



ISSN Print: 2664-7281
ISSN Online: 2664-729X
Impact Factor: RJIF 8
IJSEPE 2024; 6(2): 205-207
www.sportsjournals.net
Received: 08-08-2024
Accepted: 14-09-2024

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The relationship between leg muscle strength on edging techniques in rock climbing sport POPB athletes the special capital region of Jakarta

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DOI: <https://doi.org/10.33545/26647281.2024.v6.i2c.129>

Abstract

This study aims to explore the relationship between edging technique leg muscle strength among POPB rock climbing athletes in the Special Capital Region of Jakarta. Hopefully, the results of this study can contribute to the development of more effective and data-driven training programs for rock climbing athletes. This study adopted a quantitative design with a correlation approach, aiming to explore the relationship between leg muscle strength and edging techniques in male and female athletes from the Rock Climbing Sports Association (POPB) in the Special Capital Region of Jakarta. The population studied were athletes who were members of POPB, The sample technique used purposive sampling with a sample consisting of 30 male and female athletes. Leg muscle strength was measured through the leg dynamometer test, which allows an accurate assessment of muscle strength in the leg. To measure the ability of edging techniques, the edging climbing test was used. The results showed that the increase in leg muscle strength was positively correlated with the effectiveness of edging techniques applied by athletes, with the contribution of leg muscle strength of 52.9% to the results of edging techniques. Thus, there is an increase in athletes' ability in edging techniques and overall performance in rock climbing competitions.

Keywords: Leg muscle, edging, rock climbing

Introduction

Rock climbing is a complex sport, combining technical skills, physical strength and mental strategy. Among the various techniques used, edging is one of the most crucial. This technique requires athletes to efficiently use the sides of their shoes to create a stable foothold on the cliff face. Leg muscle strength plays a very important role in the success of this technique (Schöffl, V. *et al.*, 2006) ^[1]. According to them, rock climbing is a multidimensional sport that requires a combination of strength, endurance, flexibility and technical skills. Good technique is essential to maximize movement efficiency and reduce the risk of injury. good leg muscle strength is a key indicator of high climbing performance. They explain that muscles such as the quadriceps, hamstrings, and calf muscles contribute to providing stability and strength when edging, thereby improving the athlete's movement efficiency.

Based on research conducted (González-Badillo *et al.*, 2014) ^[2] highlights the importance of muscle strength in reducing the risk of injury. In their study, it was found that athletes with better limb strength showed better control when performing dynamic movements, which reduced the likelihood of strain or accidental injuries. Likewise, research conducted by (van der Sande *et al.*, 2018) ^[3] showed that increased leg muscle strength not only had an effect on edging ability, but also contributed to the athlete's resilience in the face of physical challenges on the wall. They noted that stronger athletes have better endurance in completing difficult routes. According to (Hunt *et al.*, 2020) ^[4] the development of training programs that focus on leg strength can improve overall climbing performance. They recommend specific strength training that targets the leg muscles to improve edging ability and overall performance.

However, based on observations and realities in the field that researchers observed and observed in the Special Capital Region of Jakarta, with rapid growth in the sport of rock

climbing. Research on the effectiveness of leg muscle strength in edging techniques is very relevant. This study aims to explore the relationship between edging technique leg muscle strength among POPB rock climbing athletes in the Special Capital Region of Jakarta. Hopefully, the results of this study can contribute to the development of more effective and data-driven training programs for rock climbing athletes.

Research Methods

This study adopted a quantitative design with a correlation approach, aiming to explore the relationship between leg muscle strength and edging technique in male and female athletes from the Rock Climbing Sports Association (POPB) in DKI Jakarta. In this study, the population studied were athletes who are members of POPB, with a sample consisting of 30 male and female athletes.

Leg muscle strength was measured through the leg dynamometer test, which allows an accurate assessment of muscle strength in the leg. To measure edging technique ability, the edging climbing test was used, which is specifically designed to evaluate the effectiveness and efficiency of movements during climbing. This method provides a comprehensive overview of the role of leg muscle strength in improving edging technique ability, which is a crucial aspect of climbing performance.

With this approach, the study aims to provide a deep insight into how physical strength affects climbing technique, as well as offer recommendations for a more effective training program for rock climbing athletes in the Jakarta Special Capital Region.

Research Results

Table 1: Description of Research Data

Variables	Leg muscle strength (X ₁)	Edging technique (Y)
Lowest Score	16	1
Highest Score	80	5
Averaged	36	3,567
Median	30	4
Mode	30	5
Standard Deviation	16,873	1,454

1. Variable Leg muscle strength (X₁)

The results showed that the range of leg muscle strength scores (X₁) was 16 to 30, the average value was 36.6 standard deviation 16.873, the median was 30 and the mode was 30. Frequency distribution can be seen below:

Table 2: Frequency distribution of leg muscle strength (X₁)

No	Class Interval (-)		Center Point	Frequency	
				Absolut	Relative (%)
1	16	26	21,0	10	33,33
2	27	37	32,0	10	33,33
3	38	48	43,0	4	3,567
4	49	59	54,0	4	3,567
5	60	70	65,0	0	0,00
6	71	81	76,0	2	6,67
Total				30	100,00

Based on the data from above compared to the average value, it can be seen that the different samples in the average class are 10 samples (33.33%) and those below the average class are 10 samples (33.33%), while the samples above the

average class are 10 samples (33.33%). Furthermore, the histogram of the limb muscle strength variable can be seen in the picture below:



Fig 1: Pie chart of leg muscle strength data (X₁)

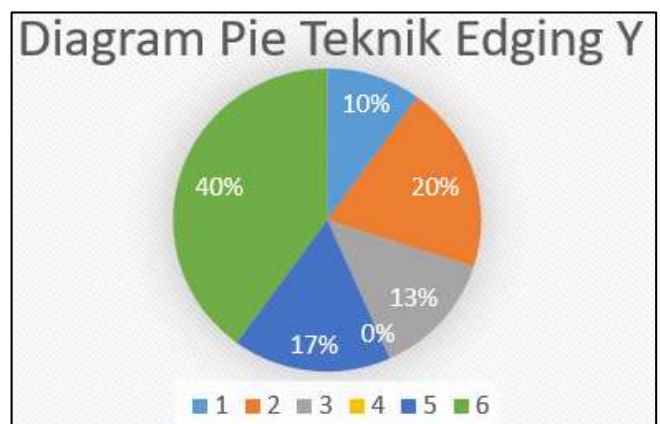
2. Variable Edging technique (Y)

The results showed that the edging technique score range was between 1 and 5, the mean value was 3.567, the standard deviation was 1.454, the median was 4 and the mode was 5. The Frequency Distribution can be seen below.

Table 3: Frequency distribution of edging technique (Y)

No	Class Interval (-)		Center Point	Frequency	
				Absolut	Relative (%)
1	1,00	1,67	1,33	3	10,00
2	1,68	2,34	2,01	6	20,00
3	2,35	3,02	2,69	4	3,567
4	3,03	3,70	3,36	0	0,00
5	3,71	4,37	4,04	5	16,67
6	4,38	5,05	4,72	12	40,00
Total				30	100,00

Based on the data from above compared to the average value, it can be seen that the samples below the average class are 13 samples (33.33%), while the samples above the average class are 17 samples (46.67%). Furthermore, the histogram of the edging technique variable can be seen in the picture below:



Pie chart of edging technique (Y)

3. Hypothesis

The relationship between leg muscle strength and edging technique is expressed by the regression $\hat{Y} = 1.272 + 0.063X_1$. This means that the edging technique can be known or estimated by the regression equation, if the

variable leg muscle strength (X_1) is known. The relationship between leg muscle strength (X_1) and edging technique (Y) is shown by the correlation coefficient $r_{y_1} = 0.727$, before being used to draw conclusions. The results of the correlation coefficient test can be seen in the following form:

Table 4: Significance test of correlation coefficient (X_1) on (Y)

Correlation coefficient	t account	t. table
0,727	5,609	2,045

From the significance test of the correlation coefficient above, it can be seen that $t_{hitung} = 5.609$ is greater than $t_{table} = 2.045$, meaning that the correlation coefficient $r_{y_1} = 0.727$ is significant. Thus there is a significant relationship between leg muscle strength and edging techniques supported by research data. Which means the better the leg muscle strength, the better the edging technique. The coefficient of determination of leg muscle strength with edging technique ($r_{y_1^2}$) = 0.529 This means that 52.9% of the edging technique is determined by leg muscle strength (X_1).

Discussion

Leg muscle strength plays a crucial role in the effectiveness of edging techniques in rock climbing athletes. The study showed that the limb muscle strength variable contributed 52.9% to the edging technique results. This suggests that the stronger a climber's leg muscle strength, the better he or she can execute the edging technique effectively. Leg muscle strength is one of the determinant factors in rock climbing performance. Athletes who have good leg strength can more easily attach their lower body to the wall, optimally distribute the load on the legs, and reduce strain on the arms. This is in line with the findings of (González-Badillo *et al.*, 2014) [2] who emphasized that adequate muscle strength not only improves the performance of edging techniques, but also contributes to preventing injuries.

When edging techniques are applied well, the use of leg muscle strength is maximized. The climber can efficiently step on small points on the wall, which in turn improves stability and control while climbing, especially on vertical walls and overhangs. Thus, a training program that focuses on developing leg muscle strength is essential to improve the effectiveness of edging techniques, as suggested by (van der Sande *et al.*, 2018) [3], who emphasized the importance of specific exercises for muscle strengthening. Therefore, the integration of leg muscle strength in edging technique is not just a physical aspect, but is key to achieving peak performance in rock climbing.

Conclusions

Based on the results of the research conducted, it can be concluded that leg muscle strength has a significant influence on edging techniques in male and female athletes from the Rock Climbing Sports Association (POPB) in the Special Capital Region of Jakarta. Data analysis shows that increasing leg muscle strength is positively correlated with the effectiveness of edging techniques applied by athletes, with a contribution of leg muscle strength of 52.9% to the results of edging techniques.

This finding confirms the importance of leg muscle strengthening as one of the crucial physical components in improving rock climbing performance. Athletes who have good leg muscle strength are able to optimize edging

techniques, so they can climb more efficiently and reduce the risk of injury due to muscle fatigue.

Recommendations for training programs are for coaches to focus on developing leg muscle strength through specific exercises, such as squats, lunges, and other exercises that target leg muscles. Thus, it is expected that athletes can improve their edging technique and overall performance in rock climbing competitions.

The results of this study also contribute to the development of more targeted and evidence-based training strategies for rock climbing athletes in the Special Capital Region of Jakarta, as well as being the basis for further research on other factors that affect performance in this sport.

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