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The Effect of Complex Training Method On The Improvement of Leg and Arm Power in Muay Thai Club Members

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Abstract

Power is key element in Muay Thai to executing quick attacks and avoiding opponent attacks, Therefore, developing power through a structured training program is crucial for Muay Thai athletes to improve their performance in the fighting arena. The aim of this study is to investigate the effect of complex training on improving leg and arm power among members of a Muay Thai club. This study employed a one group pre-test post-test design with 15 participants. The complex training program was carried out in 12 sessions over 4 weeks. The Standing long jump Test was used to measure leg power, while the Medicine ball chest pass Test was used to measure arm power. Data were analyzed using the Shapiro-Wilk normality test, homogeneity test, and paired sample t-test with SPSS version 27. The findings revealed that leg power increased by 8.87% (from 201.53 ± 24.26 cm to 219.40 ± 31.55 cm), but this increase was not statistically significant ($p = 0.132$; $p > 0.05$). Meanwhile, arm power increased by 20.16% (from 332.93 ± 74.49 cm to 400.07 ± 53.77 cm) with a statistically significant difference ($p = 0.015$; $p < 0.05$). Complex training significantly improved arm power but did not significantly affect leg power.

Keywords: *complex training, leg power, arm power, muay thai.*

INTRODUCTION

Muay Thai is a complex martial art, not only because of its diverse range of basic techniques, such as kicks, punches, elbows, and knees, but also because it demands excellent physical condition. In addition to mastering techniques and strategies, physical condition plays a crucial role in determining an athlete's performance. Optimal physical condition is key to victory for Muay Thai athletes, making it an essential factor in every match. (Kurniawan & Khoiriyah, 2021). Bhumipol et al., (2023) emphasized that muscle strength, especially in the arms and legs, plays a crucial role in producing effective strikes, with athletes with higher muscle strength tending to be more successful in punching and kicking techniques.

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Furthermore, Crisafulli et al., (2009) emphasized that power is essential for executing quick attacks and avoiding opponent attacks, which are key elements in Muay Thai fighting strategy. Therefore, developing power through a structured training program is crucial for Muay Thai athletes to improve their performance in the fighting arena.

Power in Muay Thai plays a vital role in both attack and defense, enabling athletes to launch stronger and faster attacks and effectively avoid their opponent's attacks. Studies show that muscle strength, especially in the arms and legs, plays a crucial role in increasing striking power. Athletes with greater muscle strength tend to be able to deliver punches and kicks with greater precision and effectiveness in competition. This indicates that training to simultaneously increase strength and speed is a key factor in developing Muay Thai athletes' performance (Persadanta et al. (2020). Therefore, emphasizing power development through a systematic training program is crucial for Muay Thai athletes to achieve peak performance in the competition arena. This suggests that optimal power development requires specific training methods to enhance athlete power. Leg power is the ability of lower body muscles such as the quadriceps, hamstrings, gluteus maximus, and gastrocnemius to generate power during activities like kicking, jumping, and sprinting. Leg power plays a crucial role in producing powerful and fast kicks in Muay Thai. This ability is enhanced through high-intensity weight training and plyometric exercises such as squats, leg presses, and jump squats, which target explosive power and speed of leg muscle contraction. (Amrullah & Widodo, 2017; Baechle & Earle, 2008). Meanwhile, arm power involves upper body muscles like the pectoralis major, deltoids, and triceps, which are used during explosive movements like punches. Exercises like the bench press, push press, and medicine ball chest pass are effective for developing arm power, which in Muay Thai is crucial for strengthening uppercut combinations (Rusli et al., 2021; Zatsiorsky & Kraemer, 2006). Thus, developing leg and arm power simultaneously is crucial to supporting a Muay Thai athlete's performance. Therefore, specific training methods are required to ensure the power generated supports maximum performance in the competition arena..

Common training methods used at the Bravo Muay Thai Club include circuit training, plyometrics, and cardio, which are the primary focus of the daily training routine. A measurement test conducted on May 6, 2025, on nine male members of the Bravo Muay Thai Club revealed an average medicine ball chest pass test of 263.56 cm, which is below average. Meanwhile, the average standing long jump test was 174.78 cm, which is considered poor. This indicates that the members' power capabilities are still not optimal. These results demonstrate the need for appropriate training methods to support physical development. This condition is also supported by field observations and interviews with trainers, which revealed that the members' power capabilities have not shown optimal development and still need to be improved through appropriate training methods..

Complex training (CT) is a proven method for increasing power, especially for athletes. This method combines alternating heavy weight training with light plyometric exercises, utilizing the principle of post-activation potentiation (PAP) to improve power and performance in sprinting, jumping, and agility. (Thapa et al., 2021; Uysal et al., 2023). The combination of these two types of training aims to maximize neuromuscular adaptation, thus positively impacting athletic performance. Research has shown that complex training can significantly improve various physical abilities. A systematic review revealed that complex training positively impacted sprint speed, jumping ability, and change of direction in soccer players, demonstrating its effectiveness in power-based sports (Thapa et al., 2021). These findings are reinforced by other studies that emphasize the importance of strength training in improving performance in various sports, including basketball and soccer (James et al., 2018; Uysal et al., 2023). The main mechanism behind the effectiveness of this method is the activation of fast-twitch muscle fibers during heavy weight training, which then increases the power output immediately afterward (James et al., 2018; Thapa et al., 2021).

The low power capabilities of Bravo Muay Thai athletes and the limited specific research on the effects of complex training on adolescent Muay Thai athletes demonstrate an urgent need for research. Therefore, this study is crucial to examine the effects of complex training methods on increasing leg and arm power in Bravo Muay Thai Club members. This research is expected to provide useful results in developing more targeted training programs and supporting improved athlete performance.

METHOD

Study design

The method used was a pre-experimental one-group pretest-posttest design, involving one group of subjects receiving a specific treatment. This study began with a pretest using the standing long jump (SLJ) and medicine ball chest pass (MBCP) tests to measure leg and arm power. Next, the treatment consisted of complex training for four weeks, totaling 12 sessions. After the treatment was completed, a posttest was administered using the same instruments to assess any changes.

Participants

This study involved members of the Bravo Muay Thai Club who were selected as samples based on inclusion and exclusion criteria. Sample selection was carried out using a purposive sampling method. A total of 15 people participated in this study from 20 members (*population*). The inclusion criteria were: (1) active and official members of the Bravo Muay Thai club, (2) have participated in training regularly for at least the last 6 months; (3) Not a coach or trainer at the Bravo Muay Thai club; (4) Willing to be a subject in the study; (5) carry out training at least 2 times a week; (6) male; (7) Aged between 15–18 years. The exclusion criteria were: (1) Not meeting the established inclusion criteria; (2) Having certain health conditions that could affect the results of the study (recent injuries, cardiovascular desease, metabolic deseases).

Treatment (Training Program)

Treatment was carried out for four weeks. This time span was chosen based on Karunia Saraswati et al. (2019) study, which states that the duration is sufficient to allow the body to adapt to the training stimulus, so that changes in physical ability can be optimally observed. In designing this program, the principle of progression is applied by increasing the load in the second week, with the aim of providing a greater adaptation stimulus than the first week. Next, in the third week the load is reduced again to give the body the opportunity for active recovery and prevent overtraining. After the deload phase, in the fourth week the training intensity is increased again, even higher than in the second week. This strategy was chosen to achieve supercompensation, a condition where physical performance increases beyond previous levels due to a combination of training stress, recovery, and a gradual increase in load. (Schoenfeld & Snarr, 2021).

Tabel 1. Program design of *complex training*

Week	Exercise program	Note
I	3 × 3-6 BS at 60% 1RM + 3 × 3-6 *Double leg tuck jump* 3 × 3-6 BP at 60% 1RM + 3× 3-6 *Medicine ball chest pass*	• There is no rest between complex exercises • 3-5 min rest between sets
II	3 × 3-6 BS at 60% 1RM (+5% / 4-7 kg week I) + 3 × 3-6 *Double leg tuck jump* 3 × 3-6 BP at 60% 1RM (+2,5% / 1-2kg week I) + 3× 3-6 *Medicine ball chest pass*	
III	3 × 3-6 BS at 60% 1RM + 3 × 3-6 *Double leg tuck jump* 3 × 3-6 BP at 60% 1RM + 3× 3-6 *Medicine ball chest pass*	
IV	3 × 3-6 BS at 60% 1RM (+5% / 4-7 kg week II) + 3 × 3-6 *Double leg tuck jump* 3 × 3-6 BP at 60% 1RM (+2,5% / 1-2kg week II) + 3× 3-6 *Medicine ball chest pass*	

*BS = *Back squat*
*BP = *Bench press*

Standing Long Jump Measurement

The standing long jump is performed by setting up a starting line using adhesive tape and ensuring participants perform a standardized warm-up, including three to five moderate-intensity jumps, followed by three to five minutes of rest. Participants stand with their toes on the line, then jump as far as possible using a countermovement, landing stably on both feet. The measurement is taken from the starting line to the nearest heel, and the test is repeated at least three times with one-minute intervals. The best result is used as the final score (Fukuda, 2019).

Medicine Ball Chest Pass Test Measurement

The medicine ball chest pass test is performed with participants sitting on the floor, legs extended or bent, and their backs against a wall. After a specific upper body warm-up and several moderate-intensity throws, participants hold a medicine ball at their chest with both hands and throw it explosively forward as far as possible. The back must remain against the wall throughout the throw. The distance of the throw is measured from the starting point to the point where the ball lands closest to the ground. The test is performed at least three times, each with a 2–3 minute rest period. The final score is determined based on the distance of the longest throw. (Fukuda, 2019).

Data Analysis

The collected data was analyzed using SPSS version 27 statistical software to test the research hypotheses. Because the study used a one-group pre-test and post-test design, analysis was conducted using a paired sample t-test to determine whether there was a significant difference between the pre-test and post-test results after the complex training intervention.

RESULT

Subjects first underwent initial measurements using Bioelectrical Impedance Analysis (BIA) to obtain height, weight, and body mass index data. These measurements were followed by 1RM back squat and 1RM bench press tests to assess the subjects' average maximal strength.

Tabel 2. Research subject characteristics data

	Mean ± SD	*Min.*	*Max.*
Age (years)	16.4 ± 0.83	15	18
Height (cm)	168 ± 7.2	153.5	185.0
Weight (kg)	66.7 ± 14.3	46.3	90.3
Body Mass Index (BMI) (kg/m^2)	23.6 ± 5.1	17.8	34.0
Training History (month)	9.2 ± 2.3	7	15
1RM *Back squat* (kg)	58.4 ± 11.7	46	86.2
1RM *Bench press* (kg)	65.2 ± 11.4	46	86.2

Standing Long Jump* (SLJ) *Test Result

The SLJ data were tested for normality, with a significance value of 0.614 for the pre-test and 0.880 for the post-test ($p > 0.05$). Therefore, the standing long Jump data were declared normally distributed, and the homogeneity test showed a significance value of 0.245. Therefore, a paired sample t-test was used to determine significant differences between the pre-test and post-test scores for both variables.

The test was conducted to determine whether there was a significant difference between the pre-test and post-test results in leg power ability. The mean and standard deviation of the measurement results are presented in the following table:

Tabel 3. Paired Sample T Test of SLJ Result

Test		*n*	*Mean±Std. Dev*	Sig. (2-tailed)
SLJ	***Pre test***	15	201.53±24.26	0.132
	Post test	15	219.40±31.55	

The test results showed a significance value of 0.132 ($p>0.05$). So there was no significant difference between the pre-test and post-test values in leg power. However, the average result increased by 17.87 cm from 201.53 cm to 219.40 cm, indicating an improvement in performance even though there was no statistically significant difference.

***Medicine Ball Chest Pass* (MBCP)**

The Shapiro-Wilk test for normality was used for the MBCP data, with a significance value of 0.213 for the pre-test and 0.701 for the post-test ($p > 0.05$), indicating that the Medicine Ball Chest Pass data were normally distributed. The homogeneity test for the MBCP data was also conducted, with a p-value of 0.084.

Both values were ($p > 0.05$). A paired sample t-test was used to determine significant differences between the pre-test and post-test scores.

Tabel 4 Paired Sample T Test MBCP Result

Test		*n*	*M±Std. Dev*	**Sig. (2-tailed)**
MBCP	***Pre test***	15	332.93±74.49	0.015*
	Post test	15	400.07±53.77	

*difference (p < 0,05)

The rest results showed a significance value of 0.015 ($p < 0.05$). The statistical test results indicated a significant difference between the pre-test and post-test arm power scores. The average result increased by 67.14 cm, from 332.93 cm to 400.07 cm, indicating a significant improvement in performance.

DISCUSSION

The results of this study indicate that the four-week training program had different effects on the two variables tested. A significant increase occurred in arm power, as demonstrated by the Medicine Ball Chest Pass Test with an average increase of 67.14 cm, from 332.93 cm to 400.07 cm, with a significance value of 0.015 ($p < 0.05$). These results indicate that complex training significantly increased the arm power of Muay Thai members. Furthermore, in leg muscle power, there was an average increase of 17.87 cm, from 201.53 cm to 219.40 cm based on the results of the Standing Long Jump Test, but there was no statistically significant difference with a significance value of 0.132 ($p > 0.05$). Thus, Complex training did not provide a significant increase in leg power of Muay Thai members. These findings indicate that the purpose of the study to determine the effect of complex training on increasing leg power and arm power showed different results, where this training program was more effective in developing arm power than leg power in Muay Thai members who were the subjects of the study. These results are in line with the theory of muscle adaptation Schoenfeld & Snarr (2021) which states that muscle strength can increase significantly in just 4–6 weeks through a combination of weight and power training, while increasing power requires a longer adaptation period and higher training intensity. This is in line with Bompa & Buzzichelli (2019) which states that power development requires structured periodization to achieve optimal transition from strength to power. Leg power development may be more effective if training is provided over a period of more than four weeks. The process of muscle power production is the result of a combination of complementary mechanical and neurophysiological mechanisms. From a mechanical perspective, when a muscle undergoes rapid stretching during the eccentric phase, elastic energy is generated, stored in the series elastic component (SEC). This energy is then released when the muscle contracts concentrically, thereby increasing the amount of force produced. However, if the transition to concentric contraction is prolonged, the elastic energy is lost as heat, no longer contributing optimally to force production. Neurophysiologically, rapid stretching of a muscle stimulates muscle spindles to send signals to the central nervous system, which then triggers reflex contraction in the same muscle. This response accelerates muscle fiber recruitment while increasing the speed and strength of contraction. Thus, the combination of elastic energy utilization and stretch reflex activation is the key to enabling muscles to produce greater power in a short time. (Schoenfeld & Snarr, 2021)

This research supports the findings Saragih & Imran Akhmad (2021) which showed that decline push-ups and medicine ball throws can significantly increase arm power in Muay Thai athletes. These results are consistent with other studies Garcia-Carrillo et al. (2023) which confirms that plyometric training for the upper body, including the medicine ball throw, can improve throwing performance and power in the short term through explosive mechanisms. The rapid response to increased arm power can also be explained by neuromuscular adaptations. Ahmadabadi et al. (2023) stated that a four-week intervention was sufficient to produce changes in motor unit recruitment and an acceleration in time to peak force, contributing to increased explosive output even though morphological adaptations in the muscles were not yet fully formed. This provides a scientific basis for the effectiveness of a four-week intervention in triggering significant increases in arm power.

The effectiveness of complex training is different when applied to the lower body (legs). Meta-analisis study by Wang et al. (2023) Studies have shown that both plyometric and complex training can improve explosive performance, but results are highly dependent on duration, load, and the muscle groups targeted (in this case, lower body muscles are larger than arm muscles). Short-term training sessions often show significant results in the upper body compared to the legs. Training method factors also play an important role, as noted by Thapa et al. (2024), which states that participant training status, program duration, training volume, and individual load management are the main moderators of complex training success. Therefore, the insignificant increase in leg power in this study may be due to the larger size of leg muscles compared to arm muscles and factors such as suboptimal training methods.

The duration of intervention is one of the most determining factors in the development of leg power. (Shen et al., 2025) showed that an eight-week complex training program significantly improved the standing long jump in adolescent long jump athletes, confirming that a longer adaptation period is needed to produce significant changes in the legs. The 17.87 cm increase in this study does indicate a positive response, but it is not statistically significant because neuromuscular and morphological adaptations are likely not yet optimal. This condition is further strengthened by uncontrolled external factors such as fatigue from regular Muay Thai training, quality of rest, and nutritional intake. Overall, this study shows that complex training is effective in increasing arm power in the short term, but requires a longer period to have a significant effect on leg power.

The results of this study confirm that the implementation of a four-week complex training program is more effective in increasing arm power than leg power in Muay Thai participants. A significant increase in the results of the medicine ball chest pass indicates a rapid neuromuscular adaptation response in the upper muscles through a combination of weight training and plyometrics. The standing long jump did show an average increase but was not statistically significant, indicating that the leg muscles require a longer adaptation period. The novelty of this study lies in the training principle: the progressive application of loads with a pattern of increasing, decreasing, and increasing again to prevent the risk of overtraining while utilizing the principle of supercompensation, thus providing a new contribution that appropriate load manipulation can optimize physiological adaptation and increase the effectiveness of the program in developing power in the context of martial sports such as Muay Thai.

CONCLUSSION

The complex training program, conducted over 4 weeks with a total of 12 sessions, significantly increased arm power, while leg power was not significantly improved in members of Muay Thai Club. For further research, the author suggests to using a research design with larger subjects with a control group and the duration of the exercise treatment needs to be extended to at least 8 weeks or 2 months to see how much the effects it has on increasing arm and leg power.

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