



The Effect of Plyometric Training on Kumite Karate Athletes' Mawashi Geri Kick Speed

Aulia Shafira¹, Boyke Mulyana², Mulyana³

^{1,2,3}Fakultas Pendidikan Olahraga dan Kesehatan, Universitas Pendidikan Indonesia

* Corresponding Author. E-mail: auliashafira15@upi.edu¹

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Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh latihan plyometric terhadap kecepatan tendangan mawashi geri pada atlet kumite karate junior klub SESKO AU Lembang. Metode yang digunakan adalah eksperimen kuantitatif dengan desain one group pretest-posttest, melibatkan 20 atlet yang dipilih menggunakan teknik purposive sampling. Perlakuan berupa latihan plyometric yang dikonversikan kedalam pola gerak mawashi geri diberikan selama enam minggu dengan frekuensi tiga kali per minggu. Kecepatan tendangan diukur menggunakan instrumen tes berbasis analisis video (aplikasi Kinovea) sebelum dan sesudah perlakuan. Data dianalisis menggunakan uji normalitas Shapiro-Wilk, uji hipotesis Wilcoxon Signed Ranks Test, serta perhitungan effect size Cohen's d. Hasil penelitian menunjukkan rata-rata waktu tendangan menurun dari 0,4465 detik menjadi 0,3738 detik, dengan seluruh sampel (100%) mengalami peningkatan kecepatan. Uji Wilcoxon menunjukkan nilai $Z = -3,921$ dan Sig. (2-tailed) = 0,000 ($p < 0,05$), yang berarti terdapat pengaruh signifikan, dengan Cohen's $d = 1,14$ (kategori besar). Temuan ini menunjukkan bahwa latihan plyometric efektif meningkatkan kecepatan tendangan mawashi geri, sehingga dapat direkomendasikan sebagai bagian dari program latihan fisik atlet kumite karate junior.

Kata Kunci: latihan plyometric; kecepatan tendangan; mawashi geri; kumite karate

Abstract

This study aims to determine the effect of plyometric training on mawashi geri kick speed among junior kumite karate athletes at SESKO AU Lembang karate club. The method used was a quantitative experiment with a one-group pretest-posttest design, involving 20 athletes selected through purposive sampling technique. The treatment, consisting of plyometric exercises converted into the mawashi geri kick movement pattern, was given for six weeks with a frequency of three times per week. Kick speed was measured using a video analysis-based test instrument (Kinovea application) before and after the treatment. Data were analyzed using the Shapiro-Wilk normality test, the Wilcoxon Signed Rank Test for hypothesis testing, and Cohen's d effect size calculation. The results showed that the average kick time decreased from 0.4465 seconds to 0.3738 seconds, with all samples (100%) experiencing an increase in speed. The Wilcoxon test showed a Z value of -3.921 and Sig. (2-tailed) = 0.000 ($p < 0.05$), indicating a significant effect, with Cohen's $d = 1.14$ (large category). These findings show that plyometric training is effective in increasing mawashi geri kick speed, and can therefore be recommended as part of a physical training program for junior kumite karate athletes.

Keywords: Plyometric Training; Kick Speed; Mawashi Geri; Kumite Karate

INTRODUCTION

Karate is a martial arts sport that demands high speed, precision, and technical control particularly in the kumite category, in which athletes are required to score points through fast and effective attacks (Achika, 2019). Kumite matches themselves are governed internationally through standardized scoring systems and category divisions (Kagawa, 2018). Among the various attacking techniques used in kumite, the mawashi geri kick is considered one of the most decisive in determining point acquisition, owing to its unpredictable trajectory and difficulty for opponents to anticipate. Mawashi geri is a circular kick

oriented more toward speed and snapping impact against the opponent's body; this kick leans more toward a heavy-impact kick, or in other words, involves a pushing and retracting motion. One of the success factors in achieving athletic performance in karate, as well as in executing a good mawashi geri kick, is being supported by good physical condition, since an individual's success or achievement in sport is highly dependent on the quality of their physical ability (physical condition) (Udara & Chandana, 2024).

Observations of junior kumite athletes at the SESKO AU Lembang karate club indicate that the execution speed of the mawashi geri kick remains suboptimal, thereby reducing the effectiveness of attacks during sparring and official matches. This issue is critical, given that movement speed is fundamental physical component that determines the success of technique execution across various sports (Sun et al., 2025). In the context of kumite, where scoring opportunities are often decided within fractions of a second, even a marginal delay in kick execution can significantly reduce an athlete's competitiveness against opponents of similar skill level.

This condition is further compounded by the training methods applied at the club, which remain conventional and have not yet systematically integrated explosive training into technical training programs. In contrast, plyometric training operates through the stretch-shortening cycle mechanism, which has been shown to be effective in increasing muscular power across various sports (Sole, Bellon, & Beckham, 2022). This form of training has also been reported to significantly improve contraction speed and strength in elite athletes (Huang & Huang, 2023). Given that muscular power and contraction speed are directly linked to the velocity of limb movement, plyometric training presents a theoretically sound approach to addressing the speed deficiencies observed among the athletes in this study.

Several alternative training methods have in fact been examined to improve similar physical performance outcomes. Skipping and barrier hops training, for instance, has been shown to influence vertical jump improvement in volleyball athletes (Sapraji et al., 2024). In addition, a combination of leg muscle strength and flexibility has also been reported to affect mawashi geri kicking ability in karate athletes (Chan & Chandra, 2024). However, these methods are generally generic in nature and have not been specifically designed to follow the movement pattern of the target kicking technique itself.

On the other hand, a systematic review of plyometric training studies among combat sport athletes indicates that research specifically evaluating the effectiveness of such training on kicking speed among junior athletes remains very limited (Ojeda-Aravena et al., 2023). Prior research on male athletes of the UNTAN karate club has demonstrated that plyometric training can significantly improve mawashi geri kick speed (Nata, 2024). Similar findings have also been reported among Shorinji Kempo athletes, where knee tuck jump plyometric training was shown to affect the speed of a roundhouse-type kick technically similar to mawashi geri (Lamusu & Harmain, 2024). Nevertheless, these studies have not specifically converted plyometric training into the movement pattern of the technique itself, meaning that training transfer to the specific skill can still be further optimized.

This study also introduces two elements of novelty compared to previous plyometric research on mawashi geri kicks: training and data collection were conducted on a karate mat without footwear to reflect actual competition conditions, and kick speed was measured on both legs (left and right) alternately to represent athletes' overall performance.

Based on this gap, the present study adopts plyometric training that is directly converted into the mawashi geri kick movement pattern as the intervention, under the assumption that movement specificity in training will produce more optimal performance transfer compared by findings indicating that plyometric training plays an important role in improving strength and power among combat sport athletes (Yuan, Deng, & Soh, 2025). This study aims to determine the effect of the aforementioned plyometric training on mawashi geri kick speed among junior kumite karate athletes at the SESKO AU Lembang karate club, while also providing empirical contributions to the still-limited body of research on technique-specific plyometric training within the sport of karate.

METHODS

This study used a quantitative experimental method with a one-group pretest-posttest design, a quasi-experimental design in which subjects' abilities are measured before and after treatment without a control group for comparison. The research was conducted at the SESKO AU Lembang karate club, with the treatment consisting of plyometric training administered for six weeks at a frequency of three sessions per week, with each session lasting approximately 30 to 45 minutes.



The population of this study consisted of all junior kumite karate athletes at the SESKO AU Lembang karate club, encompassing all parties relevant to the research problem within a specific scope (Ismayani, 2019). The sample consisted of 20 athletes selected through purposive sampling, a sampling technique based on specific considerations aligned with the research objectives (Waruwu et al., 2025), with the following criteria: (1) aged 16-17 years (junior category); (2) actively participating in regular training at the club; (3) having mastered the basic mawashi geri technique; (4) not currently experiencing an injury; and (5) willing to participate in the entire research process.

The procedure began with a pretest measurement of mawashi geri kick speed, followed by a plyometric training program converted into the mawashi geri kick movement pattern, consisting of jump squat, tuck jump, depth jump, bounding, and lunge jump variations. A posttest measurement was then conducted after the training program was completed to determine the resulting change in kick speed.

The instrument used was a mawashi geri kick speed test adapted from Simbolon and Siahaan (2020), with kick time measured using the Kinovea video analysis application. The test began with the athlete positioned in front of a target, supporting foot 50 cm (female) or 60 cm (male) behind the line; upon the “go” command, the athlete performed mawashi geri kicks alternately with the left and right leg from both front and rear stances, with a 30-second rest between kicks. The testing position and execution of the mawashi geri kick speed test are shown in Figure 1.



Figure 1. *Execution of the Mawashi Geri Kick Speed Test on the Karate Mat*

Data collection was conducted on both the left and right legs alternately, from both front and rear stances, reflecting the demands of kumite competition, in which athletes must be able to execute effective kicks with either leg. Data from both legs were subsequently averaged into a single variable, namely mawashi geri kick speed, for both pretest and posttest, so that subsequent analyses (normality testing, hypothesis testing, and effect size) were conducted on two final variables: pretest and posttest kick speed.

Data were analyzed using the Shapiro-Wilk normality test. As the pretest data were not normally distributed, hypothesis testing was conducted using the Wilcoxon Signed Ranks Test rather than the paired sample t-test, at a significance level of $\alpha = 0.05$ ($p < 0.05$ indicating a significant effect). Effect size was calculated using Cohen's d, categorized as small (0.2), medium (0.5), or large (≥ 0.8).

RESULT AND DISCUSSION

Research Result

This study involved 20 junior kumite karate athletes from the SESKO AU Lembang club, whose mawashi geri kick speed was measured before and after six weeks of plyometric training.

Table 1. *Descriptive Data of Mawashi Geri Kick Speed*

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	20	0.33	0.70	0.4465	0.08072
Posttest	20	0.31	0.47	0.3738	0.04000

Table 1 presents descriptive analysis showed that the mean kick time decreased from 0.4465 seconds (SD = 0.08072) at pretest to 0.3738 seconds (SD = 0.04000) at posttest, indicating an improvement in kick speed following the treatment.

Table 2. *Normality Test*

Normality Test - Shapiro-Wilk	Statistic	df	Sig
Pretest Speed	0.854	20	0.006
Posttest Speed	0.930	20	0.154

According to table 2, the Shapiro-Wilk normality test showed that the pretest data were not normally distributed ($p = 0.006 < 0.05$), while the posttest data were normally distributed ($p = 0.154 > 0.05$). since one of the datasets was not normally distributed, hypothesis testing was conducted using the non-parametric Wilcoxon Signed Ranks Test as an alternative to the paired sample t-test.

Table 3. *Wilcoxon Signed Ranks Test Results*

	N	Z	Sig. (2-tailed)
Posttest – Pretest	20	-3.921	0.000

As shown in table 3, the Wilcoxon test results showed that all 20 samples (100%) exhibited negative ranks (posttest < pretest), with no samples showing an increase in kick time. The value of $Z = -3.921$ with an Asymp. Sig. (2-tailed) of 0.000 ($p < 0.05$) indicated that plyometric training had a significant effect on mawashi geri kick speed.

Table 4. *Cohen's d Effect Size Calculation Results*

Component	Value
Mean Pretest	0.44650
Mean Posttest	0.3738
SD Pretest	0.08072
SD Posttest	0.04000
$d = \frac{0.4465 - 0.3738}{0.0637} = \frac{0.0727}{0.0637} = 1.14$	
Cohen'sd	1.14
Effect Size Category	Large

Based on Table 4, a Cohen's d value of 1.14 was obtained, which according to the interpretation criteria of Cohen's d is classified as a large effect, since $d \geq 0.8$. This indicates that plyometric training had not only a statistically significant effect but also a substantial practical impact on improving mawashi geri kick speed among kumite karate athletes.

Discussion

Based on the results of the data processing that has been described, it was found that all 20 samples in the study (100%) experienced a decrease in mawashi geri kick execution time after being given a six-week plyometric training program. The mean kick time decreased from 0.4465 seconds at pretest to 0.3738 seconds at posttest. The results of the Wilcoxon Signed Ranks Test showed a Z value of -3.921 with an Asymp. Sig. (2-tailed) of 0.000 ($p < 0.05$), indicating a significant effect of plyometric training on mawashi geri kick speed. In addition, the effect size calculation using Cohen's d formula showed a value of 1.14, which falls into the large effect category. Thus, the research hypothesis stating that plyometric training has a significant effect on mawashi geri kick speed ability among junior category karate athletes can be accepted.

These findings confirm the problem addressed in this study, namely the suboptimal mawashi geri kick speed among junior athletes at the SESKO AU Lembang club, resulting from the application of conventional training methods that had not yet systematically incorporated explosive training into technical training programs. Following the administration of plyometric training converted into the mawashi geri kick movement pattern for six weeks at a frequency of three sessions per week, all athletes (100%) showed an improvement in kick speed, with no sample exhibiting a decline in performance (0% positive ranks). This consistency of response across all samples indicates that the effectiveness of



plyometric training was not merely incidental to a subset of athletes, but applied uniformly across the junior athlete population despite their varying physical characteristics, thereby strengthening the external validity of the intervention administered.

Theoretically, this result can be explained through the working mechanism of plyometric training, which emphasizes the stretch-shortening cycle (SSC), namely a combination of rapid and sequential eccentric and concentric muscle contractions. Plyometric training works through the mechanism of rapid stretching and contraction within the stretch-shortening cycle, which plays an important role in increasing muscular power. Plyometric movements such as jump squat, tuck jump, depth jump, bounding, and lunge jump administered in this study were designed to improve the strength and contraction speed of the leg muscles, so that this strength transfer could be applied to improving the execution speed of the kicking technique.

In addition to the muscular strength aspect, plyometric training also plays a role in enhancing neuromuscular adaptation, namely the nervous system's ability to recruit muscle fibers more quickly and efficiently during explosive movements. This neuromuscular adaptation is what enables athletes to execute the mawashi geri kick with a shorter reaction time and execution time compared to before the treatment, since movement speed fundamentally reflects the efficiency of the muscles and nervous system in working simultaneously. From a biomechanical perspective, the execution of the mawashi geri kick involves the sequential coordination of the hip, knee, and ankle joints to produce a fast and powerful circular movement. The increase in leg muscle power resulting from plyometric training allows these three body segments to move faster within the same kinetic chain, thereby shortening the total execution time of the kick.

CONCLUSION

Based on the results and discussion presented above, it can be concluded that plyometric training converted into the mawashi geri kick movement pattern had a significant effect on improving mawashi geri kick speed among junior kumite karate athletes at the SESKO AU Lembang club. This was demonstrated by the results of the Wilcoxon Signed Ranks Test, which showed a Z value of -3.921 with an Asymp. Sig. (2-tailed) of 0.000 ($p < 0.05$), as well as all samples in the study (100%) experiencing a decrease in kick execution time after receiving the six-week treatment. In addition to being statistically significant, the magnitude of the effect produced was also classified as large, with a Cohen's d value of 1.14, indicating that plyometric training had a meaningful practical impact on athletes' performance, rather than merely a statistically significant difference.

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