THE RELATIONSHIP BETWEEN LEG MUSCLE EXPLOSIVE POWER AND SWIMMING SPEED OF 50-METER BREASTSTROKE SPRINT ATHLETE

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Abstract

Objective: is to determine the relationship between the explosive power of the leg muscles and the swimming speed of the 50m breaststroke sprint athlete aged.

Methods: this research is a non-experimental research in the form of a correlation study to analyze the relationship between leg muscle explosive power and swimming speed of 50m breaststroke sprint athletes. There are 23 swimmers as the samples from Tumit Mitra Bangsa Swimming Association with an age range of 12-17 years taken with purposive sampling technique. The measurements taken were leg muscle explosive power with vertical jumps and swimming speed by mathematical calculation of the division of the pool distance (50m) with a record of the swimmer's time measured using a stopwatch.

Result: the correlation test with the Spearman rank correlation coefficient showed a significant relationship with a value of $p = 0.001$ ($p < 0.05$) with a very strong relationship ($r = 0.997$), which means greater explosive power of the leg muscles increases the swimming speed of the 50m breaststroke sprint athlete. The average with a standard deviation of leg muscle explosive power is 45.85 ± 5.99 and at swimming speed is 1.07 ± 0.15.

Conclusions: there is a significant relationship between leg muscle explosive power and 50m breaststroke swimming speed.

Keywords: *leg muscle explosive power, swimming speed, breaststroke swimming*

Introduction

Sport is a form of physical activity that is carried out systematically with specific goals and has rules such as time rules, repetition of movements, pulse targets and others. Sport is not something that is foreign to humans, considering that there are so many benefits that can be obtained from exercising. UU No. 3 (2003) concerning National Sports states that the objectives of national sports are to maintain and improve health and fitness, achievement, human quality, instil moral values and noble character, sportsmanship, discipline, strengthen and foster national unity and integrity, strengthen resilience. national and raise the dignity and honour of the nation.

One of the sports that is quite popular with the people of Indonesia is swimming. Judging from the data from the Indonesian Survey Scale (SSI), swimming is included in the top five types of sports that are most favoured by the people of Indonesia. According to Supriyanto in Kurniasari 2010:1, swimming is an activity carried out in water with various forms and styles that have long been known and provide many benefits to humans (Kahono, 2019). The combination of foot and hand movements in swimming makes it can be grouped into swimming styles. Some of the most popular swimming styles are the freestyle (crawl), the backstroke, the breaststroke (frog), and the butterfly (dolphin).

The breaststroke is also often known and referred to as the frog style because its movement resembles the movement of a frog when swimming. According to the Indonesian Swimming Association, the breaststroke is a swimming style that starts from the first arm row after the start and after turning the body must be face down and both shoulders are in line with the water. The breaststroke is often considered a very challenging style because of the discontinuous action of the arm and leg thrusters requiring complex time synchronization. During the breaststroke, the movement cycle consists of arm punches and leg kicks performed in succession. The movement that affects this style is the acceleration of the hand movement when sliding, but the kick which is the foot movement is the driving force that plays a more dominant role in breaststroke swimming.

During the breaststroke swimming, arm and leg movements are not performed simultaneously, but also not performed alternately. Movements are carried out in tandem with arm movements and leg movements. Coordination of arm and leg movements in breaststroke swimming in a coherent manner in the form of: pull start, just before legs recovery (arm rowing just before leg recovery begins) and legs kick start, arms start recovery (leg kick starts, as well as arm recovery begins) (Faradise Lekso, 2013).

In order to win a swimming race, the athlete must be the first to reach the finish line. Therefore, swimming speed determines the victory of this sport. Swimming speed can be

interpreted as the ability of a swimmer to make his movements to cover a distance in the shortest

possible time. To calculate swimming speed, a mathematical calculation is needed with the formula v = s/t with v = velocity or speed, s = space or distance that can be measured using a meter, or in this study the distance travelled as far as 50m, and t = time or travel time which is generally measured using a stopwatch.

To be able to achieve achievements in swimming, an athlete must have four main aspects which include: physical, technical, tactical, and mental which can be developed through regular practice based on the principles of proper training. Factors that affect swimming speed are broadly divided into 2, namely: exogenous factors which include environmental factors in the place of practice, social environment, living environment, and other factors outside the individual; and endogenous factors which are attributes or characteristics inherent in the physical and psychological aspects of athletes, such as anatomical factors (weight, height, arm length, leg length, body composition), physiological factors (cardiovascular ability, agility, balance, coordination). , endurance, strength, muscle explosive power, flexibility), biomechanical factors (speed of movement, pedalling frequency), psychological factors, and technical and exercise factors.

Maglischo (1993) states that the legs play a more dominant role than arm movements in the breaststroke. According to him, 60 percent of the movement in breaststroke swimming is leg movement. This means 60% of the power is generated by the legs and 40% by the arms. The muscles attached to the legs have the ability to generate power or explosive power. Muscle explosive power is one of the dominant elements that are needed in almost all sports, including swimming. The definition of explosive power itself is the ability that allows muscles or muscle groups to produce explosive movements, while the explosive power of the leg muscles is the ability of the leg muscles to produce explosive movements, where the limbs can move with maximum strength and speed so that they can produce a body thrust forward quickly when swimming.

Each swimming athlete may have different leg muscle explosive power. Therefore, it is necessary to measure it to be able to assess it. Measurement of leg muscle explosive power can be done with the standing broad jump test. The movement of the standing broad jump test can show an increase in the explosive power of the leg muscles as the main mover. When jumping, the mass moves from one place to another with a certain acceleration so that the muscles will maximize the effort / work of the leg muscles.

Performance enhancement is one of the four competencies of Indonesian sports physiotherapy, and muscle explosive power is one of the performance components that can be improved. The role of leg muscle explosive power in increasing speed has been proven through

several studies, such as Bayu Mustaqim's thesis in 2020 stating that there is a significant relationship between leg muscle explosive power and running speed in soccer players. In 2016, Darmawansyah through his thesis also stated that there was a significant relationship between leg muscle explosive power and the freestyle swimming speed of the Garuda Laut and Paotere

Makassar swimmers. These studies form the basis that muscle explosive power is an important component of increasing speed, and muscle explosive power can be increased with the help of physiotherapists to support increased sports performance, especially sports that use speed as a measure of victory.

Based on this background, this study was conducted to determine whether or not there is a relationship between the explosive power of the leg muscles and the swimming speed of the 50m breaststroke sprint athlete.

Material and Method

This research was conducted with a quantitative approach which is included in analytical research. This research is a descriptive analytic study with the type of correlation study between the explosive power of the leg muscles as measured by the vertical jump test and the swimming speed of the 50m breaststroke sprint athlete which was measured by comparing the distance of the pool with the time taken with a stopwatch. The population in this study consisted of athletes from the Tumit Mitra Bangsa Swimming Association.

The sample obtained in this study as many as 23 people using purposive sampling technique where the sample taken must meet the predetermined criteria, including: inclusion criteria (1) athletes of the Tumit Mitra Bangsa Swimming Association (2) male (3) aged 12 – 17 years old (4) physically and mentally healthy (5) active for at least 2 years with a frequency of exercise at least 2 times a week (6) informed consent; Exclusion criteria (1) have acute injury to the upper or lower extremities (2) have a history of surgery on the upper or lower extremities (3) have a disorder or history of heart and lung disease.

The processing and data analysis was carried out with the IBM SPSS Statistics software system ver. 21. The normality test was carried out with the Saphiro-Wilk test ($p<0.05$) and the hypothesis test was carried out with the Spearman rank correlation coefficient at the significance level (α) = 0.05

Results

1. Sample Characteristics Overview

The characteristics of the sample in this study consisted of age, weight, height, and body mass index (BMI). Data is presented in numerical form and categorized in terms of mean, SD, median, minimum, and maximum. The presentation of characteristic data can be seen in the following table:

Table 1. Sample Characteristics

Characteristic	*Mean*	SD	Min.	Max.
age (years)	14,43	1,65	12	17
weight (kg)	53,36	7,43	39,80	69,90
height (cm)	162,65	8,59	146	173
BMI (kg/cm^2)	20,09	1,57	18,11	24,19

2. Data Prerequisite Test

In this study, normality testing was carried out using the Saphiro-Wilk test with the help of the IBM SPSS Statistic ver.21 system software so that the results were interpreted in the following table:

Table 2. Kolmogorov-Smirnov Normality Test Results

Variables	*p*
leg muscle explosive power	0,031
swimming speed	0,031

In testing the normality of the research variable data, the results of data processing from the two variables were leg muscle explosive power and swimming speed with p-values of both 0.031, which means $p<0.05$, so it can be said that the data is not normally distributed. So, based on these results, hypothesis testing was carried out with the Spearman rank correlation coefficient.

3. Hypothesis Test

Data analysis of hypothesis testing consists of correlation analysis which aims to analyze the meaning of the relationship between variables, the strength of the relationship, and the direction of the variable relationship. Due to the abnormal distribution of the data, hypothesis testing was carried out with the Spearman rank correlation coefficient and the

results were obtained as shown in the following table:

Table 3. Spearman-Rank Correlation Test Results

variable	leg muscle explosive power	
swimming speed	*r*	0,997
	p	0,001
	n	23

From the table above, it can be seen that the p value = 0.001 where p < α (0.05) which means H0 is rejected and H1 is accepted so that the conclusion is that there is a relationship between the explosive power of the leg muscles and the swimming speed of the 50m breaststroke sprint athlete with the strength of the correlation (r) of 0.997, which means that the greater the explosive power of the leg muscles, the greater the value of swimming speed.

Discussion

This research is a quantitative descriptive to determine the relationship between muscle explosive power and swimming speed of the 50m breaststroke sprint athlete. The population in this study are all members of the Tumit Mitra Bangsa Swimming Association, with a total sample of 23 people who have met all the criteria that have been set. Characteristics of the sample in this study an average age of 14.43 years, an average weight of 53.36kg, an average height of 162.65cm, and an average BMI of 20.09 which is included in the normal category.

1. Leg Muscle Explosive Power

   Based on the measurement results in this study, the average value of the explosive power of the leg muscles as measured by the vertical jump test was 45.85cm. If viewed from the normative data, then the value is included in the less category.

   This means that the explosive power of muscles in the athletes of the Tumit Mitra Bangsa Swimming Association can and needs to be improved.

2. Swimming Speed

   Based on the results of measurements in this study, which were carried out in a swimming pool with a distance of 50m, the average travel time of the sample measured using a stopwatch was 47.46 seconds. Based on these data, the average swimming speed of the sample is 1.07m/s which is calculated by dividing the

distance between the pools and the time of each athlete.

When compared with the record time of Indra Gunawan who is a 50m breaststroke swimmer who competed at the 2017 SEA Games Malaysia with a record time of 28.25 seconds, the swimming speed of the Tumit Mitra Bangsa Swimming Association athletes is still lacking.

3. Breaststroke Swimming Speed

From the results of hypothesis testing using the Spearman rank correlation coefficient with a value of p = 0.001 (p>0.05) it shows that H1 is accepted and H0 is rejected indicating a significant relationship between leg muscle explosive power and swimming speed of the 50m breaststroke sprint athlete, so that it can It was concluded that the explosive power of the leg muscles affected the swimming speed of the 50m breaststroke sprint athlete at the Tumit Mitra Bangsa Swimming Association athletes. In this test, the correlation strength value (r) was 0.997 (very strong), which means that the greater the explosive power of the leg muscles, the greater the value of swimming speed.

This is in line with research conducted by Darmawansyah which states that there is a contribution or relationship between the explosive power of the leg muscles and the speed of freestyle swimming.

The existence of this relationship is because the legs play a more dominant role, which is about 60% compared to the role of the arms in breaststroke swimming. Good leg muscle explosive power is needed when athletes do jump start. A good jump start will throw the athlete further so that the swimming trajectory becomes closer.

In addition, muscle explosive power is also needed when athletes perform a series of swimming movements in the water because the explosive power of the leg muscles affects the kick force. The greater the kick force when swimming, the greater the thrust produced by the legs to push the water back, so that the forward thrust which is the reaction of the water is also greater (Newton's 3rd law). This means that with a strong explosive power of the leg muscles, the legs can move with maximum strength and speed so that they can produce a body thrust forward quickly when

swimming and a distance of 50m can be covered in a relatively short duration.

Conclusion

Based on the results of research and data analysis in this study, it can be ascertained that there is a significant relationship and a very strong correlation between muscle explosive power and swimming speed of 50m sprint athletes. Also, muscle explosive power is needed as one of the determinants of breaststroke swimming athlete achievement.

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