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Establishing the Interaction between Training Methods and Power Levels in Wrestling: A 2x3 Factorial Design of Hip Toss Skills

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Abstract

Objectives. This study aimed to evaluate the effects of resistance band exercises, good morning drills, and bicep curls on improving the hip throw technique among wrestling athletes, considering their initial power levels.

Materials and methods. This study employed a 2×3 factorial design involving 66 male students, grouped based on power levels (high and low) and training methods. The training was conducted over six weeks with a frequency of three weekly sessions. The measured parameters included improvements in hip throw technique skills, encompassing strength, stability, and execution speed. Data analysis was performed using ANOVA and Tukey's test to evaluate significant differences between groups.

Results. The results indicated a significant main effect of the training method factor (A) on hip toss skills ($F = 5.413$, $p = 0.007$), demonstrating that variations in training methods led to marked differences in skill outcomes. The second main effect, power level (B), showed an even more substantial influence ($F = 99.426$, $p = 0.000$), indicating that athletes' baseline power plays a crucial role in determining hip toss performance. Regarding the interaction effect, there was a considerable interaction between training methods and power levels ($F = 7.914$, $p = 0.001$).

Conclusions. This study concludes that resistance band exercises are the most effective method for athletes with high power in enhancing dynamic strength and flexibility relevant to hip toss techniques. The "good morning" exercise effectively supports postural stability, while bicep curls contribute to grip strength. A multidimensional approach integrating resistance band exercises, good morning drills, and bicep curls provides complementary benefits for improving hip toss technique skills in wrestling. These findings can serve as a foundation for coaches to design evidence-based training programs tailored to the specific needs of athletes.

Keywords: resistance band, good morning, bicep curl, hip toss, wrestling.

Introduction

Wrestling is a multidimensional sport that combines physical strength, technical skills, and psychological aspects to achieve optimal performance. Success in this sport is heavily influenced by dynamic strength, body composition, and aerobic endurance, which support rapid recovery and consistent performance during matches (Prokopczyk et al., 2024). The hip toss technique is a key wrestling skill that demands muscle strength, agility, and precise coordination (Mavropulo et al., 2022). However, developing this skill presents challenges, particularly in identifying the most effective training methods. One innovation in sports training is using resistance bands, which have been proven to enhance muscle strength and flexibility and reduce the risk of injury, especially in combat sports like judo and mixed martial arts (Sivaraman et al., 2024). Other exercises, such as the "good morning" drill and bicep curls, have long been recognized for their effectiveness in supporting postural stability and grip strength, both essential for mastering the hip toss technique (Ceylan, 2023; Franco-López et al., 2024). Nevertheless, most previous studies have evaluated the effects of these methods individually without exploring the synergistic potential of combining these approaches (Devi et al., 2022; Ross et al., 2024).

Resistance bands have become a versatile and effective training tool for various sports, including wrestling. They play a central role in enhancing performance, particularly in

combat sports that require balance, stability, and explosive strength (Ilahi et al., 2023; Ioannides et al., 2024). Resistance bands can improve shoulder muscle strength, flexibility, and injury prevention, crucial for sports involving dynamic movements, such as wrestling (Francino et al., 2022; Sivaraman et al., 2024). Research indicates that resistance band exercises also support core muscle development, enabling athletes to maintain optimal posture during complex techniques like the hip toss. This is achieved through more efficient energy transmission along the kinetic chain (Devis et al., 2022; Harmanci et al., 2024; Luo et al., 2022; Sabillah et al., 2022).

The good morning exercise is another method with significant benefits for developing the lower back, gluteus, and hamstring muscles. Studies indicate that this exercise can enhance postural stability during explosive movements, which is highly relevant for techniques like hip tosses in wrestling (Franco-López et al., 2024). The good morning exercise provides critical stability during explosive actions by strengthening the lower back, gluteus, and hamstrings. However, compared to other exercises, particularly in lifting and controlling opponents during wrestling, its effects remain underexplored (Franco-López et al., 2024; Ross et al., 2024). The bicep curl exercise plays a vital role in improving arm strength. Research shows that greater arm strength helps wrestlers control their opponents during hip tosses (Ceylan, 2023; Matkarimov et al., 2024). Improved arm strength not only enhances technical performance but also boosts athletes' confidence, leading to overall better performance (Cherara et al., 2022).

While the benefits of resistance band exercises, good morning drills, and bicep curls have been individually recognized, research examining the combination of these three methods in the context of hip toss techniques in wrestling remains scarce. Most studies have focused solely on the effectiveness of each technique (Bavaresco et al., 2023; Coratella et al., 2023; Janep et al., 2024; Nuzzo et al., 2023; Oranchuk et al., 2020) without exploring the interactions or synergies between these training forms. The lack of empirical evidence on how the combination of resistance bands, good morning drills, and bicep curls can enhance hip toss skills, especially when considering differences in athletes' initial strength levels, presents an opportunity for further exploration. Baseline strength plays a critical role in the effectiveness of training methods; athletes with higher strength levels may respond better to intensive exercises like good morning drills, whereas resistance bands offer optimal benefits for those with lower strength levels due to the adjustable resistance they provide (Hoseini et al., 2022; Sabillah, 2023). A commonly proposed solution is to integrate various training methods into a multidimensional program, combining their unique benefits to address the specific needs of athletes and maximize their performance.

This study aims to address gaps in the existing literature by employing a multidimensional approach to enhance hip toss techniques in wrestlers. The multifaceted approach integrates three training methods resistance band exercises, good morning drills, and bicep curls into a single training model to improve hip toss skills among wrestling athletes. This approach significantly contributes to the literature, which has predominantly focused on the individual effects of training methods on athletic performance (Francino et al., 2022; Ross et al., 2024). Using a 2x3 factorial design, this study not only compares the effectiveness of each training method individually but also explores the synergistic interactions among the three methods, with athletes' baseline strength levels as a moderating variable. This focus is particularly relevant, as differences in athletes' initial strength levels may influence their responses to specific training methods (Hoseini et al., 2022; Sabillah, 2023).

The novelty of this research lies in integrating three training methods in the context of hip toss techniques. Resistance bands, for instance, are widely recognized for their ability to improve dynamic strength, flexibility, and injury prevention (Francino et al., 2022; Ioannides et al., 2024). This study extends these benefits by evaluating their role in supporting explosive movements and muscle flexibility, which are critical for executing hip toss techniques. Good morning exercises effectively strengthen the lower back, gluteus, and hamstrings—muscles essential for body stability during explosive movements (Franco-López et al., 2024). Meanwhile, bicep curls, though simple, provide the grip strength necessary for optimal control over opponents during hip tosses (Ceylan, 2023). This study explores synergies primarily overlooked in prior research by combining these three methods.

Additionally, this study emphasizes the importance of athletes' baseline strength in determining the effectiveness of applied training methods. Athletes with higher strength levels are predicted to respond better to intensive exercises like good morning drills. In comparison, resistance bands offer greater flexibility and are more suitable for athletes with lower strength levels (Hoseini et al., 2022). Thus, the research contributes new insights into how training methods can be personalized to maximize outcomes for athletes with different physical characteristics. Furthermore, the study focuses on evaluating hip toss skills through three critical phases: the initial position, execution, and final position. Unlike previous research, which often assessed overall performance outcomes, this approach provides an in-depth analysis of the training's effectiveness at each stage of technique execution (Sabillah, 2023).

This study is expected to uncover the mechanisms by which resistance band exercises, good morning drills, and bicep curls holistically enhance athletic performance. Using a factorial design also represents a methodological innovation in this research. This design enables simultaneous analysis of the interactions between training methods and athletes' baseline strength levels, providing insights into how variations in training combinations affect hip toss technique skills. The findings can produce evidence-based guidelines for coaches to design more personalized and effective training programs for competitive-level wrestlers (Devi et al., 2022; Harmanci et al., 2024). This study complements previous findings and challenges the assumption that all training methods yield similar impacts regardless of athletes' physical characteristics. The unique contribution of this research lies in offering evidence-based guidance for coaches to develop more tailored and effective training programs, enhancing training outcomes, and supporting the advancement of multidimensional training strategies in wrestling.

Materials and Methods

Study Participants

The study population comprised 200 male students from the Department of Physical Education, Health, and Recre-

ation, Faculty of Sports and Health Sciences, Makassar State University, aged 20 years or older. This age selection was based on previous studies indicating that individuals at this stage have achieved stable physical development, enabling a more valid analysis of the effects of training on muscle strength (Ross et al., 2024; Sabillah et al., 2022). The sample was randomly selected using a randomized group design. In the first step, the population was randomized to select 123 participants. The participants were then categorized based on their initial strength scores measured using the Rotational Power Ball Throw test. The top 27 % of scores from each group were classified as high strength, while the lowest 27 % were categorized as low strength. Scores falling between these categories were excluded to minimize potential analytical bias. Each strength category was subsequently divided into three groups based on the training method, resulting in six experimental groups comprising 11 participants.

Table 1. Experimental sample grouping

Power (B)	Training Methods (A)			Total
	Resistance Band (A_1)	Good Morning (A_2)	Bicep Curl (A_3)	
High	11	11	11	33
Low	11	11	11	33
Total	22	22	22	66

Training Procedure and Instrument

The training program lasted six weeks, with three sessions per week, during which the duration and intensity were progressively adjusted to optimize results while minimizing the risk of injury. Before the program, all participants attended a detailed briefing on the training procedures, including execution techniques and training objectives. The presence of professional trainers during training sessions served as a control variable to ensure that all participants performed the exercises with proper technique. Trainer supervision not only ensured compliance with the protocols but also minimized injury risks and provided immediate feedback to enhance the quality of the training. Studies have indicated that direct supervision enhances training effectiveness by offering additional motivation and better technique corrections (Francino et al., 2022).

To enhance internal validity, external variables were strictly controlled. Participants were instructed not to engage in similar training outside the research program. Attendance at each training session was closely monitored, and participants missing more than two sessions were excluded from the study. The experimental groups were uniformly supervised to ensure all participants adhered to consistent protocols during the training sessions. The instruments used in this study included validated and reliable tools for assessing hip toss skills in wrestling performance (Roklicer et al., 2022). Skill assessments evaluated various aspects, such as technical accuracy (body positioning and opponent control), the strength of the toss, and the speed of execution. The hip toss skill test results were presented as an accumulated score derived from several evaluation indicators. The indicators for assessment focused on the movement patterns of the hip toss technique in wrestling, characterized by the following descriptors: 1) Both wrestlers start standing with their weight balanced between both feet. 2) The wrestlers grip each other's hands while pressing their heads against each other. 3) The technique begins with a rotation where the left arm moves over the opponent's shoulder and around their neck. 4) The wrestler then performs a lifting motion using the hips while bending forward. 5) The opponent is thrown forward. The technique concludes with the opponent pinned to the mat by applying body pressure. These detailed descriptors ensured a comprehensive evaluation of the hip toss technique, providing a robust framework for assessing skill improvement.

Study Organization

This study employed a factorial design as a systematic approach to evaluate the effects of various training variables on athletic performance, particularly in wrestling. The factorial design allows for the simultaneous examination of interactions between variables, providing an advantage in analyzing the combined effects of multiple factors, such as training intensity, recovery strategies, and nutritional patterns, on athletic performance (T. Wang et al., 2022). A 2×3 factorial design was used to observe the effects of resistance band exercises, good morning drills, and bicep curls on hip toss skills among wrestlers with high and low power levels. This approach enables an in-depth analysis of how training methods and power categories interact to improve hip toss skills (Esmailnezhad et al., 2024; Kalaycioglu et al., 2022). The factorial design in this study involved the combination of two main factors: training methods (resistance band, good morning, and bicep curl) and athletes' power levels (high and low).

Table 2. 2×3 factorial research design

Attribute Variables	Treatment Variable	Training Methods (A)		
		Resistance band (A_1)	Good Morning (A_2)	Bicep Curl (A_3)
Power (B)	High (B_1)	A_1B_1	A_2B_1	A_3B_1
	Low (B_2)	A_1B_2	A_2B_2	A_3B_2

Statistical Analysis

The research data were analyzed using analysis of variance (ANOVA) to evaluate the effects of training methods (resistance band, good morning, and bicep curl) and power levels (high and low) on hip toss skills. A 2×3 factorial ANOVA was employed to identify the main effects of the training methods and power levels and their interaction effects. This approach enables simultaneous analysis of multiple independent variables, comprehensively understanding each factor's contribution to the dependent variable. If the ANOVA results indicate significant differences ($p < 0.05$), a post hoc Tukey's Honest Significant Difference (HSD) test is conducted to determine which group pairs have substantial differences. The Tukey HSD test allows for precise mean comparisons across groups, making it possible to identify the most effective training method within specific categories (Pirruccio et al., 2022).

The application of the Tukey HSD test in this study aimed to evaluate several key aspects of hip toss skills in wrestling. These included differences between the resistance band training group and the good morning training group, between the resistance band training group and the bicep curl training group, and between the good morning training group and the bicep curl training group. The test also assessed the interaction effects between training methods and power levels on hip toss skills. Further analyses were conducted to explore differences within specific power categories. For students with high power levels, the Tukey HSD test compared the effectiveness of the resistance band training group with the good morning training group, the resistance band training group with the bicep curl training group, and the good morning training group with the bicep curl training group. Similarly, for students with low power levels, comparisons were made between the resistance band training group and the good morning training group, the resistance band training group and the bicep curl training group, and the good morning training group and the bicep curl training group. This comprehensive analysis aimed to provide detailed insights into the relative effectiveness of different training methods and their interactions with power levels in enhancing hip toss skills in wrestling.

Results

Descriptive analysis results indicate that the resistance band method (A_1) achieved the highest average score (Mean = 30.41) compared to good morning (A_2) (Mean = 25.45) and bicep curl (A_3) (Mean = 20.82), reaffirming its effectiveness in improving hip toss skills. Among athletes with high power, the resistance band method (A_1B_1) recorded the highest average score (Mean = 32.18) across all combinations, while it also remained superior in the low-power group (A_1B_2), with an average score of 25.36. The suitable morning method demonstrated moderate performance, with a higher average score than bicep curl in both the high-power group (Mean = 25.36) and the low-power group (Mean = 23.27), reflecting its contribution to enhancing postural stability. Conversely, the bicep curl method yielded the lowest average scores in both the high-power (Mean = 19.18) and low-power groups (Mean = 18.36), suggesting that while this method is less optimal for hip toss techniques, it remains relevant for improving grip strength.

Resistance band exercises demonstrated the best performance with the highest concentration of scores in the upper intervals (30-36). Specifically, 27.3 % of participants scored within the 30-32 and 33-36 intervals, indicating that this method is highly effective in enhancing complex explosive skills. The good morning method exhibited a more even distribution, with the highest frequency concentrated in the 25-28 interval (31.8 %), reflecting its role in improving postural stability, albeit less optimal for dynamic skills. For the bicep curl method, most participants scored in the mid-to-upper range (29-32), with the highest relative frequency of 45.5 %. This indicates that bicep curls primarily support arm muscle strength but are less relevant for improving the dynamic strength required for technical skills.

The resistance band method (A_1B_1) exhibited a balanced frequency distribution in the upper intervals, with the highest concentration in the 24-36 range (27.3 % in each interval of 24-27, 28-31, and 32-36). This indicates that resistance bands are highly effective in enhancing technical skills among athletes with high power, supporting optimal dynamic strength development. The good morning method (A_2B_1) showed the highest concentration in the 28-31 interval (36.4 %), underscoring its role in improving postural stability in the high-power group. However, its contribution to enhancing explosive skills was lower compared to resistance bands, with a more even distribution across the lower to middle intervals. Conversely, the bicep curl method (A_3B_1) had the highest concentration in the lower to middle intervals (19-22) with a relative frequency of 54.5 %. This suggests that bicep curls are less effective for improving dynamic skills but remain relevant for supporting arm muscle strength, which is beneficial for grappling techniques.

The resistance band method (A_1B_2) demonstrated the highest concentration in the upper interval (31-34), with the highest relative frequency of 54.5 %. This finding indicates that resistance bands remain effective in the low-power group, supporting the gradual development of dynamic skills through adjustable resistance tailored to the

Table 3. Descriptive statistics of hip toss skill test results

Group	Resistance band (A_1)	Good Morning (A_2)	Bicep Curl (A_3)	Resistance band HP (A_1B_1)	Good Morning HP (A_2B_1)	Bicep Curl HP (A_3B_1)	Resistance band LP (A_1B_2)	Good Morning LP (A_2B_2)	Bicep Curl LP (A_3B_2)
N	22	22	22	11	11	11	11	11	11
	0	0	0	11	11	11	11	11	11
Mean	30.41	25.45	20.82	32.18	25.36	19.18	25.36	23.27	18.36
Median	31.00	25.50	20.50	34.00	27.00	18.00	25.00	23.00	19.00
Mode	31	25	20	34	28	14	20	23	16
Std. D	4.19	6.12	4.15	4.85	5.03	4.89	5.92	3.82	2.87
Varian	17.59	37.49	17.20	23.56	25.26	23.96	35.06	14.62	8.26
Range	15	20	18	16	15	16	18	14	8
Min	21	16	14	20	16	14	16	18	14
Max	36	36	32	36	31	30	34	32	22
Sum	669	560	458	354	279	211	279	256	202

Table 4. Frequency distribution of hip toss skills by training method

Training Method	Interval Class			Lower Limit	Upper Limit	Freq. Absolute	Freq. Relative
Resistance Band	21	-	23	20.5	23.5	2	9.1 %
	24	-	26	23.5	26.5	3	13.6 %
	27	-	29	26.5	29.5	5	22.7 %
	30	-	32	29.5	32.5	6	27.3 %
	33	-	36	32.5	36.5	6	27.3 %
			Total			22	100 %
Good Morning	16	-	20	15.5	20.5	4	18.2 %
	21	-	24	20.5	24.5	4	18.2 %
	25	-	28	24.5	28.5	7	31.8 %
	29	-	32	28.5	32.5	3	13.6 %
	33	-	36	32.5	36.5	4	18.2 %
			Total			22	100 %
Bicep Curl	14	-	16	13.5	16.5	2	9.1 %
	17	-	20	16.5	20.5	3	13.6 %
	21	-	24	20.5	24.5	3	13.6 %
	25	-	28	24.5	29.5	4	18.2 %
	29	-	32	28.5	32.5	10	45.5 %
			Total			22	100 %

Table 5. Frequency distribution of hip toss skills by training method with high power

Training Method With High Power	Interval Class			Lower Limit	Upper Limit	Freq. Absolute	Freq. Relative
Resistance Band With High Power (A_1B_1)	20	-	23	19.5	23.5	2	18.2 %
	24	-	27	23.5	27.5	3	27.3 %
	28	-	31	27.5	31.5	3	27.3 %
	32	-	36	31.5	36.5	3	27.3 %
			Total			11	100 %
Good Morning With High Power (A_2B_1)	16	-	19	15.5	19.5	2	18.2 %
	20	-	23	19.5	23.5	3	27.3 %
	24	-	27	23.5	27.5	2	18.2 %
	28	-	31	27.5	31.5	4	36.4 %
			Total			11	100 %
Bicep Curl With High Power (A_3B_1)	14	-	18	13.5	18.5	3	27.3 %
	19	-	22	18.5	22.5	6	54.5 %
	23	-	26	24.5	26.5	1	9.1 %
	27	-	30	26.5	30.5	1	9.1 %
			Total			11	100 %

athletes' physical capabilities. The good morning method (A_2B_2) had the highest frequency concentration in the lower to the middle interval (18-21), with a relative frequency of 36.4 %, followed by two other middle intervals (22-25 and 26-29), each at 27.3 %. This distribution reflects that the good morning method improves postural stability but is less impactful in enhancing performance at higher score intervals. Conversely, the bicep curl method (A_3B_2) showed the most extensive distribution in the middle interval (20-22), with a relative frequency of 45.5 %, while the other intervals had lower frequencies. This confirms that bicep curls are less effective in supporting hip toss skills in the low-power group, though they benefit grip strength and arm muscle development.

The first main effect, namely the training method factor (A), significantly influenced hip toss skills ($F = 5.413$, $p = 0.007$). This indicates that variations in training methods lead to significant differences in skill outcomes. The second

Table 6. Frequency distribution of hip toss skills by training method with low power

Training Method With Low Power	Interval Class			Lower Limit	Upper Limit	Freq. Absolute	Freq. Relative
Resistance Band With Low Power (A_1B_2)	16	-	20	15.5	20.5	1	9.1 %
	21	-	25	20.5	25.5	1	9.1 %
	26	-	31	25.5	31.5	3	27.3 %
	31	-	34	30.5	34.5	6	54.5 %
			Total			11	100 %
Good Morning With Low Power (A_2B_2)	18	-	21	17.5	21.5	4	36.4 %
	22	-	25	21.5	25.5	3	27.3 %
	26	-	29	25.5	29.5	3	27.3 %
	30	-	32	29.5	32.5	1	9.1 %
			Total			11	100 %
Bicep Curl With Low Power (A_3B_2)	14	-	15	13.5	15.5	2	18.2 %
	16	-	17	15.5	17.5	3	27.3 %
	18	-	19	17.5	19.5	1	9.1 %
	20	-	22	19.5	22.5	5	45.5 %
			Total			11	100 %

Table 7. Summary of ANOVA results of hip toss skill data. Tests of between-subjects effects. Dependent variable: hip toss skill

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1729.212[a]	5	345.842	25.216	.000
Intercept	43171.879	1	43171.879	3147.751	.000
A	148.485	2	74.242	5.413	.007
B	1363.636	1	1363.636	99.426	.000
A * B	217.091	2	108.545	7.914	.001
Error	822.909	60	13.715		
Total	45724.000	66			
Corrected Total	2552.121	65			

a. R Squared = .678 (Adjusted R Squared = .651)

main effect, the power level factor (B), also showed a much more substantial influence (F = 99.426, p = 0.000), highlighting that athletes' baseline power plays a key role in hip toss performance. Based on the interaction effect, there was a significant interaction between training methods and power levels (F = 7.914, p = 0.001). This demonstrates that the effectiveness of training methods varies depending on the athletes' initial power levels. The results indicate that both independent factors (training methods and power levels) significantly affect hip toss skills, and their interaction underscores the importance of selecting training methods appropriate to the athletes' initial power levels.

Table 8. Results of the analysis of the interaction between training methods and power on hip toss skills

Interaction	F-count	F-table	Sig.	Explanation
Interaction A vs B	7.914	3.17	0.001	There is a interaction

There is a significant interaction between training methods (A) and power levels (B) on the hip toss skills of FIK UNM students (F-count = 7.914, F-table = 3.17, p = 0.001). The F-count value, which is greater than the F-table value, and the significance level of less than 0.05 indicate that the effects of training methods cannot be considered independent of athletes' power levels. In other words, the effectiveness of training methods is influenced by power levels, and vice versa, suggesting that these two variables interact in influencing hip toss skill outcomes. To better illustrate the interaction between training methods and power levels on hip toss skills in the Department of Physical Education, Health, and Recreation students, refer to the following figure:

Among the primary groups, the resistance band (A_1) showed significantly better results compared to good morning (A_2) (MD = 5.000, p = 0.007) and bicep curl (A_3) (MD = 9.636, p < 0.001). This indicates that resistance band exercises are the most effective method for improving hip toss skills. Good morning exercises also showed a significant advantage over bicep curls (MD = 4.636, p = 0.017), emphasizing their role in supporting postural stability. In

Table 9. Advanced ANOVA results with tukey test

Hypothesis Groups Compared		Mean Difference (I-J)	Std. Error	Sig.	95 % Confidence Interval		Exp.
(I) Group	(J) Group				Lower Bound	Upper Bound	
A_1	A_2	5.000*	1.319	.007	.84	9.16	There Is a Difference
A_1	A_3	9.636*	1.319	.000	5.47	13.80	There Is a Difference
A_2	A_3	4.636*	1.319	.017	.47	8.80	There Is a Difference
A_1B_1	A_2B_1	6.364*	1.865	.024	.47	12.25	There Is a Difference
A_1B_1	A_3B_1	4.182	1.865	.386	-1.71	10.07	There Is a Difference
A_2B_1	A_3B_1	-2.182	1.865	.961	-8.07	3.71	No Difference
A_1B_2	A_2B_2	-1.818	1.865	.987	-7.71	4.07	No Difference
A_1B_2	A_3B_2	3.091	1.865	.771	-2.80	8.98	No Difference
A_2B_2	A_3B_2	4.909	1.865	.184	-.98	10.80	There Is a Difference

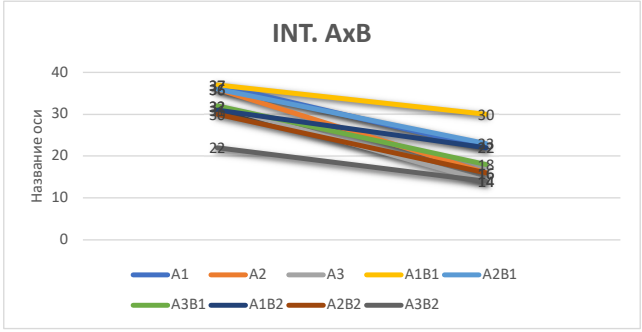

Fig. 1. Interaction between resistance band training, bicep curl training, and power levels on hip toss skills

the combination of training methods and high-power levels, resistance band (A_1B_1) demonstrated a significant difference compared to good morning (A_2B_1) (MD = 6.364, p = 0.024), but no significant difference compared to bicep curls (A_3B_1) (MD = 4.182, p = 0.386). Furthermore, no significant difference was found between good morning (A_2B_1) and bicep curl (A_3B_1) (MD = -2.182, p = 0.961), suggesting similar effectiveness of these two methods within the high-power group. In the low-power group, no significant differences were observed between the resistance band (A_1B_2) and good morning (A_2B_2) (MD = -1.818, p = 0.987) or bicep curl (A_3B_2) (MD = 3.091, p = 0.771). However, good morning exercises (A_2B_2) showed an almost significant advantage over bicep curls (A_3B_2) (MD = 4.909, p = 0.184).

Discussion

The research findings in Table 9 indicate that the training methods of resistance band exercises, good morning drills, and bicep curls have a significant impact on improving hip toss skills in wrestlers, with effectiveness varying based on the athletes' initial power levels. Resistance band training proved the most effective, particularly for athletes with high power, by enhancing dynamic strength and muscle flexibility crucial for executing hip toss techniques. The good morning exercise significantly contributed to postural stability and strengthening of the posterior chain, while bicep curls improved grip strength, which is essential for grappling techniques (Nguyen et al., 2023; Nuzzo et al., 2023; Peres et al., 2023; Ross et al., 2024).

In Table 9, The interaction between resistance band training and high-power levels yielded the best results compared to other combinations. Athletes with high power tend to have more muscular foundational strength, enabling them to effectively utilize the variable resistance provided by resistance bands (Arifin et al., 2024; Kusumawati et al., 2022; Novak et al., 2023). This resistance facilitates intensive training, significantly enhancing dynamic strength and technical skills. The good morning exercise also produced positive results in the high-power group, though its effectiveness was lower than resistance bands. High-power athletes benefited from the postural stability reinforcement provided by the good morning exercise, which supports body control during hip toss techniques (Ross et al., 2024). However, due to the lack of direct contribution to dynamic strength, its results were more limited than resistance band training.

In Table 9, Resistance band training maintained its superiority in the low-power group compared to other methods. The adjustable resistance allows athletes with low power to progressively train their strength without the risk of injury from excessive loads (Gupta et al., 2022; Long et al., 2024; Shadgan et al., 2024). The ability of resistance bands to target multiple muscle groups simultaneously offers a significant advantage in the context of technical skills. The good morning exercise showed moderate results in the low-power group. While effective for strengthening the posterior chain, its limitations in providing comprehensive muscle reinforcement make it less ideal for athletes with low power. The postural stability developed through good morning exercises may not be sufficient to support significant improvements in hip toss skills. Based on these comparisons, resistance band training consistently proved superior across all conditions, whether in high-power or low-power groups. The good morning exercise significantly contributed to postural stability, particularly in the high-power group, while bicep curls were more relevant as a supplementary exercise to support grip strength.

The findings of this study provide valuable insights into the advantages of resistance band training, which was proven to be the most effective method for improving hip toss skills

in both high-power and low-power groups. This advantage aligns with previous research showing that resistance bands offer variable resistance, allowing for better neuromuscular adaptation than traditional training methods (Devi et al., 2022; Woo et al., 2024). Resistance bands also facilitate the dynamic strength development required for explosive movements such as the hip toss (Francino et al., 2022).

This study reinforces evidence that resistance bands are a flexible training tool suitable for athletes across various skill levels. They allow a wide range of motion and adjustable resistance, making them adaptable to the specific needs of each athlete. This adaptability makes resistance bands ideal for dynamic strength development, especially in competitive sports (Long et al., 2024). Additionally, resistance bands support functional strength and balance two critical components in dynamic strength development. This has also been demonstrated in research involving broader populations, including older adults (Davis et al., 2022; Hejazi et al., 2024; Konukman et al., 2022).

The findings of this study align with previous literature highlighting the advantages of resistance bands in enhancing dynamic strength. (Sivaraman et al., 2024) emphasize that resistance bands effectively target core and shoulder muscles, critical for explosive movements such as hip tosses in wrestling. Resistance bands have also been proven to support flexibility and injury prevention, making them an ideal training tool for athletes with varying levels of initial strength (Wang, 2024; Wangi, 2023). The good morning exercise has long been recognized as an effective method for strengthening the posterior chain. Research by (Franco-López et al., 2024) shows that this exercise enhances postural stability, which is crucial for maintaining body balance during dynamic techniques. While this is important for executing hip tosses, its results in improving dynamic strength were lower than resistance band training (Ross et al., 2024).

On the other hand, bicep curls provide significant benefits in improving grip strength, though their contributions to dynamic movements and postural stability are more limited. Bicep curls strengthen the biceps brachii and brachioradialis muscles, which are critical in enhancing grip strength. Ceylan (2023) notes that improved grip strength helps athletes control opponents during grappling techniques. However, the findings of this study suggest that bicep curls are better suited as a complementary exercise in a multidimensional training program.

The implications of this study's findings are significant for designing multidimensional training programs in wrestling. Resistance band training can serve as the core component of such programs, as it substantially improves dynamic strength and flexibility. Coaches can utilize resistance bands to train explosive movements relevant to hip toss techniques, as outlined by (Wang et al., 2023). Studies by (Ross et al., 2024) emphasize the importance of body stability in maintaining balance during hip toss techniques. Incorporating good morning exercises as a complement to resistance bands can effectively strengthen core muscles, supporting stability during dynamic movements.

Bicep curls can be incorporated to enhance grip strength and arm power, which are crucial for grappling techniques and contribute directly to grip performance (Sabillah et al., 2022). This aligns with findings by (Ceylan, 2023), who highlighted that greater grip strength boosts confidence and control over opponents. Furthermore, research suggests that variations of the bicep curl, such as the reverse grip curl, can increase maximum arm strength, benefiting control during grappling and throwing techniques (Dereshgi, 2023). Different grip positions in these exercises influence muscle activation patterns, allowing for muscle strengthening tailored to the specific demands of combat sports (Coratella et al., 2023). Thus, combining these training methods provides a holistic approach to improving hip toss skills in wrestlers, addressing dynamic strength and sport-specific needs.

Integrating resistance bands, good morning exercises, and bicep curls offers a comprehensive approach to improving hip toss skills. Resistance bands enhance dynamic strength, good morning exercises improve postural stability, and bicep curls strengthen grip, creating a synergy that enhances overall performance. This study demonstrates that this multidimensional approach can be applied across various martial arts disciplines, such as judo and taekwondo, to improve sport-specific technical skills. Training programs incorporating these methods should consider athletes' initial strength levels and individual needs. Athletes with high power may benefit from prioritizing resistance bands and good morning exercises, while those with low power gain the most from resistance band training to build a more muscular foundational strength (Rusmi, 2023). This tailored approach ensures optimal outcomes for athletes across different strength levels and disciplines.

Conclusions

This study demonstrates that the training methods of resistance bands, good morning exercises, and bicep curls significantly impact improving hip toss skills in wrestlers. Resistance bands were the most effective method for enhancing dynamic strength and muscle flexibility, particularly for high-power athletes. The good morning exercise supports postural stability and strengthens the posterior chain, which is essential for maintaining body balance during hip toss techniques. Meanwhile, bicep curls significantly improve grip strength, although their influence on explosive movements and overall body stability is limited. These findings emphasize the importance of a multidimensional training approach in wrestling, where integrating resistance bands, good morning exercises, and bicep curls provide complementary benefits to enhance technical skills. The study also highlights that athletes' initial strength levels affect their response to training methods, with resistance bands showing flexibility for use by both high- and low-power athletes.

Coaches and athletes are encouraged to prioritize resistance bands as a primary training method in programs designed to enhance dynamic strength and muscle flexibility, particularly for explosive movements such as hip tosses. Resistance bands can be effectively combined with good morning exercises to improve postural stability and strengthen the posterior chain. At the same time, bicep curls should be included to boost grip strength, especially for grappling techniques. Training intensity and duration should be tailored to the athlete's initial strength levels to maximize results. For future research, it is essential to explore the effectiveness of these training methods in more diverse populations, including professional athletes, adolescents, and individuals

with specific conditions such as injuries. Studies of longer duration are also recommended to evaluate the long-term impact of these training methods. Additionally, incorporating advanced technologies like motion capture or wearable sensors could facilitate deeper biomechanical analyses of hip toss techniques, providing further insights into training effectiveness. Training centers should consider integrating a multidimensional approach into their wrestling training curriculums, combining various methods that address the specific needs of their athletes. Furthermore, additional training for coaches is essential to effectively implement resistance bands, good morning exercises, and bicep curls, leveraging evidence-based practices. By adopting these strategies, wrestling programs can significantly improve athletes' technical skills in executing hip toss techniques, leading to enhanced competition performance.

Conflict of Interest

The authors declare that they have no conflicts interests.

References

Prokopczyk, A., Sokołowski, M. & Witkowski, K. (2024). Effect of Body Composition on Aerobic Capacity Level and Post-Workout Restitution during the Training Camp Preparing for the European Wrestling Cadet Men's Championships. *Applied Sciences (Switzerland), 14*(13). https://doi.org/10.3390/app14135533

Mavropulo, O., Demyanova, L., Ryzhkin, N., Usova, I. & Aldoshin, A. (2022). Analysis of the competitive activity of qualified judoists in standing wrestling. *BIO Web of Conferences,* 48. https://doi.org/10.1051/bioconf/20224801017

Sivaraman, C., Rajkumar, N. C. J., Sanjaykumar, S., Kalmykova, Y., Pomeshchikova, I. & Lebediev, S. (2024). Efficacy of Resistance Band Training on Shoulder Muscle Strength and Injury Prevention in Volleyball Athletes. *Slobozhanskyi Herald of Science and Sport, 28*(3), 116-121. https://doi.org/10.15391/snsv.2024-3.003

Ceylan, B. (2023). The Relationship Between Judo Specific Test Performances and Physical Fitness in Prepubescent Male Judo Athletes. *Revista De Artes Marciales Asiáticas, 18*(1), 12-22. https://doi.org/10.18002/rama.v18i1.7400

Franco-López, F., Durkalec-Michalski, K., Díaz-Morón, J., Higueras-Liébana, E., Hernández-Belmonte, A. & Courel-Ibáñez, J. (2024). Using Resistance-Band Tests to Evaluate Trunk Muscle Strength in Chronic Low Back Pain: A Test–Retest Reliability Study. *Sensors, 24*(13). https://doi.org/10.3390/s24134131

Devi, S. N., Fauzi, F., Sukamti, E. R., Tirtawirya, D. & Prabowo, T. A. (2022). The Effect of 8 Weeks of Training With Resistance Band on Limb Power of Taekwondo Athletes. *International Journal of Multidisciplinary Research and Analysis, 05*(12). https://doi.org/10.47191/ijmra/v5-i12-27

Ross, S., Comfort, P. & McMahon, J. (2024). The Good Morning - Exercise Technique and Exercise Selection Principles. Strength and Conditioning Journal, 46(3), 378–382. https://doi.org/10.1519/SSC.0000000000000802

Ilahi, B. R., Okilanda, A., Raibowo, S., Yarmani, Y., Sugihartono, T., Syafrial, S., Nopiyanto, Y. E., Hiasa, F., Ihsan, N. & Putra, J. (2023). The Effect of Resistance Bands Rubber Spring Exercise on the Front Kick Speed of Adolescent Pencak Silat Women. *International Journal of Human Movement and Sports Sciences, 11*(2), 418-423. https://doi.org/10.13189/saj.2023.110219

Ioannides, C., Despotopoulou, C., Hadjicharalambous, M. & Zaras, N. (2024). Effects of Warm-Ups with Weighted Vests and Resistance Bands on Physical Fitness and Combat Ability of Kumite Karate Athletes. *Sports, 12*(3). https://doi.org/10.3390/sports12030079

Francino, L., Villarroel, B., Valdés-Badilla, P., Ramírez-Campillo, R., Martín, E. B., Ojeda-Aravena, A., Aedo-Muñoz, E., Pardo-Tamayo, C. & Herrera-Valenzuela, T. (2022). Effect of a Six Week in-Season Training Program on Wrestling-Specific Competitive Performance. *International Journal of Environmental Research and Public Health, 19*(15), 9325. https://doi.org/10.3390/ijerph19159325

Davis, N. M., Pringle, A., Kay, A. D., Blazevich, A. J., Teskey, D., Faghy, M. A. & Mina, M. A. (2022). Feasibility, Psychosocial Effects, Influence, and Perception of Elastic Band Resistance Balance Training in Older Adults. *International Journal of Environmental Research and Public Health, 19*(17). https://doi.org/10.3390/ijerph191710907

Harmanci, H., Demirel, P., Koç, H. & Tekin, R. (2024). Effects of plyometric warm-up performed with different resistances on jumping performance as post-activation potentiation. *Journal of Human Sport and Exercise, 19*(4), 1130-1138. https://doi.org/10.55860/6n4vq665

Luo, S., Soh, K. G., Nasiruddin, N. J., Sun, H., Du, C. & Soh, K. L. (2022). Effect of Core Training on Skill Performance Among Athletes: A Systematic Review. *Frontiers in Physiology,* 13. https://doi.org/10.3389/fphys.2022.915259

Sabillah, M I, Nasrulloh, A. & Yuniana, R. (2022). The effect of plyometric exercise and leg muscle strength on the power limb of wrestling athletes. *Journal of Physical Education and Sport, 22*(6), 1403-1411. https://doi.org/10.7752/jpes.2022.06176

Matkarimov, R., Korobeynikov, G., Tropin, Y., Biletska, V., Curby, D., Dokmanac, M. & Kerimov, F. (2024). Indicators of Spectacle in Wrestling at the 2021 Olympic Games. *Slobozhanskyi Herald of Science and Sport, 28*(1), 38-43. https://doi.org/10.15391/snsv.2024-1.005

Cherara, L., Adel, B., Mesaliti, L. & Beboucha, W. (2022). Characteristics of Handgrip (Kumi-Kata) Profile of Georgian Elite Judo Athletes. *Gymnasium, 23*(1), 54-66. https://doi.org/10.29081/gsjesh.2022.23.1.04

Bavaresco Gambassi, B., Nobre, I., Prazeres, J., De Melo, M. H., Bianco, R., Novais, T. M., Oliveira, P. D. L., Souza, T. A., Ribeiro, M. J. & Schwingel, P. A. (2023). Impact of dynamic explosive resistance exercise with elastic bands on pulse pressure in hypertensive older adults: a randomized crossover study. *Blood Pressure Monitoring, 28*(4), 208-214. https://doi.org/10.1097/MBP.0000000000000650

Coratella, G., Tornatore, G., Longo, S., Esposito, F. & Cè, E. (2023). Bilateral Biceps Curl Shows Distinct Biceps Brachii and Anterior Deltoid Excitation Comparing Straight vs. EZ Barbell Coupled with Arms Flexion/No-Flexion. *Journal of Functional Morphology and Kinesiology, 8*(1). https://doi.org/10.3390/jfmk8010013

Janep, M., Marsal, M. Z., Malek, N. F. A., Lee, E. L. Y., Tan, K., Pratama, R. S. & Nadzalan, A. M. (2024). Electromyographic activation and performance analysis during three sets of bicep curl exercises among untrained women. *AIP Conference Proceedings, 2750*(1). https://doi.org/10.1063/5.0148595

Nuzzo, J. L., Pinto, M. D. & Nosaka, K. (2023). Muscle fatigue during maximal eccentric-only, concentric-only, and eccentric-concentric bicep curl exercise with automated

drop setting. *Scandinavian Journal of Medicine and Science in Sports, 33*(6), 857-871. https://doi.org/10.1111/sms.14330

Oranchuk, D. J., Ecsedy, E. N. & Robinson, T. (2020). Effects of a Sport-Specific Upper-Body Resistance-Band Training Program on Overhead Throwing Velocity and Glenohumeral Joint Range of Motion. *The Journal of Strength and Conditioning Research, 35*(11), 3097-3103. https://doi.org/10.1519/jsc.0000000000003303

Hoseini, A., Zarei, M., Nobari, H., Hovanloo, F., Abbasi, H. & Pérez-Gómez, J. (2022). Isokinetic muscle strength cannot be related to the odds ratio of musculoskeletal injuries in young elite wrestlers. *BMC Sports Science, Medicine and Rehabilitation, 14*(1). https://doi.org/10.1186/s13102-022-00423-3

Sabillah, M. I., Tomoliyus, Nasrulloh, A., Dev Omar Dev, R., & Fauzi. (2023). The Effect of the Pyramid Exercise Method on the Maximum Strength of the Wrestler's Arm Muscles. *Physical Education Theory and Methodology, 23*(4), 512–519. https://doi.org/10.17309/tmfv.2023.4.04

Roklicer, R., Rossi, C., Bianco, A., Stajer, V., Ranisavljev, M., Todorovic, N., Manojlovic, M., Gilic, B., Trivic, T. & Drid, P. (2022). Prevalence of rapid weight loss in Olympic style wrestlers. *Journal of the International Society of Sports Nutrition, 19*(1), 593-602. https://doi.org/10.1080/15502783.2022.2119095

Wang, T., Liu, Y.-X. & Weng, Z. (2022). Core Strength Training in University Female Tennis Players. *Revista Brasileira De Medicina Do Esporte, 28*(6), 651-653. https://doi.org/10.1590/1517-8692202228062022_0087

Esmailnezhad, S., Daneshmandi, H., Samami, N. & Mirzaei, B. (2024). The Effect Of The Wrestling+ Warm-Up Program On Balance And Proprioception Of Adolescent Wrestlers. *Journal of Kinesiology and Exercise Sciences, 34*(107), 45-52. https://doi.org/10.5604/01.3001.0054.6754

Kalaycioglu, T., Apostolopoulos, N. C., Yurt, Y. & Tunay, V. B. (2022). The effectiveness of different ankle strengthening training programs on performance. *Journal of Sports Medicine and Physical Fitness, 62*(4), 435-447. https://doi.org/10.23736/S0022-4707.21.12130-9

Nguyen, P. K., Nguyen, A. T., Doan, T. B., Trung, P. N. & Thi, N. D. (2023). Assessing Bicep Curl Exercises by Human Pose Application: A Preliminary Study. *Lecture Notes in Networks and Systems,* 648 LNNS, 581-589. https://doi.org/10.1007/978-3-031-27524-1_55

Peres, A. B., Espada, M. C., Santos, F. J., Robalo, R. A. M., Dias, A. A. P., Muñoz-Jiménez, J., Sancassani, A., Massini, D. A. & Pessôa Filho, D. M. (2023). Accuracy of Hidden Markov Models in Identifying Alterations in Movement Patterns during Biceps-Curl Weight-Lifting Exercise. *Applied Sciences (Switzerland), 13*(1). https://doi.org/10.3390/app13010573

Arifin, Z., Amrullah, R., Suhairi, M., Sari, S. & Aji, T. (2024). The Effect of Using Body Chest Rig Resistance Band on Students-Athletes Strength in Pontianak. *International Journal of Human Movement and Sports Sciences, 12*(6), 993-1000. https://doi.org/10.13189/saj.2024.120610

Kusumawati, M., Hidayat, I. I., Haqiyah, A. & Subarno, L. (2022). The effects of forearm resistance band training on the throwing velocity of male handball players. *Journal of Physical Education and Sport, 22*(11), 2879-2885. https://doi.org/10.7752/jpes.2022.11364

Novak, D., Loncar, I., Sinkovic, F., Barbaros, P. & Milanovic, L. (2023). Effects of Plyometric Training with Resistance Bands on Neuromuscular Characteristics in Junior Tennis Players. *International Journal of Environmental Research and Public Health, 20*(2). https://doi.org/10.3390/ijerph20021085

Gupta, P., Dhanireddy, K., Vemulapalli, K., Amdur, R. & Paul, G. (2022). Spinal injuries in high school men's wrestling. *PM and R, 14*(10), 1303-1305. https://doi.org/10.1002/pmrj.12688

Long, C., Ranellone, S. & Welch, M. (2024). Strength and Conditioning in the Young Athlete for Long-Term Athletic Development. *HSS Journal, 2*0(3), 444-449. https://doi.org/10.1177/15563316241248445

Shadgan, B., Molavi, N., Abaeva, E., Falahati, S., Sikimic, S., Konstantinou, L. & Molnar, S. (2024). Wrestling injuries during the 2016 Rio and 2020 Tokyo Olympic Games. *British Journal of Sports Medicine, 58*(15), 818-825. https://doi.org/10.1136/bjsports-2023-108056

Woo, S.-C., Chen, M.-Y., Chen, L.-K. & Liu, C.-Y. (2024). Effectiveness of Resistance Band Use in Conjunction With Tai Chi Among Older Adults With Prefrailty to Improve Functional Fitness, Quality of Life, and Heart Rate Variability. *Journal of Gerontological Nursing, 50*(5), 19-26. https://doi.org/10.3928/00989134-20240416-04

Hejazi, K., Nezamdoost, M., Azim Nasab, R., Shiri, N. & Toghdari, A. (2024). The Effects of Eight Weeks of Plyoball and Resistance Band Training on Glutathione Peroxidase and Malondialdehyde in Handball Players. *Physical Treatments, 14*(2), 83-92. https://doi.org/10.32598/ptj.14.2.260.2

Konukman, F., Filiz, B., Tufekcioglu, E., Afrouzeh, M., Ghayebzadeh, S. & Erdogan, M. (2022). Coaching Resistance Bands Training for Children during COVID-19. *Strategies, 35*(3), 46-49. https://doi.org/10.1080/08924562.2022.2052548

Wang, Y. (2024). Impact of Resistance Exercise Program on Muscle Strength, Cardiopulmonary Function and Glycolipid Metabolism of Bedridden Population Aged 80 Years and Above: A Randomized Controlled Trial. *Medicine, 103*(24), e38412. https://doi.org/10.1097/md.0000000000038412

Wangi, S. P. (2023). The Effect of 8 Weeks of Punch Resistance Band and Dumbbell Training on the Arm Power of 'Youth' Male Boxers. *International Journal of Physical Education Sports and Health, 1*0(5), 299-304. https://doi.org/10.22271/kheljournal.2023.v10.i5e.3120

Wang, Q., Chen, W., Wan, Z. & Liu, W. (2023). Clonal Outbreak of Trichophyton tonsurans Causing Tinea Capitis Among a Wrestling Team in Beijing, China. *Mycopathologia, 188*(5), 537-544. https://doi.org/10.1007/s11046-022-00689-8

Dereshgi, H. A. (2023). The Rest-Pause Biceps Curl Exercise Effect on Biceps Brachii Muscle of Women: A Study of Mechanical Responsiveness. *Ieee Access,* 11, 116967-116978. https://doi.org/10.1109/access.2023.3325669

Rusmi, R. (2023). Resistance Band Training to Increase the Arm Muscles Strength in Swimming Athletes. *Juara Jurnal Olahraga, 8*(1), 24-35. https://doi.org/10.33222/juara.v8i1.2583

Встановлення взаємозв'язку між тренувальнами методами та рівнями показників потужності у спортивній боротьбі: Факторний дизайн 2×3 щодо навичок виконання кидка через стегно

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 11 с., 9 табл., 1 рис., 45 джерел.

Мета дослідження. Це дослідження мало на меті визначити вплив виконання комплексу вправ з еспандером, тренувань "Good morning" (нахили корпусу зі штангою на спині) та згинання рук на біцепс щодо покращення техніки кидка через стегно у спортсменів-борців, враховуючи їхній початковий рівень показників потужності.

Матеріали та методи. У цьому дослідженні застосовано факторний дизайн 2×3 із залученням 66 студентів чоловічої статі, яких було згруповано за рівнем показників потужності (високий і низький) та методами тренування. Тренування проводилися протягом шести тижнів із частотою трьох щотижневих занять. Параметри, що вимірювалися, включали в себе вдосконалення навичок техніки кидка через стегно, в тому числі показників сили, стабільності та швидкості виконання. Аналіз даних проведено із застосуванням методу дисперсійного аналізу (ANOVA) та тесту Тьюкі з метою оцінки достовірних відмінностей між групами.

Результати. Результати показали суттєвий основний вплив фактору методу тренування (A) на навички виконання кидка через стегно ($F = 5{,}413$; $p = 0{,}007$), демонструючи, що варіації в методах тренування призвели до помітних відмінностей у показниках володіння цими навичками. Другий основний ефект, рівень потужності (B), виявив більш істотний вплив ($F = 99{,}426$; $p = 0{,}000$), що свідчить про ключову роль вихідного рівня розвитку потужності спортсменів у визначенні результативності виконання кидка через стегно. Щодо ефекту взаємодії, встановлено значний взаємозв'язок між методами тренування та рівнями показників потужності ($F = 7{,}914$; $p = 0{,}001$).

Висновки. За результатами цього дослідження можна стверджувати, що вправи з еспандером є найефективнішим методом підвищення динамічної сили та гнучкості для спортсменів з високими показниками потужності, необхідними для виконання техніки кидків через стегно. Вправа "Good morning" забезпечує ефективну підтримку постуральної стабільності, а згинання рук на біцепс сприяє зміцненню сили хвату. Багатовимірний підхід, що поєднує вправи з еспандером, нахили зі штангою на спині та згинання рук на біцепс, надає додаткові переваги щодо вдосконалення навичок техніки виконання кидка через стегно у спортивній боротьбі. Отримані дані можуть слугувати основою для розроблення тренерами науково обґрунтованих тренувальних програм з урахуванням конкретних потреб спортсменів.

Ключові слова: еспандер, вправа "Good morning", згинання рук на біцепс, кидок через стегно, спортивна боротьба.

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