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The Effectiveness of Weight Training on Speed in Rock Climbing Athletes in the Speed World Record Category

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Abstract

Study Purpose. This study aims to determine the effectiveness of weight training on increasing the speed of rock climbing athletes in the Speed World Record category .

Materials and methods. This study involved 10 Speed World Record category rock climbers from FPTI Semarang City. For one month, they followed a weight training program to increase muscle strength to support acceleration and climbing speed. Climbing time tests were conducted before (pretest) and after the training program (posttest). Data were analyzed using the T-Test to identify significant differences in average climbing time.

Results. The results showed that the average climbing time decreased from 11.8610 seconds (pretest) to 10.6040 seconds (posttest), with a significant decrease of 1.257 seconds. The T-Test produced a significance value <0.001, indicating that this difference was very significant. Cohen's d> 0.8 indicates that the effect of weight training is very large on increasing athlete speed.

Conclusion. This study found that weight training significantly improved the speed performance of Speed World Record category rock climbers. This decrease in time not only indicates an increase in movement efficiency but also represents a 10.6% reduction in climbing time, reflecting the strengthening of muscles and speed that support acceleration during climbing.

Keywords: Rock Climbing, Speed, Weight Training, Word Record

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Introduction

Speed is an important element in the Speed World Record category of rock climbing, which requires a combination of strength, agility, and quick reactions (Pramukti and Junaidi 2015; Romadlon and Pramono 2023; Sakti and Irmansyah 2016). Although the sport of rock climbing is increasingly popular, many athletes face challenges in achieving optimal climbing times due to the lack of structured and specific training programs (Bernhardin 2022; Hartadji et al. 2023). This is particularly evident among athletes from the Indonesian Rock Climbing Federation (FPTI) in Semarang City, where the majority of athletes have not yet achieved target times set for national or international championships.

Observations indicate that the average climbing times of FPTI Semarang athletes are still far from optimal, often falling behind their competitors from other regions. For instance, the average time for male climbers in the Speed World Record category in Semarang is 13.25 seconds, with the best recorded time being 7.81 seconds, still lagging behind the current world record of 4.75 seconds held by Samuel Watson from the USA. Similar trends are observed among female athletes, whose best time of 10.55 seconds is significantly slower than Aleksandra Miroslaw's world record of 6.06 seconds.

The suboptimal performance of these athletes may be attributed to inadequate training programs that fail to focus on the specific physical components required for climbing speed, such as explosive strength and muscle endurance. Additionally, the lack of systematic integration of weight training and agility exercises further hinders their progress.

Weight training not only increases muscle strength, but also endurance, agility, and flexibility, which are important components in sports performance (Mulki and Sapulete 2022; Reynaldy, Wahyudi, and Sidik 2021). Speed and agility are vital for athletes (Purnomo and Irawan 2021). Their study on sports education students showed that a structured weight training program can improve overall physical fitness, which is relevant for sports activities such as rock climbing that require explosive strength.

Previous research by Andika (2023) showed the effectiveness of a combination of weight training and speed drills on increasing climbing speed. The average climbing time decreased from 9.8 seconds (pretest) to 8.905 seconds (posttest), with a significant decrease of 0.953 seconds. The Paired Sample T-Test produced a significance value of 0.002 (<0.05), indicating a significant increas Another study by Suryadi et al. (2021) confirmed the effectiveness of high-intensity circuit training in increasing muscle strength, agility, and cardiovascular endurance (Suryadi, Samodra, and Purnomo 2021). However, most of these studies focus on various sports without specifically examining the application of weight training programs to the performance of rock climbing athletes.

Although empirical evidence supports the benefits of weight training , research specifically evaluating its effects on Speed World Record climbing speeds is limited. Furthermore, few have explored optimal training design to meet the specific needs of climbing athlete Weight training is a planned exercise program that uses weights to increase muscle strength with the aim of improving the athlete's physical condition, preventing injury, or for general health (Suharjana, 2018). Weight training is a method that focuses on increasing fitness by involving repetitive movements, such as biceps curls or shoulder raises , using weights that do not reach maximum capacity (Budiawan 2020; Hakimah 2022; Musálek et al. 2020). This load is individual, meaning it is adjusted to each person's abilities (Andika, 2023) .

The essence of weight training is to increase strength and muscle mass by using external loads, such as barbells , dumbbells , or your own body weight (Hanum 2018; Nasugian and Suripto 2021; Vanagosi et al. 2022). These exercises are designed to engage specific muscle groups, with the goal of improving physical performance, posture, stability, and muscular endurance.

Weight training plays an important role in improving the performance of rock climbers (Nursalam 2018; Romadlon and Pramono 2023). Weight training can improve muscle strength, endurance, and grip strength (Wicaksono and Kristiyandaru 2021; Yahya 2016). Good muscle strength helps athletes hold and pull their bodies while climbing, while muscle endurance supports them in staying strong during long climbing sessions. Speed, as a critical component of climbing, is influenced by both strength and endurance. Strength contributes to the athlete's ability to generate maximum force in a short period, enabling explosive movements, while endurance ensures the muscles can sustain repeated efforts without fatigue.

In the context of climbing, the combination of strength and endurance significantly affects the athlete's speed. Strength enables the climber to execute dynamic moves quickly and efficiently, while endurance ensures they maintain their performance throughout the climb. Therefore, an optimal balance between these two components is essential for achieving higher climbing speeds, especially in categories like Speed World Record climbing.. In addition, weight training can help prevent injuries by strengthening supporting muscles and improving joint stability (Ruban and Ermolaev 2020).

This study aims to fill this gap by evaluating the effectiveness of weight training as a primary strategy in increasing the speed of Speed World Record category rock climbers . This study makes a novel contribution by presenting specific results on how this training affects climbing speed, while also providing a structured guideline for integrating weight training into rock climber training programs.

Materials and Methods

Study participants

The population in this study were 10 rock climbing athletes who are members of the Indonesian Rock Climbing Federation (FPTI) of Semarang City. All of these athletes competed in the Speed World Record category , which requires high speed, strength, and agility in completing standard climbing routes.

The selection of this population was done by total sampling, so that all athletes in the group were involved in the study. Training and measurements were carried out under controlled conditions to ensure valid and reliable results.

Study Organization

This study used a one-group pretest-posttest experimental design , where the athlete's climbing speed was measured before (pretest) and after (posttest) undergoing a weight training program . The weight training exercises were designed in stages with increasing intensity each week. In the first and second weeks, the focus of the training was on strengthening basic muscles with an intensity of 70% of 1 Repetition Maximum (1RM) through movements such as squats , pull-ups , calf raises , stiff leg deadlifts , and bench presses . The training intensity increased in the third and fourth weeks to 75% 1RM, with the addition of repetition and set volumes to maximize adaptation of muscle strength and endurance.

Table 1. Weight Training Exercises for 1 Month

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Upper Body Weight Training	Full Speed	Full Body Weight Training	Rest	Full Body Weight Training	Full Speed	Weight Training Lower Body

Based on Table 1 Each training session was performed 3-5 sets in one training session, with a rest between sets for 90 seconds and between movements for 4 minutes to ensure muscle recovery. In addition to weight training, athletes also performed Speed World Record route climbing exercises on certain days to train maximum speed. After one month of the training program was completed, the athlete's climbing time was re-measured to evaluate significant changes compared to the initial results. The pretest and posttest results were then

analyzed using the Paired T-Test statistical test to ensure the effectiveness of the intervention given.

Statistical analysis

After the data is entered, the next step is to conduct a normality test to ensure that the data distribution is in accordance with the normality assumptions required for parametric tests. This study began by conducting a normality test to ensure that the pretest and posttest data had a normal distribution. The normality test was carried out using the Kolmogorov-Smirnov or Shapiro-Wilk method via the Analyze> Descriptive Statistics> Explore menu in statistical software. If the significance value (p) is greater than 0.05, then the data is considered to be normally distributed, which allows the use of further parametric statistical tests.

The next step is to conduct a Paired Sample T-Test to analyze the significant differences between the pretest and posttest results. This test aims to test whether there is a significant difference between climbing time in conditions before and after the training intervention. If the p-value is less than 0.05, then the difference is considered significant, indicating that weight training has a significant impact on the speed of athletes in rock climbing.

As a final step to evaluate the magnitude of the training effect, this study calculated Cohen's d value from the mean difference and standard deviation of the pretest and posttest. Cohen's d value greater than 0.8 indicates a large training effect on the performance of rock climbers, confirming the effectiveness of the weight training intervention in significantly improving the speed of athletes.

Results

The results of this study indicate that weight training has a significant impact on increasing the speed of rock climbers in the Speed World Record category . As a first step, the data on the athletes' climbing time before and after weight training are presented in the following Table 2, which shows the average time achieved by each athlete in the pretest and posttest . The data shows a decrease in the average climbing time after following the weight training program for one month, which illustrates an increase in performance .

Table 2. Athletes' Pretest and Posttest Results

Name	For 1 Month	
	Before (Second)	After (Second)
Sample 1	06.81	06.25
Sample 2	16.62	15.45
Sample 3	21.59	19.22
Sample 4	10.55	09.14
Sample 5	15.32	13.28
Sample 6	09.33	08.46
Sample 7	10.05	09.23
Sample 8	11.72	10.82
Sample 9	08.81	07.47
Sample 10	07.81	06.72

This Table 3 shows the decrease in average time for all athletes after they underwent a weight training program . To test whether this change was significant, a Paired T-Test was conducted, the results of which are presented in the following table. The results of the

statistical test show a Sig. value <0.001, which means that the difference in climbing time before and after training is very statistically significant. This indicates that weight training has a significant effect on increasing the speed of rock climbers.

Table 3. Normality Test

	Kolmogorov-Smirnov			Shapiri-Wilk		
Class	Statistic	df	Sig.	Statistic	df	Sig.
Test 1	0.212	10	0.200	0.892	10	0.180
Test 2	0.229	10	0.147	0.892	10	0.10

The normality test results show that the data for Test 1 and Test 2 are normally distributed, with Kolmogorov-Smirnov and Shapiro-Wilk significance values > 0.05.

Table 4. Homogeneity Test

	Levene Statistic	df 1	df 2	Sig.
Based on Mean	0.198	1	18	0.662
Based on Median	0.181	1	18	0.675
Based on Mean and with adjusted df	0.181	1	17.746	0.675
Based on trimmed mean	0.219	1	18	0.646

The homogeneity test results show that the data have homogeneous variances, with Levene Statistic significance values > 0.05 for all calculation methods.

Table 5. Hypothesis Test

		Mean	N	Std.Error Mean	Lower	Upper	t	df	Sig.(2-tailed)
Pair 1	Test 1 – Test 2	1.25700	0.56486	0.1786	0.85291	1.6610	7.03	9	<0.001

The hypothesis test results show a significant difference between Test 1 and Test 2, with t = 7.03, df = 9, and a (2-tailed) significance value of < 0.001.

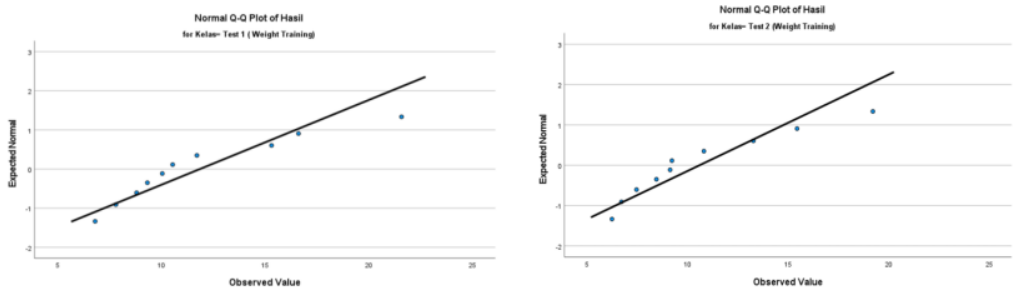

Figure 1. Normal QQ Plot

Based Figure 1 on data analysis, the Normal QQ Plot shows that the distribution of data on the difference in athlete climbing time before and after weight training approaches a normal distribution. This can be seen from the pattern of dots on the QQ Plot which are mostly around the diagonal line for both test groups (Test 1 and Test 2). With the fulfillment of the normality assumption, the use of the Paired T-Test as a statistical test method becomes valid. The results of the statistical test show a significant value (Sig. <0.001), which confirms that weight training has a very significant impact on increasing the speed of rock climbing athletes. The decrease in average time of 1.257 seconds and the large effect value (Cohen's d> 0.8) support the conclusion that this training program is effective in significantly improving athlete performance. The combination of evidence of data normality from the QQ Plot and strong statistical test results strengthen the validity of the conclusions of this study. Therefore, the results of this study support that weight training can be an effective method to increase the speed of athletes in rock climbing in the Speed World Record category .

Discussion

The results of this study showed that weight training had a significant effect on increasing the speed of rock climbing athletes in the Speed World Record category . The decrease in average time of 1.257 seconds, from 11.8610 seconds (pretest) to 10.6040 seconds (posttest), reflects the effectiveness of the intervention. The results of statistical tests strengthen these findings, with data that meet the assumptions of normality (Sig. value 0.180) and homogeneity of variance (Sig. value above 0.05). Further analysis with the Paired T-Test showed a significant value (Sig. <0.001) with a large effect (Cohen's d> 0.8), indicating that these changes did not occur by chance.

Figure 2. Comparison before and after weight training

Based Figure 2 Physiologically, the athlete's increased speed can be attributed to increased muscle strength, endurance, and movement efficiency that are direct results of weight training. Lower body exercises , such as squats and calf raises , strengthen the leg muscles for faster acceleration during the initial push-off. Upper body training , such as pull-ups and bench presses , increases grip strength and body pulling power, which are essential for maximizing body transfer from one grip to another. In addition, full body training supports stability, coordination, and injury prevention, which are important factors in supporting optimal performance (Suharjana, 2018).

This study also confirms the relevance of the theory of increasing explosive strength in sports, as stated by Purnomo and Irawan (2021), who stated that a weight training program can increase an athlete's strength, agility, and endurance. In the context of Speed World Record category rock climbing , explosive strength allows for faster acceleration in the start phase and transition of movements between holds. A significant decrease in average time indicates optimal neuromuscular adaptation during the training program, as explained by the theory of muscle adaptation to high-intensity weight training (Suryadi et al., 2021).

However, this study has limitations. The small sample size (10 athletes) may affect the generalization of the results to a wider population of athletes. In addition, other factors such as mental condition, training environment, and climbing technique were not evaluated in this study, although these factors have a contribution to climbing speed. This study was also limited to a training duration of one month, so it does not reflect the long-term effects of weight training on athlete performance.

Conclusions

This study concludes that weight training significantly improves the speed of rock climbing athletes in the Speed World Record category, with an average time reduction of 1.257 seconds, supported by statistical results (Sig. < 0.001) and a large effect size (Cohen's d > 0.8). The study was limited by a small sample size of 10 athletes and a training duration of only one month. Future research should explore the long-term effects of weight training with larger sample sizes for broader generalization.

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Conflict of interest

There is no conflict of interest of this study.

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