International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (6), November-December 2023, pages 425-436. Old ISSN 2774-0366: New ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2023.3756

Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes

[1]Gong Huiping, [2]Suvachai Rittisom, and [3] Prakit Hongsaenyatham
[1,2,3] Faculty of Sports Science and Technology Bangkokthonburi University, Thailand
[1] E-mail: 591342989@qq.com, ORCID ID: https://orcid.org/0009-0006-1803-5537
[2] E-mail: chaivasu5348@gmail.com, ORCID ID: https://orcid.org/0009-0006-6435-8804
[3] E-mail: prakitsport@gmail.com, ORCID ID: https://orcid.org/0009-0009-2196-0258

Received 16/10/2023 Revised 21/10/2023 Accepted 28/10/2023

Abstract

Background and Aim: Core strength exercises have become a focus in sports performance and injury prevention research. The core muscles, which include the diaphragm, abdominal muscles, and pelvic floor muscles, are instrumental in providing stability and power during athletic activities. The study focuses on the impact of core strength exercises on specific performance metrics—namely, the standing long jump and rebound jump—in martial arts athletes.

Materials and Methods: The study employs a structured, eight-week intervention program to investigate the effects of core exercises on martial arts athletic performance. The study involves forty student-athletes from Guangzhou Sport University, divided into an Experimental Group (EG) and a Control Group (CG). Various physical tests are conducted both pre- and post-intervention to measure the effects. Statistical analyses, including Two-way ANOVA, are used to interpret the data.

Result: For the standing long jump, the Two-way ANOVA showed no significant effect of training (F=1.129, p=0.291) or time point (F=0.587, p=0.446). Effect sizes, measured by Cohen's d, indicate a slight benefit in the core reinforcement group with a value of d=0.425, compared to d=0.111 in the non-reinforcement group. In the case of the rebound jump index, there is a pronounced effect from the group (F=4.92, p=0.03) and the time point (F=105.97, p<0.001). Large effect sizes were observed, with d=2.5522 for the core reinforcement group and d=2.0457 for the no core reinforcement group.

Conclusion: For standing Long Jump: Given the absence of a significant impact of core reinforcement on this metric, coaches, and athletes might consider incorporating other methodologies, such as plyometrics or attentional focus strategies, into their training regimen. For the rebound Jump Index: Core reinforcement exercises should be strongly considered for inclusion in warm-up routines for martial arts athletes, given the substantial effect size observed.

Keywords: Core Exercises; Martial Arts Performance; Standing Long Jump; Rebound Jump

Introduction

Core strength exercises have become a focus in sports performance and injury prevention research. The core muscles, which include the diaphragm, abdominal muscles, and pelvic floor muscles, are instrumental in providing stability and power during athletic activities. These exercises are particularly relevant for martial arts athletes, who require enhanced performance in specific skills like the standing long jump and rebound jump.

Several studies (Feng, 2023a; Lestari et al., 2020; Prieske, Muehlbauer, & Granacher, 2016) have substantiated the benefits of core stability exercises for athletes. For instance, research on male volleyball athletes indicated that core stability exercises significantly increased core muscle strength and positively influenced overall performance. Similarly, a study on adolescents suggested that core strength training on stable surfaces led to improved physical fitness. Additional research has emphasized the role of core training in enhancing physical stability and flexibility. Tao L et al. found that core strength training improved the physical stability of juvenile martial arts athletes. Another study indicated that core exercises positively affected flexibility in Kung Fu athletes (Feng, 2023).

Furthermore, core strength exercises have been demonstrated to improve jump performance. A study involving female handball players showed that core training programs significantly increased bilateral jump height and reactive strength index. Research on elite youth soccer players revealed that core strength exercises, especially those performed on unstable surfaces, resulted in improvements in neuromuscular and athletic performance.

Citation
Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756

International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (6), November-December 2023, pages 425-436. Old ISSN 2774-0366: New ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2023.3756

Warm-up routines are pivotal in preparing athletes for optimal performance. A study involving elite male collegiate handball players compared the effects of traditional warm-up protocols with those involving core stability and elastic band exercises, revealing that core stability exercises in the warm-up positively influenced athletic performance.

While core strength exercises offer numerous benefits, it is essential to consider their integration into warm-up routines carefully. Some evidence suggests that active static stretching exercises may hurt certain performance parameters, such as vertical and long jumps, particularly in younger athletes.

Incorporating core stability exercises into warm-ups improves neuromuscular control and reduces the risk of injury, which in turn improves athletic performance (Willardson, 2007) athletic performance, there is still a gap in understanding the specific performance of core strength in competitive martial arts athletes. This study aims to fill this gap by assessing whether incorporating core strength exercises into warm-up routines enhances these specific performances in martial arts athletes. Core strength exercises offer several benefits in enhancing athletic performance, including improvements in core muscle strength, physical stability, flexibility, and jump performance. This study seeks to extend the current understanding by investigating the efficacy of these exercises in the warm-up routines of martial arts athletes, aiming to optimize their performance and reduce injury risk.

Objectives

To assess the impact of core strength exercises on standing long jump and rebound jump performance in martial arts athletes during warm-up.

Literature Review

1. Assess the impact of core strength exercises on standing long jump and rebound jump performance in martial arts athletes during warm-up

Core strength exercises have been shown to significantly impact the performance of martial arts athletes in various capacities. The relevance of core training extends to several athletic performance variables, including, but not limited to, standing long jump and rebound jump.

Li & Du (2023) conducted an elaborate study on martial arts athletes, employing a randomized controlled trial design. They found that core strength exercises, particularly planking and rotational movements, significantly improved the core muscle stability of the participants. This finding indicates that incorporating core strength training into the warm-up routine of martial arts athletes can enhance their overall stability, which is a critical factor in achieving better performance in standing long jump and rebound jump.

Feng (2023) took a slightly different angle by investigating the influence of abdominal core strengthening on flexibility in Kung Fu athletes. While the primary focus was not on jumping performance, the study emphasized the role of core strength training in augmenting physical stability. This is crucial because stability is a foundational component for executing various movements in martial arts, including jumps. Hence, a plausible link suggests that core strength exercises could enhance performance in standing long jumps and rebound jumps.

Ferri-Caruana et al. (2022) conducted a study focusing on female handball players. They used a six-week core training program consisting of planks, side planks, and Russian twists. The results demonstrated significant improvements in vertical jump performance. Though not directly related to martial arts, this study's findings are translatable, suggesting that a structured core training regimen could be beneficial for martial arts athletes in improving their standing long jump and rebound jump performance.

Prasetyo et al. (2023) explored the nuanced relationship between balance, hand grip strength, and archery ability. The study employed balance tests and identified specific exercises like bracing maneuvers, bridges, quadruped bird dogs, and modified curl-ups as effective for improving core muscle strength. While the study did not directly measure jump performance, it elucidated the critical role of core strength in maintaining balance, which is an essential factor in executing a successful jump.

Porter et al. (2013) provided additional insights into jump performance by showing that directing attention externally at greater distances enhanced the jumping capabilities of skilled athletes. Although not directly focused on core strength, this study offers valuable perspectives for martial arts athletes. Combined with a stable core, an athlete's ability to focus externally could be another avenue for improving standing long jump performance.

Citation
Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756

International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (6), November-December 2023, pages 425-436. Old ISSN 2774-0366: New ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2023.3756

In summary, existing research suggests that core strength exercises can positively impact standing long jump and rebound jump performance in martial arts athletes. The benefits include enhanced core muscle stability, improved balance, and potentially optimized focus, although further research is needed for conclusive evidence. Incorporating core strength training into warm-up routines for martial arts athletes appears advisable based on current studies.

2. Types of core strength exercises

Core strength exercises are fundamental in enhancing functional ability, postural stability, and dynamic balance. The literature delineates a myriad of core strength exercises, each targeting specific muscle groups and offering distinct advantages.

Pratama and Salam (2021) conducted an empirical investigation to evaluate the impact of core stability exercises on functional ability in patients diagnosed with lumbar herniated nucleus pulposus. Employing a regimen that included pelvic tilting, bridging, four-point kneeling with arm and leg lifts, and cat-camel exercises, the study evidenced a notable improvement in functional ability, ~~thereby~~ substantiating the efficacy of targeted core exercises.

A comprehensive systematic review by Martuscello et al. (2013) undertook the task of categorizing core muscle activities during various physical fitness exercises. The review discerned five overarching categories: traditional core exercises, core stability exercises, ball/device exercises, free weight exercises, and noncore free weight exercises. This taxonomical approach facilitates a nuanced understanding of the disparate types of exercises conducive to core muscle development, allowing ~~for~~ individualized exercise regimens.

Moreover, a comparative study published in 2020 scrutinized the effectiveness of Bosu Ball exercises against Thera Band exercises in ~~the realm of core~~ stabilization and balance performance. The research illuminated a plethora of alternative modalities for core strengthening, such as Pilates, Tai Chi, yoga, and graded abdominal exercises, thereby expanding the gamut of options available for individualized core training.

A randomized controlled trial by Aly (2017) probed the responsiveness of trunk muscles to core stability exercises in a population suffering from chronic low back pain. The trial revealed that while both core stability and dynamic strength groups exhibited gains in trunk flexor and extensor strength, the core stability group demonstrated supplementary advancements in endurance time across various muscle groups.

Finally, Eng (2020) assessed the longitudinal effects of an 8-week core strength training regimen on young male cyclists. The study underscored the indispensability of consistent and regular exercise, with participants engaging in five types of core exercises per session over a total of 24 sessions.

Studies confirm the benefits of individualized exercise regimens, from clinical treatments for lumbar and back issues to athletic performance enhancement. These collective findings establish core strength exercises as versatile and indispensable tools in physical fitness and rehabilitation.

3. Empirical studies showing their impact on standing long jump and rebound jump performance

Empirical studies have shown the impact of various factors on standing long jump and rebound jump performance. One study by Porter et al. (2013) focused on the effect of external focus of attention on jumping performance. The researchers instructed skilled athletes to focus their attention externally at greater distances, and they found that this immediately improved standing long jump performance in the highly trained population. Increasing the distance of an external focus of attention relative to the body can enhance jumping performance.

Another study by Wu et al. (2003) conducted a biomechanical analysis of the standing long jump. They verified that standing long jump performance improved when arm movement was employed. This indicates that incorporating arm movement can positively impact standing long jump performance.

In addition to these studies, Lin et al. (2023) conducted a systematic review and meta-analysis to explore the correlations between horizontal jump, sprint acceleration, and maximal speed performance. They found ~~that there were~~ correlations between standing long jump distance and maximum speed performance, with correlation coefficients ranging from 0.35 to 0.47. The study also reported correlation coefficients between standing long jump distance and acceleration performance, which ranged from 0.35 to 0.43. These findings suggest that standing long jump performance may be related to sprinting abilities.

Lotfi (2018) investigated the optimal distance of an external focus of attention in the standing long jump performance of athletes. The results of this study showed that having an external focus of

Citation Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756

International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (6), November-December 2023, pages 425-436. Old ISSN 2774-0366: New ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2023.3756

attention compared to control conditions had a significant advantage in the performance of the athlete's standing long jump. This further supports the idea that the external focus of attention can positively impact jumping performance.

Furthermore, a study by Yang et al. (2020) examined the effects of a jump rope-based physical activity after-school program on physical fitness promotion among adolescents. Although the study did not specifically focus on standing long jump performance, it found that the intervention groups' performance in the standing long jump was significantly improved. This suggests that engaging in physical activities, such as jump rope exercises, can positively impact standing long jump performance.

Based on the above insights, the research framework integrates insights from existing literature to take a multi-modal approach in investigating the impact of core strength exercises on standing long jump and rebound jump performance in martial arts athletes. Informed by prior studies highlighting the role of core strength in athletic performance, balance, and focus of attention, the framework aims to understand the research question comprehensively.

Conceptual Framework

Independent Variable

- Experimental methods applied and analyzed comparatively
- a six-week core strengthening program within the warm-up routines for martial arts athletes.
- This program, which is a controlled factor, is systematically varied between the control group (no core strengthening) and the experimental group (with core strengthening).

Dependent Variable

- Performance in the standing long jump test, used to assess lower-body power.
- Performance in the rebound jump test, used to gauge explosive strength and power.

Figure 1 Conceptual Framework

Methodology

1. Population

In the study, an initial pool of 60 student-athletes from Guangzhou Sport University's Chinese martial arts program was screened, out of which 40 met the inclusion criteria and volunteered for the trial. These participants were all male, aged between 18 and 20, and qualified as Chinese national level 2 athletes. The remaining 20 candidates were excluded due to pre-existing injuries or diseases, or for not meeting athletic qualification standards. Stratified random sampling was employed based on their athletic qualifications to ensure equal representation of skill levels. All participants were thoroughly informed of the potential risks and benefits of partaking in the trial and signed an informed consent form before its commencement. Additionally, participants were instructed to maintain their regular exercise habits and to abstain from ingesting any stimulants or alcohol for 48 hours leading up to the training session and subsequent test.

2. Intervention Methodology

The study employs a structured, eight-week intervention program designed to isolate the effects of core exercises on athletic performance in martial arts. The intervention is bifurcated into two distinct groups: the Experimental Group (EG) and the Control Group (CG).

3. Experimental Group (EG):

20 Participants will engage in a comprehensive warm-up routine that incorporates core exercises specifically tailored to enhance performance in martial arts. The core exercises include:

Citation
Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756

International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (6), November-December 2023, pages 425-436. Old ISSN 2774-0366: New ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2023.3756

4. Dead Worm Pose

In a supine position with the back flat against the ground, extend the arms straight out in front of the shoulders. Assume a tabletop posture with the knees bent at a 90-degree angle, aligned directly above the hips. Keep both feet relaxed and engage the pelvic muscles, pressing the lower back into the ground. Slowly move one arm towards the head while simultaneously extending the opposite leg towards the ground. Inhale while engaging the core muscles and continue until both the arm and leg are momentarily suspended above the ground. Reverse the movement to return to the starting position. Perform the exercise at a tempo of 120 beats per minute for 40 seconds.

5. Bar Pose Torso Side Rotation

Initiate from a plank position and gradually tilt the hips towards the right side, descending as far as possible without making contact with the ground. Subsequently, elevate the hips to return to the plank position and repeat the movement towards the opposite side. Execute the exercise at a rate of one second per side for a total duration of 40 seconds.

6. Bar Pose Torso Side Rotation

Initiate from a plank position and gradually tilt the hips towards the right side, descending as far as possible without making contact with the ground. Subsequently, elevate the hips to return to the plank position and repeat the movement towards the opposite side. Execute the exercise at a rate of one second per side for a total duration of 40 seconds.

7. Data collection

Pre- and Post-Intervention Assessment: Participants will undergo the standing long jump test, rebound jump test, and lotus kick rotation degree test before starting the 6-week program.

- *Standing Long Jump Measure*

The test is performed on a track and field long jump mat, tape measure, chalk, and other marking materials. Participants stand on the starting line with their feet shoulder-width apart. After standing on the starting line, both feet must jump at the same time and land on the ground at the same time. The distance from the starting line to the heel is measured as the performance of the standing long jump. If one foot or body lands on the ground, a 1-minute rest is required, and then the measurement is repeated. Each subject will make 3 attempts, with a 2-minute break between each attempt, and the best of the 3 vertical jumps (in meters) will be recorded. The best performance of each subject will be recorded in meters with two decimal places.

- *Rebound Jump Measure*

The subject prepared by standing in front of the camera on the tablet computer. At the start of the test, the subject performed 6 consecutive vertical jumps. The subject was asked to shorten the time of contact with the ground as much as possible and to jump as high as possible. Each subject was tested 3 times, the maximum jump height and the minimum ground contact time were analyzed using My Jump Lab APP, and the Rebound Jump index (jump height/contact time) was calculated according to the research (Tauchi et al., 2008).

Data Analysis

Before initiating any statistical analyses, a thorough screening of the dataset for missing values and outliers will be conducted. Outliers will be identified using Z-scores, and decisions regarding their retention or removal will be guided by specific contextual considerations and data distributions. Descriptive statistics, including means, standard deviations, and 95% confidence intervals, will be calculated for each variable. Stratification by group (Experimental and Control) and time point (Pre-intervention and Post-intervention) will be implemented to provide an initial understanding of the data.

Reliability analyses will be conducted to assess the internal consistency of the metrics used. For performance tests that consist of multiple trials or components, Cronbach's alpha will be calculated. The Intraclass Correlation Coefficient (ICC) will be employed to assess test-retest reliability, particularly if baseline measurements are taken multiple times.

For inferential analyses, a Two-way ANOVA Analysis will be applied to each performance metric, addressing objectives Time (pre-intervention vs. post-intervention) will function as the within-subjects factor, while Group (Experimental vs. Control) will serve as the between-subjects factor. Interaction effects between Time and Group will also be scrutinized. If significant interaction effects emerge, post-hoc pairwise comparisons using Bonferroni correction will be employed. The magnitude of any effects will be quantified using Cohen's d.

Citation Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756

International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (6), November-December 2023, pages 425-436. Old ISSN 2774-0366: New ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2023.3756

Results

In this section, we present the findings of our empirical investigation into the effects of distinct training methods on performance metrics such as standing long jump, rebound jump index, and other related variables. We employ a comprehensive array of statistical analyses, including descriptive statistics, t-tests, Two-way Analysis of Variance (ANOVA), and Cohen's d for effect sizes, to rigorously assess these impacts. The results are organized into four subsections: 1) Demographic statistics comparing the Experimental Group (EG) and Control Group (CG); 2) pre-and post-intervention metrics for both groups; 3) Effects of core reinforcement training on standing long jump performance; and 4) Effects of core reinforcement training on rebound jump index. Each subsection provides detailed statistical evidence to evaluate whether the observed differences and changes are statistically significant, thereby offering valuable insights into the efficacy of the examined training methods.

1. Demographic statistics

Table 1 Demographic statistics (EG =20, CG=20)

Group	Variable	Mean	Standard Deviation	95% CI Lower	95% CI Upper	t	p
EG	Age	18.68376	0.770048	18.43749	18.930	1.847903	0.068407
CG	Age	18.38504	0.672535	18.16995	18.60013		
EG	Height (cm)	167.5363	6.170324	165.5629	169.5097	2.255602	0.026898
CG	Height (cm)	164.4129	6.214843	162.4253	166.4006		
EG	Weight (kg)	64.41224	6.684412	62.27446	66.55001	-1.18616	0.239158
CG	Weight (kg)	66.01735	5.344532	64.30808	67.72661		
EG	Years_of_Training	6.629318	0.893722	6.343492	6.915144	7.883829	1.58E-11
CG	Years_of_Training	5.069897	0.875359	4.789944	5.34985		

EG: experimental group. CG: control group.

Table 1 reveals statistically significant differences between the experimental group (EG) and the control group (CG) regarding of Height and Years of Training. Specifically, the EG exhibited higher mean values in both categories, with p-values of 0.027 and 1.58×10^{-11}, respectively, confirming the significance. No statistically significant differences between the two groups were observed for Age and Weight.

2. **Experimental and control groups before and after the intervention**

Table 2 Descriptive statistics of the experimental and control groups before and after the intervention

Group	Time_point	Variable	Mean	Standard Deviation	95% CI Lower	95% CI Upper
EG	pre-intervention	standing_longjump (m)	2.53	0.21	2.43	2.62
		rebound_jump_Height (m)	0.4	0.04	0.39	0.42
		rebound_jump_contact_time (s)	0.27	0.04	0.25	0.29
		rebound_jump_index (m/s)	1.51	0.27	1.39	1.64
		Lotuskick_rotation (°)	565.77	42.44	545.91	585.63
		sit-up (reps/min)	72.02	4.14	70.08	73.96
	post-intervention	standing_longjump (m)	2.61	0.2	2.52	2.71
		rebound_jump_Height (m)	0.47	0.03	0.46	0.49
		rebound_jump_contact_time (s)	0.2	0.03	0.19	0.22
		rebound_jump_index (m/s)	2.4	0.41	2.21	2.6
		Lotuskick_rotation (°)	633.57	44.09	612.94	654.21
		sit-up (reps/min)	79.1	3.64	77.39	80.8
CG	pre-intervention	standing_longjump (m)	2.64	0.59	2.37	2.92
		rebound_jump_Height (m)	0.44	0.06	0.41	0.47
		rebound_jump_contact_time (s)	0.25	0.04	0.23	0.27
		rebound_jump_index (m/s)	1.78	0.27	1.65	1.91
		Lotuskick_rotation (°)	558.66	35.38	542.1	575.22
		sit-up (reps/min)	67.77	4.43	65.7	69.85
	post-intervention	standing_longjump (m)	2.71	0.6	2.43	2.99
		rebound_jump_Height (m)	0.49	0.06	0.46	0.52
		rebound_jump_contact_time (s)	0.2	0.04	0.19	0.22

Citation Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756

International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (6), November-December 2023, pages 425-436. Old ISSN 2774-0366: New ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2023.3756

Group	Time_point	Variable	Mean	Standard Deviation	95% CI Lower	95% CI Upper
		rebound_jump_index (m/s)	2.48	0.4	2.29	2.66
		Lotuskick_rotation (°)	615.18	34.25	599.15	631.21
		sit-up (reps/min)	73.05	3.94	71.21	74.89

EG: experimental group. CG: control group.

Table 2 presents descriptive statistics for the Experimental Group (EG) and Control Group (CG) before and after an intervention. Both groups improved in all measured variables post-intervention, including standing long jump, rebound jump height, contact time, index, Lotuskick rotation, and sit-ups per minute. The EG, for instance, exhibited an increase in Lotuskick rotation from 565.77° to 633.57° and in sit-ups from 72.02 to 79.1 reps/min post-intervention. The CG also showed improvements, such as in standing long jump from 2.64m to 2.71m. However, the table does not provide statistical tests to confirm whether these changes are significant, warranting further analysis to draw conclusive interpretations.

3. Effect of Training Method on Standing Long Jump Performance

Table 3 Two-way ANOVA Results of the Effect of Core Reinforcement on Standing Long Jump Performance

Source	Sum of Squares	df	F	p-value
C (Group)	0.2245	1	1.1287	0.2914
C (Time point)	0.1167	1	0.5865	0.4461
C (Group): C (Time point)	0.0021	1	0.0107	0.9176
Residual	15.1200	76		

Group: core reinforcement vs. no core reinforcement. Timepoint: pre-intervention vs. post-intervention

Table 4 Comparison of training methods in Cohen's d before and after intervention

Comparison	Cohen's d
Within Core Reinforcement (Pre vs Post)	0.425
Within No Core Reinforcement (Pre vs Post)	0.111

Cohen's d: d<0.2 is considered negligible, 0.2≤d<0.5 as small, 0.5≤d<0.8 as medium, and d≥0.8 as large.

In Table 3, the Two-way ANOVA results indicate that neither the training method nor the time point significantly impacted the standing long jump performance. Specifically, the main effect of the group (core reinforcement vs. no core reinforcement) was not significant (F=1.129, p=0.291), nor was the main effect of time (pre-intervention vs. post-intervention) ($F = 0.587$, $p = 0.446$). Furthermore, the interaction between the group and time was also not significant ($F = 0.011$, $p = 0.918$), suggesting that the training method's effect on performance did not change over time (Figure 4.1).

In Table 4, Cohen's *d* analysis corroborates the ANOVA findings, with effect sizes ranging from 0.111 to 0.425. Specifically, *Within the core reinforcement group, a small to medium effect size of d = 0.425 was observed from pre- to post-intervention (*Figure 2**)**, suggesting that core-strengthening training methods have potential benefits for Standing Long Jump, even if the differences are not significant, while within the no core reinforcement group, the effect size was negligible (d = 0.111).

Citation Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756

International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (6), November-December 2023, pages 425-436. Old ISSN 2774-0366: New ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2023.3756

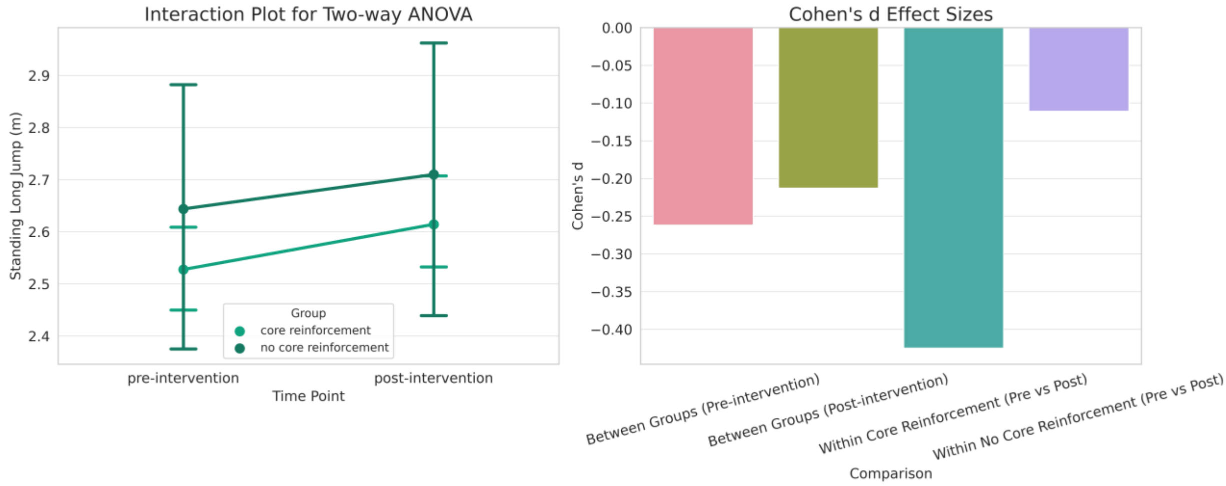

Figure 2 Effects of training methods on Standing Long Jump before and after intervention. Cohen's d: $d<0.2$ is considered negligible, $0.2\leq d<0.5$ as small, $0.5\leq d<0.8$ as medium, and $d\geq 0.8$ as large.

4. Effect of Training Method on Rebound Jump Index

Table 5 Two-way ANOVA Results of the Effect of Core Reinforcement on Standing Long Jump Performance

Source	Sum of Squares	df	F	p-value
C (Group)	0.584091	1	4.919238	0.029546
C (Time point)	12.58279	1	105.9727	4.62E-16
C (Group):C (Time point)	0.187464	1	1.578826	0.212778
Residual	9.023945	76		

Group: core reinforcement vs. no core reinforcement. Timepoint: pre-intervention vs. post-intervention

Table 6 Comparison of training methods in Cohen's d before and after intervention

Comparison	Cohen's d
Within Core Reinforcement (Pre vs Post)	2.5522
Within No Core Reinforcement (Pre vs Post)	2.0457

Cohen's d: $d<0.2$ is considered negligible, $0.2\leq d<0.5$ as small, $0.5\leq d<0.8$ as medium, and $d\geq 0.8$ as large. Pre vs Post: pre-intervention vs. post-intervention.

Table 5 presents the results of a Two-way ANOVA conducted to investigate the effects of training methods and time points on rebound jump index. The analysis revealed significant main effects for both groups (F (1,76) = 4.92, p = 0.03) and time (F (1,76) = 105.97, p<0.001). Specifically, notable differences were observed in the rebound jump index between the "core reinforcement" and "no core reinforcement" groups, and between pre-intervention and post-intervention measurements. However, the interaction effect between the group and time was not significant (F (1,76) = 1.58, p = 0.21), suggesting that the group effect remained consistent over time.

Table 6 also includes an analysis of effect sizes using Cohen's d to quantify the magnitude of changes in rebound jump index from pre-intervention to post-intervention within each group. For the "Core Reinforcement" group, Cohen's d was found to be 2.55, indicating a very large effect size. Similarly, for the "No Core Reinforcement" group, Cohen's d was 2.05, also suggesting a very large effect size. These effect sizes underscore the significant changes in the rebound jump index within each group from pre-intervention to post-intervention. Regarding of the rate of increase in the rebound jump

Citation Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756

International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (6),
November-December 2023, pages 425-436. Old ISSN 2774-0366: New ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2023.3756

index across the two groups, core-strengthening training methods demonstrate more excellent potential benefits for enhancing the rebound jump index (Figure 4.2).

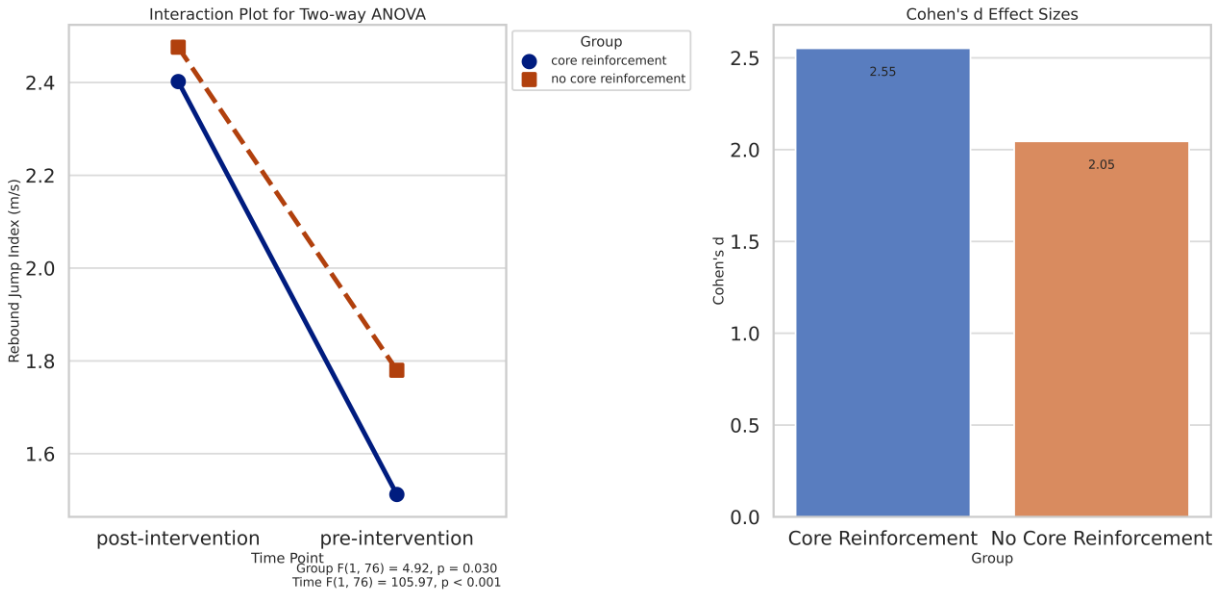

Figure 3 Effects of training methods on Rebound Jump Index before and after intervention. Cohen's d Effect Sizes are the growth values after training for both groups. Cohen's $d<0.2$ is considered negligible, $0.2\leq d<0.5$ as small, $0.5\leq d<0.8$ as medium, and $d\geq0.8$ as large.

Conclusion

This study was conducted to quantitatively assess the influence of core strength exercises, when integrated into the warm-up routine, on distinct performance metrics in martial arts athletes. The analysis provides a multifaceted perspective on the influence of core reinforcement training on various athletic parameters. For the standing long jump, the Two-way ANOVA showed no significant effect of training (F=1.129, p=0.291) or time point (F=0.587, p=0.446). Effect sizes, measured by Cohen's d, indicate a slight benefit in the core reinforcement group with a value of d=0.425, compared to d=0.111 in the non-reinforcement group.

In the case of the rebound jump index, there's a pronounced effect from the group (F=4.92, p=0.03) and the time point (F=105.97, p<0.001). Large effect sizes were observed with d=2.5522 for the core reinforcement group and d=2.0457 for the no core reinforcement group.

Discussion

This discussion aims to elucidate the implications of the current study's findings, which focused on the effects of core reinforcement exercises on two specific performance metrics: the Standing Long Jump and the Rebound Jump Index among martial arts athletes. The section provides a comprehensive analysis by contrasting these results with existing literature. Furthermore, it identifies methodological factors that may contribute to the observed outcomes and discusses the practical significance of the effect sizes calculated. Lastly, the section contemplates avenues for future research and provides insights into a multifaceted approach for optimizing performance metrics in athletes.

1. Effect of core reinforcement on Standing Long Jump Performance

The standing long jump, a widely recognized metric for assessing lower body power, has been a focal point of research across various sports disciplines. The current study endeavored to discern the impact of incorporating core reinforcement exercises during the warm-up phase on this performance metric among martial arts athletes. However, the absence of statistical significance in the results contrasts with prior research, such as that by Aslan et al. (2018) and Ferri Caruana et al. (2022), which illustrated the potential benefits of core training on jump performance. This divergence could stem

Citation Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756

International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (6), November-December 2023, pages 425-436. Old ISSN 2774-0366: New ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2023.3756

from methodological variations, diverse participant demographics, or specificities in the core training protocols employed.

Beyond core training, other methodologies like plyometrics and attentional focus strategies present themselves as promising avenues for enhancing jump performance. Insights from Romadhoni and Irianto (2018) underscore the potential efficacy of plyometrics, while research by Porter et al. (2010) illuminates the advantages of an external focus of attention. Moreover, the nascent and inconclusive research on the effect of ankle braces on jump performance, as noted by Mann et al. (2019), highlights the multifaceted intricacies inherent in optimizing this performance metric. While this study did not find statistically significant differences with core reinforcement, the observed effect size suggests potential practical benefits that warrant further exploration. Additionally, the vast landscape of research on jump performance indicates a confluence of factors that could influence outcomes, suggesting that a multi-faceted approach to training may yield the most promising results for athletes.

2. Effect of core reinforcement on Rebound Jump Index

The present research endeavored to uncover the effects of incorporating core strength exercises into the warm-up routines of martial arts athletes, with a particular emphasis on the rebound jump index. The results, encapsulated through a Two-way ANOVA, reveal salient findings. Firstly, there are demonstrable differences in the rebound jump index between the groups with and without core reinforcement during their warm-ups. This distinction underscores the pivotal role that core muscles might play in enhancing reactive strength. However, while the differences between these groups were significant, it's equally pertinent to note that the interaction effect between time and group wasn't significant. This implies that the difference between the groups remained stable over time.

Furthermore, the calculated effect sizes, as represented by Cohen's d, bolster these findings. The "Core Reinforcement" group demonstrated a Cohen's d of 2.55, signaling a very large effect size. This is particularly intriguing, as it suggests that not only does core reinforcement potentially influence the rebound jump index, but the magnitude of its influence is profound. On the other hand, the "No Core Reinforcement" group also presented a substantial effect size, though slightly less. This indicates that other elements of the training regimen, beyond just core reinforcement, also contribute significantly to changes in the rebound jump index.

In drawing parallels with existing research, the study navigates relatively uncharted waters. Previous studies have primarily pivoted around the biomechanics of the jump and factors influencing the rebound jump index. However, the emphasis on core reinforcement as a potential determinant is a fresh perspective. It offers a nuanced understanding of how preliminary exercises, such as core strengthening, can set the stage for subsequent performance metrics. In conclusion, while the rebound jump index is undoubtedly a multifactorial outcome, the inclusion of core reinforcement exercises in warm-up routines seems to be a promising avenue worth further exploration for martial arts athletes.

Recommendation

The study investigated the impact of incorporating core strength exercises into the warm-up routines of martial arts athletes, focusing on two performance metrics: the standing long jump and the rebound jump index. While no statistically significant effect of core reinforcement was found on standing long jump performance, a slight benefit was indicated through effect size (Cohen's d=0.425). On the other hand, core reinforcement significantly influenced the rebound jump index, with a large effect size (Cohen's d=2.5522).

Recommendations for Application

1. Standing Long Jump: Given the absence of a significant impact of core reinforcement on this metric, coaches, and athletes might consider incorporating other methodologies, such as plyometrics or attentional focus strategies, into their training regimen.

2. Rebound Jump Index: Core reinforcement exercises should be strongly considered for inclusion in warm-up routines for martial arts athletes, given the substantial effect size observed.

Recommendations for Future Research

1. Methodological Refinement: Future studies could benefit from investigating the methodological variations that led to differing outcomes between the current study and prior research regarding the standing long jump.

Citation Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756

2. Multi-faceted Approaches: For both performance metrics, a multi-faceted approach incorporating various training methodologies could be explored to ascertain the most effective strategies.

3. Longitudinal Studies: Given that the interaction effect between time and group was not significant in the case of the rebound jump index, longitudinal studies could provide more insight into the long-term benefits or limitations of core reinforcement.

References

Aly, S.M. (2017). Trunk Muscles' Response to Core Stability Exercises in Patients with Chronic Low Back Pain: A Randomized Controlled Trial. *International Journal of Physiotherapy and Research,* 5 (1), 1836-1845. https://doi.org/10.16965/ijpr.2016.201

Aslan, J., Mayers, K., Koomey, J.G., & France, C. (2018). Electricity intensity of internet data transmission: untangling the estimates. Journal of Industrial Ecology. 22 (4),785-798, 10.1111/jiec.12630

Bergmann, J., Kramer, A., & Gruber, M. (2013). Repetitive hops induce post-activation potentiation in triceps surae as well as an increase in the jump height of subsequent maximal drop jumps. PloS One, 8 (10), e77705.

Chen, C.-H., Chang, C.-K., Tseng, W.-C., Chiu, C.-H., Dai, X., & Ye, X. (2022). Acute Effects of Different Warm-up Protocols on Sports Performance in Elite Male Collegiate Handball Players. *Journal of Strength and Conditioning Research,* 36 (8), 2262–2267. https://doi.org/10.1519/JSC.0000000000003547

Cho, N., & Kim, H. (2023). Comparison of Effects of Static Core Training and Additional Dynamic Core Training in Young Adults: An Experimental Study. *Physical Therapy Rehabilitation Science,* 12 (1), 56-61. https://doi.org/10.14474/ptrs.2023.12.1.56

Coledam, D. H. C., Arruda, G. A. de, & Oliveira, A. R. de. (2012). Chronic effect of static stretching performed during warm-up on flexibility in children. *Rev Bras Cineantropom Desempenho Hum,* 14 (3),296-304. https://doi.org/10.5007/1980-0037.2012v14n3p296

Eng, S.C.B.C.K. (2020). Effects of 8 Weeks Core Strength Training on Core Muscle Strength Among Young Male Cyclist. *Malaysian Journal of Movement, Health &Amp; Exercise*, 9 (2). https://doi.org/ 10.15282/mohe.v9i2.383.

Feng, Y. (2023a). Influence of Abdominal Core Strengthening on Flexibility in Kung Fu Athletes. *Revista Brasileira De Medicina Do Esporte,* 29. https://doi.org/10.1590/1517-8692202329012022_0360

Feng, Y. (2023b). Influence of Abdominal Core Strengthening on Flexibility in Kung Fu Athletes. *Revista Brasileira De Medicina Do Esporte,* 29. https://doi.org/10.1590/1517-8692202329012022_0360

Ferri Caruana, A., Pardo Ibáñez, A., Cano Garrido, Á., & Cabeza Ruiz, R. (2022). The effect of a core training program on jump performance in female handball players. *Revista Andaluza de Medicina Del Deporte,* 15 (1), 22-28.

Granacher, U., Schellbach, J., Klein, K., Prieske, O., Baeyens, J.-P., & Muehlbauer, T. (2014). Effects of core strength training using stable versus unstable surfaces on physical fitness in adolescents: A randomized controlled trial. *BMC Sports Science, Medicine and Rehabilitation*, 6 (1). https://doi.org/10.1186/2052-1847-6-40

Lestari, A. D., Wibawa, A., Dewi, A.A.N.T.N., & Sugiritama, I. W. (2020). Providing core stability exercise increase the core muscle strength of adult male Balinese vocational polytechnic volleyball athletes. *Bali Anatomy Journal,* 3 (1). https://doi.org/10.36675/baj.v3i1.38

Li, J., & Du, X. (2023). Core Training in Martial Arts Athletes. *Revista Brasileira De Medicina Do Esporte,* 29. https://doi.org/10.1590/1517-8692202329012022_0376

Lin, J., Shen, J., Zhang, J., Zhou, A., & Guo, W. (2023). Correlations between horizontal jump and sprint acceleration and maximal speed performance: A systematic review and meta-analysis. *Peer J,* 11. https://doi.org/10.7717/peerj.14650

Lotfi, G. (2018). Optimal distance of an external focus of attention in standing long jump performance of athletes. *Physical Education of Students,* 22 (3). https://doi.org/10.15561/20755279.2018.0304

Citation
Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756

International Journal of Sociologies and Anthropologies Science Reviews (IJSASR), 3 (6), November-December 2023, pages 425-436. Old ISSN 2774-0366: New ISSN 2985-2730
Website: https://so07.tci-thaijo.org/index.php/IJSASR/index
DOI: https://doi.org/10.60027/ijsasr.2023.3756

Mann, F.D., DeYoung, C.G., & Krueger, R.F. (2019). Patterns of cumulative continuity and maturity in personality and well-being: Evidence from a large longitudinal sample of adults. *Personality and Individual Differences*, 169, Article 109737. 10.1016/j.paid.2019.109737

Martuscello, J., Nuzzo, J. L., Ashley, C. D., Campbell, B., Orriola, J. J., & Mayer, J. M. (2013). Systematic Review of Core Muscle Activity During Physical Fitness Exercises. *Journal of Strength and Conditioning Research,* 27 (6). https://doi.org/10.1519/jsc.0b013e318291b8da

Morikawa, M., Maeda, N., Komiya, M., Hirota, A., Mizuta, R., Kobayashi, T., Kaneda, K., Nishikawa, Y., & Urabe, Y. (2021). Contribution of plantar fascia and intrinsic foot muscles in a single-leg drop landing and repetitive rebound jumps: An ultrasound-based study. *International Journal of Environmental Research and Public Health,* 18 (9), 4511.

Porter, J.M., Anton, P.M., Wikoff, N.M., & Ostrowski, J.B. (2013). Instructing Skilled Athletes to Focus Their Attention Externally at Greater Distances Enhances Jumping Performance. *Journal of Strength and Conditioning Research*, 27 (8). https://doi.org/10.1519/jsc.0b013e31827e1521

Porter, J.M., Ostrowski, E., Nolan, R., Wu, F.W. (2010). Standing long-jump performance is enhanced when using an external focus of attention. *J. Strength Cond. Res.* 24, 1746–1750 10.1519/JSC.0b013e3181df7fbf

Prasetyo, H., Siswantoyo, S., Prasetyo, Y., & Susanto, 2&. (2023). The relationship balance of hand grip strength and body balance to archery ability. *Fizjoterapia Polska,* 23 (1). https://doi.org/10.56984/8zg07b284

Pratama, A.D., & Salam, M.E. (2021). The Effectiveness of Core Stability Exercise to Improve Functional Ability in A Lumbar Herniated Nucleus Pulposus Patient: A Case Study. *Physical Therapy Journal of Indonesia,* 2 (2). https://doi.org/10.51559/ptji.v2i2.24

Prieske, O., Muehlbauer, T., & Granacher, U. (2016). The Role of Trunk Muscle Strength for Physical Fitness and Athletic Performance in Trained Individuals: A Systematic Review and Meta-Analysis. *Sports Medicine (Auckland, N.Z.),* 46 (3), 401–419. https://doi.org/10.1007/s40279-015-0426-4

Prieske, O., Muehlbauer, T., Borde, R., Gube, M., Bruhn, S., Behm, D. G., & Granacher, U. (2016). Neuromuscular and athletic performance following core strength training in elite youth soccer: Role of instability. *Scandinavian Journal of Medicine & Science in Sports,* 26 (1), 48–56. https://doi.org/10.1111/sms.12403

Romadhoni, W. N., & Irianto, D. P. (2018). The Effect of Plyometrics Training and Strengths on Power Skills and Agility of Male Player in Extracurricular Volleyball. *2nd Yogyakarta International Seminar on Health, Physical Education, and Sport Science (YISHPESS 2018) and 1st Conference on Interdisciplinary Approach in Sports (CoIS 2018),* 186–189. https://doi.org/10.2991/yishpess-cois-18.2018.48.

Tauchi, Kenji & Endo, Toshinori & Ogata, Mitsugi & Matsuo, Akifumi & Iso, Shigeo. (2008). The Characteristics of Jump Ability in Elite Adolescent Athletes and Healthy Males: The Development of Countermovement and Rebound Jump Ability. *International Journal of Sport and Health Science.* 6. 10.5432/ijshs.6.78.

Willardson, J.M. (2007). Core Stability Training: Applications to Sports Conditioning Programs. *The Journal of Strength & Conditioning Research,* 21, 979-985. https://doi.org/10.1519/00124278-200708000-00054

Wu, W.-L., Wu, J.-H., Lin, H.-T., & Wang, G.-J. (2003). Biomechanical Analysis of the Standing Long Jump. *Biomedical Engineering: Applications, Basis and Communications,* 186–192. https://doi.org/10.4015/ S1016237203000286

Yang, X., Lee, J., Gu, X., Zhang, X., & Zhang, T. (2020). Physical Fitness Promotion among Adolescents: Effects of a Jump Rope-Based Physical Activity Afterschool Program. *Children,* 7 (8), 95; https://doi.org/10.3390/children7080095

Yoon, S., Tauchi, K., & Takamatsu, K. (2007). Effect of ankle joint stiffness during the eccentric phase in rebound jumps on ankle joint torque at the midpoint. *International Journal of Sports Medicine,* 28 (1), 66–71.

Citation
Gong, H., Rittisom, S., & Hongsaenyatham, P. (2023). Efficacy of Core Strength Exercises in Enhancing Rebound Jump Performance in Martial Arts Athletes. International Journal of Sociologies and Anthropologies Science Reviews, 3 (6), 425-436; DOI: https://doi.org/10.60027/ijsasr.2023.3756