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Correlation Between Limb Length and Muscle Mass of The Lower Extremity

Awang Firmansyah[1]*, Hapsari Peni AgustinTjahyaningtijas[2], Ahmad Hafizh Ainur Rasy[3], Agung Prijo Budijono[4], Andika Bayu Putro[5], I Wayan Valentino Eka Putra[6]

[12346]Universitas Negeri Surabaya, Indonesia
[5]Sarana Teknologi Industri, Indonesia

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Keywords

Leg Length, Muscle Mass, Lower Extremities

Abstract

Introduction: Muscle mass has a contribution to body strength. One third of the human body is part of the lower extremity. The limbs are part of the lower extremity. This study aims to investigate the length of the limb with muscle mass. **Methods**: Cross-sectional study with the subjects of this study were 39 students (12 females and 27 males) with male characteristics (age 20.03±0.7, height 168±5.46, weight 61.92±10.98, BMI 22±4.24) while in women (age 20.16±0.83, height 158.83.3±5.13, weight 54.7±12.02, BMI 21.65±4.51). Pearson correlation from SPSS version 26 with a significance level of P-value < 0.05. **Findings**: Based on the data, there was a signifi correlation between the length of the leg and muscle mass on both the right (P-value: 0.000, r: 0.634) and the left (P-value: 0.000, r: 0.629). **Conclusion**: This study proves that the longer the limbs a person has, the greater the muscle mass he has.

*Correspondence Author:
E-mail: awangfirmansyah@unesa.ac.id

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INTRODUCTION

Muscle strength has an important role in daily activities. In line with (Nadapdap, 2021) what is said, the component of physical condition that plays the most role in a person's activity is muscle strength. Where in addition to helping a person in lifting weights, muscle strength is also proven to minimize the risk of an injury (Willems et al., 2002). Another example, the hamstring muscles contribute to jumping and braking movements while running(Crawford et al., 2023), The dominant quadriceps muscles contribute when doing sprints and the hip adductor and abductor muscles have a major role when making changes of direction quickly (Jaenada-Carrilero et al., 2024). While a person's body composition is very diverse, even with a similar BMI, it is no exception related to their muscle mass. This is greatly influenced by various factors. Starting fr genetics, muscle mass, muscle type, body anatomy to the amount of exercise performed(Högberg et al., 2024).

Lower extremity is one of the parts that often suffers from injuries (Amundsen et al., 2023 This is because all activities or sports carried out daily always involve the lower body, such as supporting body weights and objects when standing, walking, running, braking, jumping to kicking which can increase the possibility of injuries such as anterior cruciate ligament rupture and hamstring strain injury (Fortes et al., 2023). For example, from the results of research conducted by (Oleksy et al., 2023) the hamstrings are the muscle that suffers the most injuries professional football, when athletes make extreme changes in direction when running. Limb length is also one of the factors that cause injury because the longer a person's leg is directly proportional to the length of the stride, which will result in the work of the hamstring muscles getting heavier when running (Tenforde et al., 2019). Another factor that can cause injury to the limbs is the unequal length of the limbs with each other (Fields et al., 2010). There is a suspicion from observations made by stating (Kalema et al., 2021) that there is a possible relationship between biomechanics when running and injuries to the legs.

Prevention of injury can be done in various ways, some of which are by strengthening and increasing muscle mass through weight training (Nor Faiz Abd Aziz et al., 2020). The important role of balance and muscle strength contributes to the improvement of sports performance, so the need for training that can improve the balance of athletes is recommended as support for the long-term development of athletes (Ardern et al., 2015). Therefore, resistance training is also often used as the main method to stimulate muscle adaptation and increase strength. One of them is the nordic hamstring exercise, characterized by its eccentric nature and high intensity (Pi□kin et al., 2024). Considering biomechanical factors when performing exercise movements is also believed to be able to minimize the occurrence of injuries due to incorrect movements (Bramah et al., 2023). In addition to weight training, adequate protein intake can help repair muscle damage and increase muscle mass (Jäger et al., 2017).

Muscle mass and leg length play an important role in determining the strength of the leg muscles. However, the relationship between leg length and muscle mass in the lower extremities is still unclear. Previous research has shown that limb length has an influence on the strength of t leg muscles of (Kellis & Blazevich, 2022). Individuals with longer limbs may have lower muscle mass, potentially leading to differences in muscle strength (Laskou et al., 2022). Other studi have shown that limb length can affect the torque produced by muscles (Solianik et al., 2011 However, previous studies may be difficult to generalize to populations with diff characteristics such as having different body proportions, age, or growth disorders. Therefore, th study aims to find out the relationship between limb length and muscle mass in the low extremities, focusing on finding out how strong the correlation between the two i

METHODS

Participants

An observational study with a Cross-Sectional type involving research subjects totaling 39 students (12 women and 27 men) of the Sports Science undergraduate Program, State University of Surabaya with male characteristics (age 20.03±0.7 years, height 168±5.46 cm, weight 61.92±10.98 kg, BMI 22±4.24) while for women (age 20.16±0.83 years, height 158.83.3±5.13 cm, weight 54.7±12.02 cm, BMI 21.65±4.51). All students participating in this study have met the requirements in good health, and none of them have been injured at the time of data collection. With inclusion criteria: 1) S1 - Sports Science students in the 4th semester with an age range of 19 – 22 years; 2) have good physical fitness conditions and do not have physical or mental disorders that affect research; 3) not have had an extremity lower muscle injury at the time of data collection that could affect participation in the study or limit performance. As well as exclusion criteria: 1) not a Sports Science undergraduate student and under 19 years old and over 22 years old; 2) students who have unstable physical conditions; 3) having an injury to the lower extremity resulting in not being able to stand up perfectly upright.

Procedure

This data collection stage consists of 2 test instruments, namely the measurement of limb length using solo abadi anthropometry (Surakarta, Indonesia). This instrument is a measuring instrument used for careful measurement of the human body and prioritizes the accuracy of data that can be used effectively and efficiently. And body composition measurement using inbody 270 (Seoul, South Korea).

Anthropometers

In the anthropometric test, there are 2 measurements, namely standing height and sitting height, both are measured using the solo abadi anthropometry (Surakarta, Indonesia) which has been affixed to the wall. When measuring standing height, the testee is required to stand upri with the eyes straight forward and the back of the body starting from the heel of the foot (tuberositas calcanei) to the head (vertex) is required to stick to the wall. And the measurement of sitting height is carried out with both legs straightened forward, the view of the eyes straight forward and the back of the body starting from the lower back (Ischial tuberosity) until the head (vertex) is attached to the wall. From the results of the two measurements, the calculation of standing height minus sitting height (metrisis) was carried out to get the value of limb length (cm) (Ischial tuberosity until tuberositas calcanei) .

Inbody

In the body composition measurement test using the inbody type 270 (Seoul, South Korea), the testee is required to remove accessories made of metal or iron and empty the pocket of any object. Then the testee is required to stand upright on the device with a straight eye view forward and align the soles of the feet with the metal electrodes. Then the testee was asked to enter personal data on the tool in the form of height, gender, and age. After the personal data is entered, the testee is required to grab the handle and position the thumb in line with the oval electrodes. Testees are required to keep both arms straight and away from the body for about 30 seconds, after which test results will appear on the screen in the form of weight, skeletal muscle mass, and body fat percentage. And the data details such as fat free mass will appear on the laptop (microsoft excel) that has been connected by the device.

Statistical Analysis

Technical Data collection is carried out by shuffling data from the results of the two te which are then entered into Microsoft Excel. The data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. The analysis was carried out by one sample Kolmogorov Smirnov test to determine the normal distribution, while the analysis was to see the correlation between limb length and muscle mass of the right and left limbs using the Pearson correlation test. Where the significance level of P-value < 0.05 as a value to find out whether or not there relationship between limb length and muscle mass, then r-value as the value of how high the significance of the relationship between variables is which in this study is relatively strong. A data is presented in the form of scatter plots.

RESULTS AND DISCUSSIONS

The purpose of this study is to find out the correlation between the length of the legs a the muscle mass of a person's legs, to find out the length of a person's limbs is measured usi perpetual solo anthropometry (Surakarta, Indonesia) and to find out the composition of person's body is measured using a type 270 inbody (Seoul, South Korea). Both variables have been tested for normality using spss version 26 using the Kolmogorov Smirnov one sample method with normal distributed data results. The Pearson correlation test is used to determine the relationship between the two variables.

Based on the data from the results of this study, there is a significant correlation betwe limb length and muscle mass of the right leg and left limb, both of which have a strong correlation and positive value. Supported by previous research said that there was a correlation between limb length and leg muscle mass in 20 samples of sprint athletes (Karine, 2019). Athletes who have long limbs will be directly proportional to the amount of capacity to develop a lot of muscle mass or have greater muscle space potential so that they can produce great strength as well (Lieber & Fridé N, 2000). However, there is a study that says that the amount of leg muscle mass does not always affect a person's limb length or is not always linear because there are other factors such physical activity undertaken, genetics, and health conditions that affect the amount or not of l muscle mass in a person, this study used 12 participants (11 men and 1 woman) (Fukunaga et al., 1992).

The scatter plot shows the relationship between leg length (cm) with the mean 79.55 and right leg muscle mass (kg) with the mean 7.38 (p-value : 0.000, r-value: 0.634) and left leg muscle mass (kg) with the mean 7.37 (p-value: 0.000, r-value: 0.629). Both show that there is a significa correlation with the value of positive correlation and is relatively strong described through a regression line that shows a positive trend. In other words, the longer a person's limbs, the higher the muscle mass of a person's legs, both right and left.

CONCLUSIONS

Lower extremity is a part of the human body that supports all human activities. The results of this study show that the longer the limb owned by a person, the greater the muscle mass that a person has. This research cannot be generalized to a person who has one leg length or suffers fr cerebral palsy. The correlation between leg length and muscle mass of the right and left legs shows that there is a significant relationship between leg length and the muscle mass of a person's rig and left muscles. The correlation rate in the right limb is higher or stronger than the correlation in the left limb.

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