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The Correlation of Leg Length, Jump Height, and Leg Muscle Explosive Power Toward Sprint Ability
La correlación de la longitud de las piernas, la altura del salto y la potencia explosiva de los músculos de las piernas frente a la capacidad de sprint

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Abstract. The study purpose was to investigate the relationship between sprint ability at elementary school and leg length, jump height and leg explosive power. Sports coaching starting at the school level, where students are led and trained to have a strong, skilled, nimble, and agile mentality, athletic is very appropriate. One factor, specifically leg length (anatomy), jump height, and leg explosive power (physiology) in sprinting, affects an athlete's performance. The method Cross-sectional quantitative descriptive research is the method used in this study. A total of 61 male students between the ages of 10 and 12 made up the research sample. Measurements of leg length, jump height, leg explosive power, and a 40-meter sprint are used to obtain data. The normality test, correlation test, and table presentation were used in the descriptive data analysis. The results stated that the average leg length was 83.46 ± 5.43 cm, the average jump height was 17.91 ± 5.52 cm, the average explosive power of leg was 1451.61 ± 399.45 watts, and the average speed was 8.70 ± 1.61 m/s. If the calculated r value is less than the r table value, then there is a very weak correlation between the leg length variable and the speed variable. The results of the correlation test between leg length and speed obtained r count 0.137 and r table 0.254. There is a weak correlation between the leg explosive power variable and the speed variable, is evidenced by the correlation test results between leg power and speed, which were r count -0.369 and r table 0.254. There is a strong correlation between the jump height variable and the speed variable, as evidenced by the correlation value test results between the jump height value and the speed value, which show a correlation coefficient value of -0.715 and a sig value of 0.000, which is smaller than 0.05. According to the study's findings, sprint students at elementary school have a correlation between leg length, leg muscle explosive power, and jump height.
Keywords: Leg length, Explosive Power, Jump Height, and Sprint

Resumen. El propósito del estudio fue. investigar la relación entre la capacidad de sprint en la escuela primaria y la longitud de las piernas, la altura del salto y la potencia explosiva de las piernas. El entrenamiento deportivo a partir del nivel escolar, donde los estudiantes son dirigidos y entrenados para tener una mentalidad fuerte, hábil, ágil y atlética, es muy apropiado. Un factor, específicamente la longitud de las piernas (anatomía), la altura del salto y la potencia explosiva de las piernas (fisiología) en las carreras de velocidad, afecta el rendimiento de un atleta. Material y métodos. La investigación descriptiva cuantitativa transversal es el método utilizado en este estudio. Un total de 61 estudiantes varones de entre 10 y 12 años conformaron la muestra de la investigación. Para obtener datos se utilizan medidas de longitud de piernas, altura de salto, potencia explosiva de piernas y un sprint de 40 metros. En el análisis descriptivo de los datos se utilizó la prueba de normalidad, la prueba de correlación y la presentación en tablas. Resultados. Los resultados indicaron que la longitud promedio de las piernas fue de 83,46 ± 5,43 cm, la altura promedio del salto fue de 17,91 ± 5,52 cm, la potencia explosiva promedio de las piernas fue de 1451,61 ± 399,45 watts y la velocidad promedio fue de 8,70 ± 1,61 m/s. Si el valor r calculado es menor que el valor de la tabla r, entonces existe una correlación muy débil entre la variable de longitud de pierna y la variable de velocidad. Los resultados de la prueba de correlación entre longitud de piernas y velocidad obtuvieron r cuenta 0.137 y r tabla 0.254. Existe una correlación débil entre la variable potencia explosiva de piernas y la variable velocidad, se evidencia en los resultados de la prueba de correlación entre potencia de piernas y velocidad, que fueron r conteo -0,369 y r tabla 0,254. Existe una fuerte correlación entre la variable altura de salto y la variable velocidad, como lo demuestran los resultados de la prueba de valor de correlación entre el valor de altura de salto y el valor de velocidad, que muestran un valor de coeficiente de correlación de -0,715 y un valor sig de 0,000, que es menor que 0,05. Conclusiones. De acuerdo con los hallazgos del estudio, los estudiantes de velocidad en la escuela primaria tienen una correlación entre la longitud de las piernas, la potencia explosiva de los músculos de las piernas y la altura del salto.
Palabras clave: Longitud de pierna, Potencia explosiva, Altura de salto y Sprint

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Introduction

Starting sports coaching at school makes perfect sense because school is a place where children are educated, trained, and guided to be mentally, physically strong, skilled, and agile from the start. A child's locomotor abilities in running, catching, kicking, and jumping are basic movement skills that must be possessed from an early age (1)(2). Where this ability will have an impact and have a bigger role in everyday aspects. Improving students' physical fitness is one of the goals of physical education in schools. The physical aspects of fitness, such as endurance, strength, speed, explosive muscle, agility, flexibility, balance, reaction time and coordination, make it a complex topic. These elements are very helpful and support the success of one sport, namely athletics, especially short distance running (sprint). In line with this, a person's sprint ability greatly contributes to many sports (3). Sprint itself is a person's ability to cover a distance in the shortest possible time. Where during the sprint a person's ability is determined based on the ability to accelerate, the maximum speed and the ability to maintain speed against fatigue (4).

It needs to be supported by a variety of physiological and anatomical factors in athletics, especially sprinting. Leg muscle strength, leg muscle flexibility, leg muscle explosive power, and jump height are physiological factors on running speed. On the other hand, muscle flexibility and strength must also be monitored to what extent because it will indirectly affect the injury to the athlete (5). In line with this, in previous studies, running speed did not only depend on the lower limbs but also from a kinematics point of view as well (6). On the other hand, the body weight of a runner must also be considered because it has vertical resistance due to the force of gravity (7). Then one of the physiological and anatomical factors that are very decisive to achieve fast running speed is the ability to jump high and have long legs (8). Jump There is a correlation with sprint strength and speed and jump height (8).

The average tall and large people have better physical abilities than the average short and small people, such strength, speed, heart-lung endurance, muscle endurance, and others. Long limbs are a given with a tall physique, and it is thought that those with long limbs will perform better. A student's ability to run and the length of their stride when running can both be impacted by their leg length. Someone with long limbs must meet these criteria to promote sprint sports achievements. Running speed is affected by a person's height, length, size, width, weight, and leg length, among other anatomical factors. Then the speed itself is the result of a runner's step length and step frequency, where someone with long legs and a high frequency of taking steps will have a faster running time (7). The choice of leg length and its relation to stride length assumes that this element is appropriate for sprinting (9).

It has been observed that students between the ages of 10 and 12 have different leg length, jump height, and leg explosive powers when running at different speeds. Apart from having different leg lengths, it has also been observed that children in Australia aged 4 months to 12 years have a considerable influence of gross motor skills on subsequent cognitive performance (2). Which means at that age is the golden age and is very important in the development process. To support the success of sprinters, it is very important to pay attention to the relationship between anthropometry, leg muscle explosive strength, and the jump height of sprinter seed athletes. Tests and measurements are needed to see and assess how much value is contained therein a (10).

The reason for the focus on speed can be related to its relevance in certain sports and physical activities. Speed is an important parameter in many activities, including sports such as football, athletics or tennis. Therefore, understanding the factors that influence sprint ability can provide valuable insight into improving the performance of athletes or participants in these activities.

In addition, research often must have limited focus in order to be carried out effectively. By limiting the observed variables, research can achieve a higher level of accuracy in identifying causal relationships and the impact of certain factors on speed.

However, it is also important to realize that physical fitness should not only be seen from one aspect. Ideally, this research could be part of a broader series of studies that explore various aspects of physical fitness such as strength, endurance, flexibility and others. In this way, understanding of the physical fitness of students or individuals as a whole will be more complete.

This research has substantial urgency in the realm of sports and health sciences. This research provides an opportunity to deepen our understanding of the factors that complexly influence sprinting ability, which is a crucial element in various sports. By identifying and analyzing the relationships that may exist between leg length, jump height, and leg muscle strength and sprint ability, this research has the potential to detail and define more clearly the factors that support or hinder performance in sprint situations. Therefore, the results of this research can play an important role in directing the development of more focused and effective training programs, which can benefit and improve their performance in sports competitions. In addition, this research also has relevance in the context of sports injury prevention because it may help identify risk factors related to sprint ability, and finally, this research can provide a valuable contribution in developing new theories and a richer scientific literature in the field of science. sport and health.

From the above discussion it can be pursed where the purpose of this study was to find out the relationship between sprint ability in elementary schools by paying attention to leg length, jump height and explosive power of students' legs to see if there was an effect on sprint ability. This research can provide a deeper understanding of the physical factors that influence sprinting ability, assist in designing more effective training programs, improve performance, potentially prevent sports injuries, and contribute to the scientific literature in this area by enriching the understanding of the relationship. between certain physical factors and sprint ability.

Materials And Methods

Study participants

Cross-sectional quantitative descriptive research is the method used in this research. A total of sixty-one male students BMI 18,77 ± 4,19 from the ages of 10 and 12 made up the research sample A cross-sectional study is a type of research design in which data are collected from many different individuals at one point in time (11). The cross-sectional method only observes variables without anyone influencing them.

Study organization

The countermovement jump (CMJ) with Forcedecks FD Lite 400 the leg's explosive power, running speed (sprint) for 40 meters, and jump height by jumping upright with 1 minute rest in each test to reduce fatigue. CMJ itself is often used as an instrument to measure leg muscle strength, from football to athletics (12). In addition, the vertical jump itself is the most relevant variable to see someone's short distance running performance. In the previous study, there were qualitative changes in the structure and function of the muscles so as to increase vertical force and power production capacity which in turn increased sprint ability (13). Participants were asked to jump as high as possible on the forceplate with their hands placed on their waists until they finished, they were asked to descend or bend their knees in a 90 degree concentric position and jump up as high as possible and land gently to return to their original position (14). Force results will be calculated automatically and in real time using the Forcedecks FD Lite 400 from VALD HUB.

Statistical analysis

Table 1.
Characteristics descriptive data

	N	Min	Max	Mean	SD
Height (cm)	61	129	165	148,05	7,58
Weight (kg)	61	23	72	41,56	11,20
BMI (kg/m²)	61	12,60	30,76	18,77	4,19
Leg length (cm)	61	70	98	83,46	5,43
Jump height (cm)	61	9,08	35,00	17,91	5,52
Leg explosive power (watt)	61	718	2702	1451,61	399,45
Speed (m/s)	61	6,35	16,85	8,70	1,61

*BMI = Body Mass Index

In table 1 above the results obtained are a minimum height of 129 cm, a maximum of 165 cm and an average height of 148.05 ± 7.58 cm; the minimum body weight is 23 kg, the maximum body weight is 72 kg, and the average body weight is 41.56 ± 11.20 kg; the minimum BMI is 12,6 kg/m^2, the maximum BMI is 30,76 kg/m^2, and the average BMI is 18,77 ± 4,19 kg/m^2; the minimum leg length is 70 cm, the maximum is 98 cm, and the average leg length is 83.46 ± 5.43 cm; the minimum jump height is 9.08 cm, the maximum jump height is 35.00 cm, and the average jump height is 17.91 ± 5.52 cm; the minimum yield of leg explosive power was 718 watts, the maximum leg explosive power was 2702 watts, and the average leg explosive power was 1451.61 ± 399.45 watts; minimum speed of 6.35 m/s, maximum speed of 16.85 m/s, and average speed of 8.70 ± 1.61 m/s.

The results of the data normality test for leg length, jump height, leg explosive power are obtained in the table below:

Table 2.
Normality test

	Kolmogorov-Smirnov (n=61)		Shapiro-Wilk (n=61)	
	Statistic	Sig. (p)	Statistic	Sig. (p)
Leg length	0,77	0,200	0,992	0,953
Jump height	0,154	0,001	0,904	0,000
Leg explosive power	0,079	0,200	0,970	0,147

P> 0.05 indicates that the variable data is normally distributed

The results of the normality test in table 2 show the value of leg length and leg explosive power of 0.200 using the *Kolmogorov-Smirnov test* with normal distribution and followed by the *Pearson correlation test*. While the jump height value of 0.001 using the *Kolmogorov-Smirnov test* is not normally distributed and continued with the *Spearman's correlation test*.

Correlation test results for leg length, jump height, leg explosive power, to *sprint* are obtained in the table below:

Table 3.
Correlation Test

	Speed			
	N	Pearson	Spearman's	Sig. (2-tailed)
Leg length	61	0,137	-	0,294
Jump height	61	-	- 0,715	0,000
Leg explosive power	61	- 0,369	-	0,003

In table 3. correlation test results between leg length and speed found r 0.137, there is a relationship with a positive correlation and very weak strength. The results of the correlation test between explosive power and speed obtained r -0.369, there is a relationship with the direction of the correlation in a negative and weak strength. The results of the correlation test between jump height and speed obtained a value of -0.715, there is a relationship that has a negative correlation direction and has a strong strength.

Discussion

The lower limbs control movement in walking, running, jumping, and kicking. They serve as a support for the movement of the upper limbs. According to 61 students at SDN 236 Gresik, the average leg length was 83.46 cm, with the shortest being 70 cm and the longest being 98 cm. The respondents then ran quickly (in a sprint), with an average speed of 8.7 meters per second.

Leg length has a correlation of 0.137 in a positive correlation direction, according to the analysis of research data, and this correlation is very weak. Anthropometric factors, in this case leg length, have been shown to affect a

The mean and SD of the variables under study were determined using descriptive data analysis. The normality test determined whether the research data were normally distributed, and the correlation test determined whether there was a relationship and its direction between two or more variables. Using version 26 of the SPSS program to analyze this data.

Results

The distribution and summary of the data will be analyzed descriptively based on the research results that have been obtained through data collection in order to present the results. Height, weight, leg length, jump height, leg power, and 40-meter sprint speed were the data obtained for this study. The results of the descriptive data are presented in the table below:

person's ability to run in a number of earlier studies. The time spent running will increase when a person's limbs become longer. The results of the research showed that, even if the long bones in the limbs of students at SDN 236 Gresik were still growing, there were factors that contributed to the correlation between limb length and speed. Physical changes include lengthening of the bones and changes to the muscle fibers (15). In order to run quickly, students with longer leg lengths take more steps than those with shorter leg lengths (16).

Leg explosive power has a correlation of -0.369 in a negative correlation direction and has weak strength, based on the analysis of research data. The ability to display or release power quickly or explosively is known as explosive power (8). The ability to display or issue power quickly or explosively is known as explosive power. So, a sprinter athlete needs a component in leg explosive power to support success and performance. One of the factors that can affect the speed of running 100 meters is leg explosive power (17).

In sports that demand for explosive (explosive) events, like the 100-meter running sport, the limbs' explosive power in terms of speed is very dominant. Leg muscles' explosive power is a combination of strength and speed that allows them to overcome resistance with high contraction rates (18)(35). Running rate or accelerated running time are correlated with leg muscle explosive power (19)(20). The results of (21) research, which was titled the relationship between leg length and leg muscle explosiveness with results of the 40-meter sprint, showed a relationship, with the contribution was small. In line with this, athletes who have longer limbs have a greater measure of explosive power than those who have lower limbs (22).

The leg muscles' explosive power shows the power to work, which substantially aids in achieving running speed (32)(33). According to (23) research, which found that leg muscle strength and explosive power have been shown to have a contribution to the 30-meter running speed, also support this. The same notion—that there is a relationship between leg muscle strength and short-distance running results stated (1).

Jump height has a correlation of -0.715 in a negative correlation direction and has a strong strength, based on the results of the study's data analysis. Athlete that can jump height will be able to show off their muscles or strongly and quickly release their leg muscles (36). The students' generated jump height ranges from 9.08 cm at the bottom to 35 cm at the top, with an average leap height of 17.91 cm. The components in the lower limbs, such as leg length, leg muscle strength, and leg muscle explosive power, will influence the height of a person's jump and will impact the outcomes of sprinting (24)(30)(31). The resultant jump height will affect the sprint time (25). A multifactorial relationship between jump height and lower body strength affects sprint performance (8) (34). Through research conducted (26) apart from having a significant relationship to sprinting, vertical jumping ability also has a very significant relationship to agility using the zig-zag agility test without the ball (ZAWHB).

All respondents entered the age of children with a vulnerable age of 10 to 12 years, where children are at that age physiologically and physically in the stage of growth and development (27). This was based on the characteristics of the research data mentioned above. Each child's lower body extremities have unique biomotors that change with age as they grow and develop. In addition, this uniqueness is supported by differences in body weight, standing height to BMI between the two sexes when adjusted for biological age rather than chronological age (28). Children and adolescents' ability to sprint depends on a number of factors related to their physical growth and maturation (29).

Conclusion

Based on the results and discussion of this research, it can be concluded that there is a relationship between leg length, jump height, leg explosive power, and sprinting, with jump height having a particularly strong relationship to the latter. The benefits of this research can help teachers, trainers, and students identify potential sprinters at an early age. This study makes recommendations for future research that include other factors that may influence a sprinter's ability to predict early athletic talent.

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Conflict of Interest

The authors declare that there is no conflict of interest

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