the State Elementary School 15 Mangkubumen Lor Surakarta, 5th Grade students. There were 33 students involved in the measurement of the foot length and weight. The data obtained were analyzed using multiple linear regression. The results of the analysis are used as educational material and input for sports teachers at the school.

The independent variables studied were tibia bone length and body weight. The length of the tibia can be defined as the length of the shin bone which is one of the main skeletons of the lower leg, to determine the length of the tibia by measuring the length between the medial condyle and the medial malleolus. Besides, weight is one of the parameters that give an idea of body mass. Bodyweight is the result of an increase or decrease in all existing tissues in the body. Bodyweight is used as the best indicator at this time to determine the state of nutrition and growth and development. The dependent variable studied is the speed of running (sprint) which can be defined as the ability to cover a distance in the shortest time with a condition where both feet are in the air while running is interpreted differently from the road that is always in contact with the ground.

10,11,12,13,14,15

RESULTS AND DISCUSSIONS

The total number of fifth-grade students at the State Elementary School Mangkubumen Lor 15 Surakarta is 91 students. Using the sample size formula for cross-sectional research, a minimum sample size of 31 students was obtained. The researcher decided to take a sample of 33 students at random (random).

Table 1. Tibial length, Bodyweight, Running Speed

Variable	Mean	SD	Min	Max	n
Tibial Length (cm)	30,51	2,60	26,37	38,00	33
Weight (kg)	36,33	9,36	22,80	58,03	33
Running speed (m/s)	4,74	0,51	3,82	5,81	33

Table 2. Multiple Regression Analysis Results

Variable	Koefisien			Model	
	B	β	P	R ²	p
Constanta	3,147		0,002		
Tibial Length (cm)	0,084	0,424	0,018	0,264	0,010
Weight (kg)	-0,027	-0,488	0,007		

The regression coefficient for the predictor X1 is positive, making the addition of the tibia bone length mathematically will cause an increase in the value of running speed. The regression coefficient for the predictor X2 is negative, so the addition of weight values mathematically will cause a decrease in the value of running speed.

The multiple linear regression equation models obtained has a coefficient of determination (R²) of 0.264. This figure is called the coefficient of determination because it shows that 26.4% of the total variation in the value of the dependent variable, namely running speed, can be explained by the obtained regression model. This figure also states the contribution, meaning that the contribution of the effect of tibia bone length and body weight to running speed is 26.4%. This means that other factors other than the two variables contribute to the effect of (100% – 26.4%) = 73.6%.

Statistical testing (F test) on the magnitude of the coefficient of determination resulted in a significance (p) of 0.010. The p-value < 0.05 means that the difference in running speed due to the difference in tibia bone length and body weight is significant. Based on the results of this test, the obtained multiple linear regression equation models can be used to accurately predict or estimate running speed using the length of the tibia and body weight.

The standard regression coefficient for the variable length of the tibia was 0.424. The coefficient of 0.424 indicates that the level of closeness of the relationship between the length of the tibia bone and running speed is moderate. The positive coefficient indicates that the direction of the relationship is directly proportional, meaning that the longer the tibia, the higher the running speed that can be done. While the standard regression coefficient for the weight variable is -0.488. The coefficient of -0.488 indicates that the level of closeness of the relationship between body weight and running speed is moderate. A negative coefficient indicates that the direction of the relationship is inversely proportional, meaning that the higher the body weight, the lower the running speed that can be done.

This study aims to determine the effect of tibia bone length and body weight on the ability to run short distances in children. The subjects studied were fifth-graders at the State Elementary School 15 Mangkubumen Lor Surakarta. How well you can run in close quarters is judged by the speed at which you run a distance of 100 m. Random sampling is done with the aim that all the characteristics that exist in the population can be represented by the sample. This will statistically minimize errors or deviations caused by other variables not studied (besides tibia bone length and body weight).

The results showed that the length of the tibia had a significant positive effect on running speed. The longer the tibia bone, the higher the running speed that can be done. There is a relationship between these two variables as stated by Marsip (2007) that two things that guarantee a good short distance running speed are the frequency of movement and the length of the step or range. The leg length is the main factor to get a good stride length and stride frequency. In general, someone who has long legs usually has a good step.^{16, 17}

In line with that, Akhmad (2013) argues that one of the most dominant body parts in sprinting is the legs (legs). In general, the longer the legs of a person, the longer the stride of that person can be estimated. This causes the higher the speed produced when the person runs

Several previous studies although not identical, quite a lot of which provide conclusions with the same meaning. Marsip (2007) in his research on male VIII grade students of SMP Islam Karangpucung, Cilacap Regency concluded that there was a significant relationship between leg length and 100-meter running speed. Supriyadi's research (2014) on Nabil Husein Samarinda Vocational High School students found a positive relationship between leg length and 60-meter running speed with a correlation coefficient of 0.411 (medium category).^{16, 18}

The results of this study also prove that body weight has a significant effect on running speed but negatively. The heavier the individual, the lower the running speed that can be done.

This is as stated by Pradana (2013) that someone with excess body weight tends to have sluggish movements. This may be due to the extra weight (body weight) and the lack of flexibility in the body during movement. Therefore, a sprint athlete needs to maintain his body weight in an ideal condition to optimize his performance

Previous studies that support the conclusions of this study include those conducted by Pradana (2013) which proved the contribution of body weight to the speed of running a distance of 100 meters with a contribution value of 1.93%. In addition, there is also a study conducted by Setyawidi (2015) on seventh-grade female students of SMP Negeri 7 Kediri which found a

contribution to the influence of body weight on the speed of running a distance of 80 meters with a correlation coefficient value of 0.461 (medium category).^{9, 19}

In the results of this study, tibia length has a positive correlation coefficient value of 0.424, and body weight has a negative correlation coefficient value of 0.488. Both are following previous research, namely the value of the correlation coefficient with the medium category.

Several limitations might reduce the quality of the results of this study. First, the measurement of running speed is only done once. There is no guarantee that the running speed achieved during the study is the maximum achievement. Second, several uncontrollable confounding factors can bias the research results, including muscle performance, movement frequency, and perfect running technique.

For students who want to take part in competitions or pursue short-distance sports, they need to consider their physical condition, especially the length of the tibia and body weight. Then for further research, first, the quality of research results can be improved through further research by measuring more than once and controlling for confounding factors. Second, researchers are expected to compare the length of the femur and the length of the tibia to deepen the effect of the length of the tibia on running speed.

CONCLUSION

Based on the results of research conducted on fifth-graders at the State Elementary School 15 Mangkubumen Lor Surakarta, the following conclusions can be drawn: The length of the tibia has a positive effect on the ability to run short distances. The longer the tibia bone, the higher the running speed that can be done, and Bodyweight negatively affects the ability to run short distances. The higher the weight, the lower the running speed that can be done.

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