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The Effect of Lower Limb Drop Knee Jump and Box Jump Plyometric Training Methods on Mawashi Geri Kick Speed in Junior Karate Athletes

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Abstract

Study Purpose. The background of this study is the low kicking speed of several junior karate athletes, which impacts the effectiveness of attacks during competition. The aim of this study is to improve the kicking quality, specifically the speed of the mawashi geri kicks of junior karate athletes.

Materials and Methods. The research method used was an experiment with a two-group pretest-posttest design. The research sample consisted of 10 junior karate athletes with an age range of 15-17 years who were divided into two groups, namely the knee jump training group and the box jump training group . The research instrument used was a mawashi geri kick speed test by recording the time needed to perform three kicks as quickly as possible. The tools needed include a stopwatch, a meter, and a punching bag. The data were analyzed using a normality test, a homogeneity test, a paired sample t-test, and an independent sample t-test.

Results. The average percentage increase in the knee jump group was 11.84%, while the box jump group increased by 6.64%, with an overall average increase reaching 9.24%. The results of the paired sample t-test showed a significant difference between the pretest and posttest results ($p < 0.05$), while the results of the independent sample t-test showed no significant difference between the two methods ($p > 0.05$).

Conclusion. Thus, it can be concluded that plyometric training, both bent knee jumps and box jumps, is effective in increasing the speed of mawashi geri kicks in junior karate athletes. However, bent-knee jumps yielded greater average gains than box jumps, as the coordination of the knee-to-chest jump is considered to best align with the characteristics of the mawashi geri kick technique.

Keywords: Jump Box, Junior Karate, Knee Tuck Jump, Mawashi Geri, Plyometrics, Speed

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Introduction

In the context of kicking, speed is a key factor in the success of an attack because quick movements can minimize an opponent's opportunity to prevent or evade. This makes kicking speed not only a physical skill but also an effective strategy in competition (Palgunadi et al., 2021). According to Cakrawijaya, (2021) , slow kicks are caused by a lack of speed and leg muscle strength training, a lack of facilities and infrastructure for mawashi geri training, and a lack of athlete interest in kick speed training also have a significant influence.

In the development of junior athletes, increasing kicking speed is crucial because it directly relates to the effectiveness of attacks in competition, given that kicks, especially mawashi geri, are high-point attacks. However, there is a gap: training programs implemented in some dojos still focus on technique without supporting measurable explosive training. Therefore, training methods that can specifically increase mawashi geri kicking speed are needed. Coaches working with elite athletes will use various training strategies and methods to achieve optimal performance and maximize results (Purnamasari et al., 2024).

Plyometric training is the right training for people who have trained and specialized as athletes to improve and develop their maximum jump, speed and strength. Plyometrics are exercises or repetitions that aim to combine speed and strength to produce explosive movements. Plyometrics are also called the stretch reflex, myotatic reflex, or muscle rotation reflex. Plyometric exercises allow muscles to achieve maximum strength in the shortest possible time (Radcliffe, 2024).

In addition to increasing explosive power, plyometrics are also beneficial in increasing movement speed and shortening reaction time. Research (Campillo et al., 2020) shows that a 6–8-week plyometric program can significantly improve sprinting and kicking speed in athletes across various sports. According to (Yunus et al., 2023) , speed is defined as a person's ability to cover a distance in the shortest possible time. From a mechanical perspective, speed is the ratio between the distance traveled and the time required to cover that distance (Matitaputty, 2019) .

There are many methods and forms of training to improve kicking speed. One of them is plyometric training. In this study, researchers chose the knee tuck jump (vertical jump) and the box jump (horizontal jump). The knee tuck jump is an exercise that involves jumping while bending the knees towards the chest, while the box jump is an exercise that involves jumping on a box or higher platform (Rismayanthi et al., 2024). According to (Lamusu & Harmain, 2024). in karate, knee tuck jump and jump box training have the benefit of increasing leg strength which contributes to the speed of the mawashi geri kick during training according to the conditions and needs of the athlete.

Previous research was conducted prior to this study to seek inspiration and compare with related journals. The article used as a reference in this study is an article written by (Chen et al., 2023) entitled "Meta-Analysis of the Effect of Plyometric Training on Lower Limb Explosive Strength in Adolescent Athletes." The article states that increased maximal muscle strength or explosive strength after performing plyometric training allows athletes to launch with greater power at the start and increases the athlete's stride length.

This study is novel because it compares two forms of plyometric training, namely bent knee jumps and box jumps, on mawashi geri kick speed in junior karate athletes. Most previous studies only examined the effect of plyometric training on vertical jump ability or sprint speed in game sports, while this study focuses on direct application to specific karate martial arts techniques. This study focuses only on mawashi geri kick speed, to provide appropriate treatment for junior athletes and a scientific basis for coaches in developing appropriate and evidence-based training programs to improve kicking performance in junior karate athletes. With good and precise execution, the mawashi geri kick can be a very potential weapon for achieving victory in karate competitions (Fauziah & Candra, 2019). Based on a literature

review, variations of plyometric training used include low-impact, medium-impact, and high-impact plyometric movements (Burgos-Jara et al., 2023). However, research specifically examining the impact of plyometric training on mawashi geri kick speed is still limited, especially in the junior age group. Therefore, applying this method to junior karate athletes is crucial to test its effectiveness in the context of increasing kick speed.

Materials and methods

Study participants

In this study, the population selected by the researcher will be junior karate athletes aged 15-17 years. The junior karate athletes who will be the population in this study are 10 junior athletes active at Inkanas Dojo Majalaya.

Study organization

The method used in this study is an experimental method because the fundamental characteristic of the experimental approach is that researchers can observe behavior in a controlled environment. Experimental methods are trial and error, aiming to test hypotheses or identify causes and effects for specific purposes (Gani & Purbangkara, 2023) . The hypothesis tested is that there is a significant effect of the plyometric lower-limb knee tuck jump and jump box methods on the speed of the mawashi geri kick of junior karate athletes and there is no difference between the two. The design used is *Two Groups. Pretest-posttest design* (Fraenkel et al., 2022). The data analysis technique chosen was of course a two-sample t-test. The hypothesis tested was simply the difference between the pretest and posttest mean scores. This two-group pretest-posttest research design compared two forms of knee jump and box jump training. In this study, the test was conducted twice, before and after the treatment. The difference between the pretest and posttest was assumed to be the effect of the treatment or the results of the treatment were expected to be known more accurately, because there was a comparison between the conditions before and after being given the treatment and it was known which form of training was more effective in increasing the speed of the mawashi geri kick.

Research instruments

The instrument used in this study was the mawashi geri speed test. This test aims to measure the speed of karate athletes' mawashi geri kicks. Researchers adopted this instrument with a validity value of 0.098 and a reliability of 0.94 (Simbolon & Siahaan, 2020) . When the command "Ready", the testee stands in front of the target with the supporting foot behind the line as far as 50 cm (female) 60 cm (male) to prepare to kick, when the command "yes", the stopwatch is activated and the testee kicks correctly using the right foot and returns to the starting position by touching the floor behind the line, then continues the right foot kick as fast as possible, kicks are done 3 times. On the 3rd kick when the foot hits the target and then lands on the floor in the starting position, the stopwatch is stopped and the best time is recorded. For time measurement, it is expressed in the form of two decimal places. The norms for the mawashi geri speed test can be seen in Table.

Table 1. Mawashi geri speed test norms
(Source: Simbolon & Siahaan, 2020)

Gender	Very Poor	Poor	Currently	Good	Very good
Man	>3.47 seconds	3.46 – 3.02 seconds	3.01 – 2.57 seconds	2.56 – 2.13 seconds	<2.12 seconds

Woman	>4.21 seconds	4.20 – 3.68 seconds	3.67 – 3.15 seconds	3.14 - 2.61 seconds	<2.60 seconds

Research on treatment

Each training session begins with a 10-minute warm-up consisting of dynamic stretching and ABC running, followed by a 5-minute cool-down consisting of static stretching. This study was conducted over four weeks, with training intensity repeated three times per week, with training progress increasing each week. According to (Booth & Orr, 2016) four weeks of progressive plyometric training can increase leg muscle explosiveness, thereby improving performance. Ramirez-Campillo et al. (2022) argue that the basic principles of good training consist of individual needs, specialization, progression, overload, and reversibility. Therefore, in this study, the researchers emphasized the principle of progression in plyometric training to achieve optimal results.

In this study, training norms were determined from the results of an analysis of athlete needs during the match by calculating the total number of kicks. For rest periods, the athlete's heart rate was assessed. If the athlete's heart rate dropped to 120, the athlete was considered able to continue to the next set, and each rest period was counted. During the exercise, athletes were required to perform movements with fast execution and a consistent tempo. If within 1 set the movement began to slow down, the exercise would be stopped until the athlete was deemed able to continue again and repeated from the first repetition. Before entering the main exercise, athletes must warm up with dynamic stretching and ABC running, then after completing the main exercise, athletes must cool down with static stretching.

Statistical analysis

Data analysis using SPSS software, including statistical descriptions, normality tests, homogeneity tests, and hypothesis testing.

Results

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

Table 2. Pre-test and post-test **results (KNJ)**

NO	Name	Gender	Pre-test	Category (Pre)	Post-test test	Categories (Posts)	Percentage Increase
1	Athlete 1	Man	3.43	Poor	3.20	Poor	6.71%
2	Athlete 2	Man	4.50	Very Poor	3.55	Poor	21.11%
3	Athlete 3	Man	4.35	Very Poor	3.25	Poor	25.29%
4	Athlete 4	Man	3.62	Very Poor	3.40	Poor	6.08%
5	Athlete 5	Man	3.25	Poor	3.25	Poor	0.00%
Average			**3.83**		**3.33**		**11.84%**

Table 2 It was observed that the group treated with the plyometric knee tuck jump method showed an improvement in mawashi geri kick speed between the pretest and posttest. The average pretest result was in the very poor to fair category, with individual scores varying.

Overall, the average kick time decreased by 0.50. seconds, meaning kick speed increased after treatment. Most athletes who were previously in the very poor and poor categories improved to fair, while athletes in the fair category tended to remain stable, although they still showed a decrease in time.

Table 3. Pre-test and post-test results (JB)

NO	Name	Gender	Pre-test	Category (Pre)	Post-test test	Categories (Posts)	Percentage Increase
1	Athlete 6	Man	4.19	Very Poor	4.10	Very Poor	2.15%
2	Athlete 7	Man	3.60	Very Poor	3.55	Poor	1.39%
3	Athlete 8	Man	4.07	Very Poor	3.50	Poor	14.01%
4	Athlete 9	Man	3.75	Very Poor	3.30	Poor	12.00%
5	Athlete 10	Man	3.66	Very Poor	3.60	Poor	1.64%
	Average		**3.85**		**3.61**		**6.64%**

Table 3 shows that in the group treated with the plyometric jump box method, there was an increase in mawashi geri kick speed between the pretest and posttest results. The average pretest results were in the fair to very poor category, with individual values varying. In the group given jump box training, test results showed an increase in mawashi geri kick speed, although the increase was relatively small compared to the knee tuck jump group. The average difference in kick time in this group was approximately 0.24 seconds lower than the knee tuck jump group, which reached 0.50 seconds.

Table 4. Results of normality test

Variables	Practice Group	Statistics	df	Signature.
Pre-test	1 = Jump with Bent Knees	0.880	5	0.309
	2 = Jump Box	0.885	5	0.332
Post-test	1 = Jump with Bent Knees	0.871	5	0.269
	2 = Jump Box	0.878	5	0.299

Table 4 Based on the results of the normality test using Shapiro-Wilk, the significance value (Sig.) obtained in the Knee Tuck Jump group for the pretest data was 0.309 and the posttest was 0.269. Meanwhile, in the Jump Box group, the significance value obtained in the pretest was 0.332 and the posttest was 0.299. All significance values are greater than 0.05, so it can be concluded that the data in both groups, both pretest and posttest, are normally distributed. Thus, the normality assumption is met so that the analysis can be continued using parametric statistical tests, namely the Paired Sample T-Test and the Independent Sample T-Test.

Table 5. Results of homogeneity test

Test	Levene Statistics	Signature.	N	Information
Post	0.729	0.418	10	Homogeneous

Based on Table 5, the results in Table 4.5 yield a significance value of 0.418, which is greater than 0.05. This indicates that the posttest data for both groups have the same variance, or are homogeneous. Thus, the assumption of homogeneity is met.

Table 6. Paired sample t-test

Variable Pairs	Average Difference	Standard Deviation	Standard Error of the Mean	95% Confidence Interval	T	df	Sig. (2 tails)
Pretest – Posttest	0.372	0.390	0.123	0.093 – 0.651	3,013	9	0.015

Based on the results of *the Paired Sample T-Test analysis* in Table 6 above, the average difference between the pretest and posttest results was 0.372 . This indicates that, in general, the posttest score increased compared to the pretest score. The calculated t-value was 3.013 with degrees of freedom (df). = 9 and the significance level (Sig. 2-tailed) is 0.015. Since the significance value is less than 0.05 ($p < 0.05$), it can be concluded that there is a significant difference between the pretest and posttest results of the mawashi geri kick speed in athletes. The 95% confidence interval for the difference (0.093 – 0.651) does not cross zero, thus strengthening the results that there is a real effect of the training treatment given. Thus, it can be stated that the training conducted is effective in increasing the mawashi geri kick speed of junior athletes.

Table 7. Independent sample t-test

Variables	T	df	Sig. (2 tails)	Average Difference	Information
Pre-test	-0.087	8	0.933	-0.024	Not significant
Bent Knee Jump – Box Jump	-1,899	8	0.094	-0.280	Not significant

Based on Table 7, the results of the independent sample t-test on the mawashi geri pretest scores obtained a Sig. (2-tailed) value of 0.933 (> 0.05). This indicates that there was no significant difference between the knee tuck jump and jump box exercise groups before treatment.

In the mawashi geri posttest, a Sig. (2-tailed) value of 0.094 (> 0.05) was obtained. These results also indicate that there was no significant difference between the two groups after training. Thus, it can be concluded that both plyometric training methods, both knee tuck jump and box jump, did not provide a significant difference in increasing the speed of mawashi geri kicks in junior athletes.

The results showed that the bent-knee jump and box jump training methods both provided significant increases in mawashi geri kick speed in junior athletes, with greater increases in the bent-knee jump group. This increase occurs because plyometric training stimulates the nervous system and muscles explosively through the stretch-shortening cycle (SSC) mechanism. The bent-knee jump movement involves rapid contractions of the quadriceps, hamstrings, and gastrocnemius muscles that are similar to the phases of the mawashi geri kick movement, so muscle adaptations are more specific and effective in increasing movement speed.

Meanwhile, the jump box method also had a positive effect because it trained leg muscle strength through vertical jumps to higher surfaces, but the transfer of movement to the mawashi geri kick pattern was not as efficient as the bent-knee jump. Therefore, the jump box group's improvement was lower.

Discussion

This study supports the theory that plyometric training increases leg muscle strength and explosive power, which directly impacts movement speed. According to (Girgis & Duarte, 2020), plyometric training can improve neuromuscular efficiency, resulting in explosive power performance. The data obtained showed that participants who performed the knee-bend jump training experienced a significant increase in mawashi geri kick speed, compared to the control group. This phenomenon is consistent with the theory that plyometric training increases the recruitment of fast-acting muscle fibers, which are dominant for explosive movements such as kicks in karate. Research by (Davies et al., 2015) supports that this training can accelerate neuromuscular reaction time and required muscle strength.

The increased power and speed generated by the bent-knee jump are also supported by increased efficiency of energy transfer from muscles to joints during the kicking motion. According to (Rimpung, 2021) , plyometric training helps optimize neuromuscular function and enhances energy transmission mechanisms. When performed regularly and correctly, these exercises contribute to increased efficiency of muscle and joint reactions, resulting in faster and more powerful movements.

Box-based plyometric exercises allow efficient muscle fiber recruitment and increased neuromuscular capacity for rapid movements. Additionally, box jump exercises help strengthen key muscles involved in kicking movements, such as the quadriceps and calf muscles (Abi Permana et al., 2022). The use of a plyometric box also helps improve hip stability and knee joint biomechanics, which is essential for achieving a fast and precise kicking position. Research by (Batalipu et al., 2025) shows that this exercise produces significant increases in the speed and strength of the muscles directly involved in kicking.

According to recent literature (Gervasi et al., 2018), plyometric box jump training can accelerate the recruitment of fast-twitch muscle fibers and improve the efficiency of energy transmission during the kicking movement. Furthermore, this training also helps improve body stability and balance during kicking. The main advantage of this method is its ability to adapt to the training needs and skill level of the athlete. It should be noted that its effectiveness is highly dependent on overload parameters, volume, and correct execution technique.

According to the results of statistical analysis, there is no significant difference between the plyometric knee tuck jump and jump box methods in increasing the speed of mawashi geri kicks in junior karate athletes because both provide equivalent benefits when performed at the same dose. This phenomenon indicates that both exercises are capable of providing equally effective benefits when performed with the same parameters. Research by (Silva et al., 2019). also stated that variations in plyometric training do not have different effects in increasing explosive power as long as the training aspects are performed consistently. This is because the working mechanism of both exercises is similar and triggers an equivalent increase in neuromuscular capacity. Therefore, coaches are welcome to choose either method without compromising the training results. The success of this speed increase is determined more by the quality of the exercise implementation than by variations in technique.

In conclusion, statistically and practically, there is no significant difference in terms of the effect on mawashi geri kick speed between the bent-knee jump method and the box jump method as long as the correct parameters are used. Both methods are capable of improving performance effectively and can be selected according to the training situation and conditions. Although the increase is only small, it can provide improvements and results. The main factors determining success are consistency, intensity, and training technique. Therefore, coaches and athletes must utilize this flexibility for the best results. With proper management, both methods can be used simultaneously or alternately to optimally improve kicking performance (Kons et al., 2023) .

Conclusion

Based on the research findings, several recommendations can be made to relevant parties. Karate coaches are advised to incorporate plyometric training, particularly the knee-bend jump, into their routine training programs. This exercise has been shown to increase explosive leg muscle strength, which plays a crucial role in generating the speed of the mawashi geri kick. However, coaches should also consider training principles such as intensity, frequency, and progression to avoid injury to athletes. Junior athletes are expected to perform plyometric training diligently, with discipline, and consistently. Furthermore, athletes need to maintain their physical condition through a healthy diet, adequate rest, and proper warm-up and cool-down procedures to maximize training results and ensure body safety.

Based on the research results obtained, the results showed a significant increase in the lower-limb knee tuck jump and jump box plyometric training methods on the speed of junior karate athletes' mawashi geri kicks. Several recommendations can be given to related parties. Karate coaches are advised to incorporate plyometric training, especially knee tuck jumps, into their regular training programs. This exercise has been shown to increase explosive leg muscle strength, which plays a crucial role in producing mawashi geri kick speed. However, coaches should also consider training principles such as intensity, frequency, and progression to avoid injury to athletes. Junior athletes are expected to perform plyometric training diligently, disciplined, and consistently. Furthermore, athletes need to maintain their physical condition through a healthy diet, adequate rest, and proper warm-up and cool-down procedures to maximize training results and ensure body safety.

Furthermore, schools and sports clubs should provide support in the form of adequate facilities and infrastructure, such as safe training spaces, jump box facilities, and guidance from competent coaches. A supportive training environment will facilitate the implementation of more effective plyometric training methods. Finally, due to the limited population and sample size, future researchers are expected to continue this research by expanding the variables, for example, examining the effect of plyometric training on other physical aspects such as agility, strength, and coordination. In addition, research can be conducted with a larger sample size or across various age groups and populations to obtain a more comprehensive picture of the effectiveness of plyometric training in martial arts, particularly karate. With these suggestions, it is hoped that the results of this study will not only be useful for the development of sports coaching science but can also serve as a practical reference in improving athlete performance, especially in mastering the mawashi geri kick technique.

Confession

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Conflict of interest

We declare no conflict of interest in this article.

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