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The Effect of Weight Training using A Hangboard on Improving The Grip Strength Endurance of Boulder Climbing Athletes

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Abstract

Studi purpose: In boulder climbing competitions, most athletes fall because they cannot grip specific holds, preventing them from climbing on sight. This study aims to examine the effect of weight training using a hangboard on improving the grip strength endurance of boulder climbers.

Materials and methods: The method used in this study was an experimental method employing a one-group pretest-posttest design. The study population consisted of 10 active athletes from the Indonesian Rock Climbing Federation (FPTI) in Kuningan District, who also served as the study sample using a total sampling technique. The instrument used in this study was the bent-arm hang-open grip test to measure the grip strength endurance of the athletes. Data analysis was performed using SPSS software, including statistical description, normality test, homogeneity test, and hypothesis testing.

Results: From the data analysis using hypothesis testing through the Paired Sample T-Test, a significant difference was found between the pre-test and post-test averages in the weight training program using a hang board on the improvement of hand grip strength endurance in boulder climbing athletes, with a difference of 2.35 and a percentage difference of 45% between the pre-test and post-test results.

Conclusions: This study concludes that weight training using a hangboard, when performed consistently, can positively impact and significantly improve the grip strength endurance of boulder climbing athletes.

Keywords: Weight Training, Hang Board, Strength Endurance, Rock Climbing, Bouldering.

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Introduction

One of the physical components that must be possessed by someone involved in rock climbing is strength and endurance. Strength endurance cannot be obtained easily without a lengthy training process; the training process must be carried out gradually to see a significant improvement (Maki et al., 2021). Grip strength endurance is the key factor in determining performance during climbing (Ceyhan et al., 2021). Rock climbing involves the entire body in

movement but places high stress on the hands and fingers when holding points to gain height and complete the climbing route until reaching the summit (Gilmore et al., 2024).

Rock climbing can improve hand grip strength and endurance by performing a weight training program using a hangboard. This weight training program using a hangboard will involve more muscles, increasing the endurance of the athlete's hand grip strength (Mundry et al., 2021). Rock climbers can improve their hand grip strength and endurance by performing a weight training program using a hangboard. Weight training is a structured exercise program using internal or external weights to improve muscle strength and endurance (Lutfiani & Irawan, 2025). This training must be conducted systematically and progressively to achieve optimal physical performance and prevent injuries (Rismayadi et al., 2023). Systematic weight training can increase muscle strength, strengthen bones, improve performance, and prevent injuries (Nasrulloh et al., 2022).

Hangboard is a more specific exercise in rock climbing to train finger strength, significantly affecting climbing performance (López-Rivera & González-Badillo, 2019). Hangboards also have grips of different shapes, sizes, widths, and depths (Devise et al., 2022). Training with a hangboard increases maximum strength on grip, strength endurance on grip, and strength while climbing (Gilmore et al., 2024). The average intermediate climber can hang from a hanging board for 45 seconds, in advanced climbers, the average hanging time is 60 - 90 seconds, and elite climbers can hang for more than 2 minutes (Hanes, 2023). The ideal time for an athlete to hang from a skateboard with a maximum load is 10 seconds (Radall, 2023).

Before writing this study, previous research was conducted to find inspiration and compare it with related journals. The article referenced in this study was written by López-Rivera & González-Badillo (2019) and titled "Comparison of the Effects of Three Hangboard Strength and Endurance Training Programs on Grip Endurance in Sport Climbers". The article compares the effects of training programs using dead hang (maximal, intermittent, and combined) on grip endurance. The study states that future research should focus on a narrower range of climbing levels. This study will focus on intermediate-level bouldering category athletes, following suggestions from previous studies. In addition, this study provides a more specific treatment, with weight training on hangboards, which aims stranght endurance of athletes hand grip strength.

Boulder is a form of rock climbing that involves short distances and does not use ropes, but uses mats placed under the climbing board for safety (Nurjaman, 2016). In boulder competitions, it is rare for athletes to reach the top with on-sight, most athletes make several attempts to reach the top, and some do not even reach the top. The winner in a bouldering competition in the final round is the athlete who completes the climbing route in the fastest time (McKellar et al., 2023). One of the problems in bouldering routes is the different routes in each climb, and the more dynamic movements in each route (Sas-Nowosielski & Kandzia, 2022). Athletes with good grip strength and endurance have great potential to make one attempt without falling (Limonta et al., 2020). Performing a weight training program on a hangboard will increase hand grip strength endurance, so athletes will benefit if they can complete the climbing route in on-sight (Morenas et al., 2021).

Materials and methods

Study participants

The subjects of this study were 10 active athletes from the Indonesian Rock Climbing Federation (FPTI) in Kuningan Regency.

Study organization

This study utilised an experimental method, which was carefully conducted to determine the effect of independent variables on dependent variables under controlled

conditions (Fraenkel et al., 2022). This method was chosen because it allowed researchers to control the variables that influenced the research results so that the effect of weight training using a hanging board on improving hand grip strength in rock climbers could be analysed objectively. The research design is a single-group pretest-posttest design. This design consists of a single group measured or observed before and after the intervention (Fraenkel et al., 2022).

Research instrument

The tool used to collect data is the bent arm hang open grip test, which measures hand grip strength and endurance (Langer et al., 2023). In this study, all participants will first undergo a pre-test using the bent arm hang open grip test to measure grip strength and endurance. Next, all participants will be given a weight training intervention using a hanging board. Then, participants will undergo a post-test using the same tool to observe changes after the intervention. By carrying out all these steps, this study aims to test the effects of weight training using a hanging board on improving the grip strength endurance of athletes. The test results will be recorded when the athlete's position or movement is unstable. Furthermore, the bent arm hang open grip test norms can be seen in Table 1.

Table 1. Open Grip Test Bent Arm Grip Norms
(Source: Regional Rock Climbing Coach, 2025)

Gender	Very Poor	Poor	Medium	Good	Very Good
Male	<3 s	3 – 5 s	6 – 8 s	9 – 13 s	>13 s
Female	0 s	1 – 2 s	3 - 4 s	5 -6 s	>6 s

Research treatment

The treatment was conducted over 1 month, divided into 12 sessions with 3 sessions in one week. Consistent training over 12 sessions can be considered adequate, and long-lasting changes will be observed (Adrian, 2023). To improve hand grip strength endurance, intermittent training can be performed using a depth of 10–20 mm, 4–5 repetitions, 3–8 sets, duration of 3–10 seconds, intensity of 70%–80% of maximum load, rest between repetitions for 3–30 seconds, and rest between sets for 1–3 minutes (Lopez & Rivera, 2021). However, this study's sample consisted of intermediate athletes, so high-intensity training was only administered once per week.

The calculation of the maximum load for hangboard training can be seen in the crimpd application, which has been explained in terms of its implementation: the athlete hangs on a 20 mm hangboard using the half crimp grip technique while holding an additional initial load of 5 kg for 7 seconds with a rest period of 2 minutes between each set, and gradually increases the load with each set. The maximum load is the highest load completed before failure within the specified time while maintaining the same grip position, if the athlete has not reached the maximum load after 8 sets, continue the next day (Radall & Torr, 2025).

Statistical analysis

Data analysis using SPSS software, including statistical description, normality test, homogeneity test, and hypothesis testing.

Results

The data obtained from the pre-test and post-test results can be seen in Table 2.

Table 2. Pre-test and post-test results

No	Name	Gender	Pre-test	Category	Post-test	Category	Percentage
1	AJ	Male	6,8	Moderate	9,1	Good	35%
2	AK	Male	8,4	Moderate	11,7	Good	39%
3	AL	Male	4,0	Poor	7,0	Moderate	73%
4	RA	Male	6,8	Moderate	7,8	Moderate	15%
5	YA	Male	4,4	Poor	6,5	Moderate	47%
6	AU	Female	5,0	Good	6,5	Good	31%
7	DE	Female	5,0	Good	7,9	Good	57%
8	MA	Female	5,2	Good	8,6	Good	66%
9	NU	Female	4,9	Moderate	7,0	Good	43%
10	RAY	Female	1,6	Poor	3,5	Moderate	117%
Average			5,2		7,6		45%

Table 2 shows the results of the hand grip strength endurance test before and after treatment. In the pre-test, there were 3 athletes in the good category, 4 in the moderate category, and 3 in the poor category. After treatment (post-test), there was an improvement with 6 athletes in the good category and 4 athletes in the moderate category. The percentage of pre-test and post-test results showed an increase of 45%.

Table 3. Descriptive analysis

Test	N	Mean	Standard deviation
Pre	10	5,21	1,84
Post	10	7,56	2,11

Table 3 shows the summary of pre-test and post-test data on the improvement in grip strength endurance in rock climbing athletes in the pre-test and post-test. The pre-test results showed an average measurement and standard deviation of ($\bar{x}$= 5.21 and sd = 1.84), while the post-test results showed ($\bar{x}$= 7.56 and sd = 2.11).

Table 4. Normality test results

Test	Shapiro-Wilk			Description
	N	Statistics	Sig.	
Pre	10	0,202	0,605	Normal
Post		0,208	0,591	Normal

Table 4 shows the results of the normality test using the Shapiro-Wilk test, which indicates that the pretest and posttest variables for the grip strength endurance of boulder climbing athletes are normal with a value of (sig > 0.05). It can therefore be concluded that the pretest and posttest data in this study are normally distributed and can be analyzed using parametric tests.

Table 5. Homogeneity test results

Test	Levene Statistic			Description
	Statistics	Sig.	N	
Pre Post	0,094	0,763	10	Homogen

Based on Table 5 above, the results of the homogeneity test in the pre-test and post-test groups can be seen with a value of (sig > 0.05). Therefore, these variables originate from the same variance (homogeneous).

Table 6. Paired sample t-test

Test	Difference	t-count	Sig.
Pre-Post	2.35	9,417	0,000

Based on Table 6 regarding the results of the Paired Sample T-Test, a difference was found between the pre-test and post-test averages in weight training using a hangboard, with a value of 2.35 and a Sig. 0.000 < 0.05, the accepted hypothesis is H_1, indicating a significant effect of weight training using a hang board on improving grip strength endurance in rock climbing athletes in the boulder category.

Discussion

In this study, it was found that athletes had implemented training using hangboards. However, the frequency was still relatively low, and they were not yet accustomed to using external weights. After the athletes were given treatment, their bodies would respond differently and begin to adapt to new weights and intensities. The principle of adaptation in training is the body's ability to adjust to the training loads that are gradually increased and repeated (Hughes et al., 2018). This adaptation is marked by the emergence of different physiological responses, enabling desired outcomes such as increased grip strength, endurance, and efficiency in maintaining body position during hanging (Kodli, 2023).

This indicates that increasing the frequency and variety of weight training using a hangboard can significantly influence grip strength endurance, particularly in the context of climbing performance. Thus, structured and consistent training significantly improves athletes' grip strength endurance (Medernach et al., 2015). Strong grip strength is essential as it positively influences overall climbing performance (Marcolin et al., 2022). A strong grip can reduce the risk of athletes falling during climbing and enable them to complete challenges on climbing routes up to the top.

This study showed a very high increase in hand grip strength endurance, which amounted to 45.12%. In addition to the principle of adaptation, the increase was also caused by the principle of exercise specification, namely, training carried out more specifically by the physical and technical demands of the sport. Hangboard is a special media that rock climbing athletes effectively use to increase maximum grip strength, explosive strength, and grip strength endurance. This is also reinforced by Ehrich et al., (2021), who say that hangboard training is a form of specific rock climbing training that can significantly increase the endurance of hand grip strength. Hangboard is also a medium designed for finger strength training with a prearranged grip arrangement to be more precise and systematic according to the athlete's physical capacity (Anderson et al., 2016).

Previously, most of the training conducted by athletes emphasized the boulder interval method, which effectively improves rock climbing performance. However, boulder interval training has limitations regarding intensity, volume, and the specific types of holds used (Mundry et al., 2021). In contrast, hangboard training can be tailored more precisely to the athlete's abilities, making it more effective for improving grip strength endurance (Anderson et al., 2016). In boulder climbing, isometric movements push the body upward, and specific isometric movement training can be performed using a hangboard (Diez-Fernández et al., 2023). Thus, training using a hangboard can also provide a more targeted stimulus for improving grip strength endurance.

Weight training using hangboards that have been carried out can increase muscle strength, endurance, and movement efficiency (Lutfiani & Irawan, 2025). Weight training done regularly can increase muscle efficiency in supporting and holding body weight against gravity (Kusuma, 2017). Maintaining body balance against gravity with a strong grip and being able to move the body from one point to another is a key success factor in climbing (Matsouka et al., 2020). This is particularly important in rock climbing as the body constantly supports weight, maintains stability, and pulls the body upwards along the climbing route. Therefore, weight training increases muscle strength and supports the development of muscular endurance, especially in the arms, shoulders, and fingers of the major muscles involved in hanging and pulling the body.

The results of this study indicate that weight training using a hangboard can have a significant effect on improving hand grip strength endurance. This was proven through hypothesis testing, which found a difference between the pretest and posttest averages of 2.35 and a percentage difference between the pretest and posttest results of 45.12%. Weight training using a hangboard effectively and efficiently improves hand grip strength endurance (Anderson et al., 2016). In bouldering competitions, athletes must complete several climbing routes with a 5-minute rest period, and if they fall, they must repeat the route (Auer et al., 2021). Therefore, grip strength endurance is essential for athletes, as it is advantageous if they can complete the climbing route in a shorter time and only attempt it once without falling.

Conclusions

Based on careful data processing and research results, the author can conclude that weight training using a hang board, when performed consistently, can have a positive impact and significantly improve the grip strength endurance of boulder climbing athletes. The limitations of this study were related to the equipment used, particularly the hangboards, which had to be used alternately by the athletes, resulting in a long time to complete the treatment. For future studies, equipment limitations can be overcome by increasing the number of hangboards or changing the exercise routine to minimize athlete waiting time, thereby improving the effectiveness of the exercises. Additionally, the sample size in this study was relatively small, with only 10 athletes. This limited sample size may affect the statistical power of the tests. The results should be reinterpreted in future studies using a larger sample size. Suggestion for future researchers can also test other media to assess improvements in the grip strength endurance of boulder climbing athletes.

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Conflict of interest

We declare no conflict of interest in this article.

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