

citius jurnal

Citius_Margareta_19_28

 Citius vol 6 no 2

 CITIUS

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e-ISSN 2797-9962

Journal Homepage: <http://journal.unugiri.ac.id/index.php/citius>

The effectiveness of resistance band training on the mawashi geri kick speed of karate athletes

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ABSTRACT

Kicking speed is a component of physical condition that strongly determines the performance of karate athletes, especially in kumite. The mawashi geri technique requires fast, explosive, and accurate movements to score points before the opponent can anticipate them. One training method considered effective for increasing kicking speed is the resistance band, because it provides specific elastic resistance along the kicking movement pattern. This study aimed to analyse the effectiveness of resistance band training on the mawashi geri kick speed of karate athletes. A quantitative, pre-experimental one-group pretest–posttest design was used. The population was the active karate athletes of the studied dojo, and 15 athletes were selected purposively. The instrument was the measurement of the travel time of a single mawashi geri kick using a digital stopwatch, and the data were analysed with the Shapiro–Wilk normality test followed by the Wilcoxon signed-rank test. The results showed a significant increase in kicking speed, with the average kick time decreasing from 0.63 s at pretest to 0.55 s at posttest ($Z = -3.408$; $p < 0.001$; $r = 0.62$). Resistance band training was therefore effective in increasing the mawashi geri kick speed of karate athletes and is recommended as a supporting training method in athlete-development and performance-improvement programmes. Given the one-group design without a control group, the findings should be interpreted with caution.

Keywords: resistance band; elastic resistance training; kick speed; mawashi geri; karate

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Received: 15 January 2026; Accepted 26 July 2026; Published 02 August 2026

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How to Cite: Margaretha, B., Bhakti, Y. H., Aldapit, E., & Nurhikmah. (2026). The effectiveness of resistance band training on the mawashi geri kick speed of karate athletes. *Citius: Jurnal Pendidikan Jasmani, Olahraga, dan Kesehatan*, 6(2), 19–28. <https://doi.org/10.32665/citius.v6i2.6246>

Authors' Contribution*: a – Study Design; b – Data Collection; c – Statistical Analysis; d – Manuscript Preparation; e – Funds Collection.

INTRODUCTION

Karate is a martial art that requires optimal mastery of technique, physical condition, and tactical ability to achieve high performance in matches (Manullang et al., 2024). In kumite, attack speed is a key variable determining an athlete's success in scoring points and dominating an opponent. One of the most crucial techniques in kumite is the mawashi geri, a circular kick that relies on hip rotation, leg-muscle strength, and leg-swing speed to deliver an effective attack at a fast pace (Nurhadi et al., 2023). Kick speed is decisive because kumite is fast-paced and demands quick, accurate attacks and defences. Movement speed is influenced by muscle strength, neuromuscular coordination, and the

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efficiency of the central nervous system in transmitting motor impulses, all of which support kicking performance in competitive martial arts (Kusminto et al., 2021; Yusfi et al., 2024).

Biomechanically, the mawashi geri is produced through a kinetic chain that starts from hip rotation and travels down the thigh to the lower leg, so the speed of the kick depends not only on how strong the leg muscles are but also on how efficiently that force is generated and released within a very short span of time. In competitive kumite this span is extremely narrow, and a gap of only a few hundredths of a second can decide whether an attack lands before the opponent manages to react. Because of this, training that aims to sharpen kicking speed needs to work the explosive and coordinative qualities of the exact muscles involved rather than relying on general fitness alone, and this is precisely why movement-specific loading has drawn growing interest among coaches and sport scientists.

Various studies in martial arts and other sports have explored resistance band or elastic-resistance training as a method to improve physical performance, including kicking speed and muscular explosiveness (Batra et al., 2024; Endrawan et al., 2023). Research in taekwondo shows that elastic-resistance training significantly increases kick velocity and quality in athletes (Paulauskas et al., 2025; Septian et al., 2024), demonstrating the effectiveness of this tool for developing explosive kicking speed. In pencak silat, resistance band training has likewise improved the speed of the sabit (crescent) kick (Zainul Ikhwan et al., 2023; Cahyani et al., 2024).

In the specific context of karate, preliminary findings indicate that resistance band training can increase leg-muscle strength and explosive power, contributing to a higher mawashi geri jodan kick speed in athletes at the BKC Mojosari Dojo (Indriyati & Suyoko, 2025). Similar elastic-resistance approaches have improved striking speed and power in karate more broadly (Prayoga, 2023; Putri et al., 2022). In general, resistance band training supports athletic performance by increasing muscle strength, neuromuscular coordination, and explosive ability in the limbs directly involved in the movement, because the band provides progressive loading that follows the movement pattern (Hammami & Zmijewski, 2024).

The way elastic resistance develops speed can be traced to a few working principles. Unlike a fixed weight, a stretched band delivers accommodating resistance that grows as the limb extends, so the load is heaviest near the end of the range where the leg is accelerating hardest toward the target. Training under this kind of load emphasises the rate at which force is produced rather than maximal force alone, and it rehearses the stretch and release sequence that the kicking muscles use during a real strike. Because the resistance follows the natural line of the movement, the adaptations it produces tend to carry over more directly to technical execution than gains built through generic strength exercises.

Although many studies have demonstrated the effectiveness of resistance bands for improving physical performance, a clear research gap remains in karate. Most previous work has focused on other sports or different techniques, has used less specific measurement instruments, or has not addressed mawashi geri kick speed directly and comprehensively; applied approaches suited to the real training conditions of karate athletes are also under-studied. This study addresses that gap by providing measurable empirical evidence, using a movement-specific outcome (mawashi geri travel time) under structured training conditions, and by offering results that can be applied directly in karate athlete-development programmes at club and university levels.

These considerations matter a great deal in everyday coaching. Many dojos and school clubs operate with limited equipment, short sessions, and athletes at different levels, so coaches need training methods that are affordable, easy to supervise, and specific enough to sharpen the techniques that decide matches. A resistance band fits this need well, yet clear evidence on how much it improves

a defined competitive skill such as the mawashi geri, measured under realistic training conditions, is still limited. Providing that evidence would give coaches and physical education teachers a practical basis for deciding whether and how to include elastic-resistance work in their programmes.

Based on this background, novelty, and research gap, this study aims to analyse the effectiveness of resistance band training in increasing the mawashi geri kick speed of karate athletes through a pre-experimental one-group pretest–posttest approach. Because the design has no control group, the study is framed as an initial, applied evaluation rather than a controlled causal test.

METHOD

This study used a quantitative approach with a pre-experimental method and a one-group pretest–posttest design (Apriani et al., 2021). In this design, one group of subjects received resistance band training, and mawashi geri kick speed was measured before (pretest) and after (posttest) the programme. Because the design does not include a control group, causal interpretation is limited, and threats such as maturation, practice, and testing effects cannot be fully ruled out; the design was chosen for its applicability to real dojo training conditions.

The population was the active karate athletes of the studied dojo who regularly followed the training programme. A purposive sample of 15 athletes was selected using the criteria of training at least three times per week, having at least one year of training experience, being free of lower-limb injury, and being willing to participate throughout the study. Participant characteristics relevant to kick speed, namely sex, age, belt grade, and kumite experience, were recorded prior to the intervention and should be reported alongside the results.

The instrument was a mawashi geri kick-speed test, measuring the travel time of one kick from the ready position to the target with a digital stopwatch; each athlete performed two attempts and the best time was recorded. The test procedure followed the standardised mawashi geri speed test, which supports its content validity and reliability (Kadir & Haryanto, 2021). Because hand-operated timing has limited resolution relative to the small time differences involved, the same operator, signal, and measurement setup were used for pretest and posttest to maximise consistency, and the measurement precision (0.01 s) is reported so that results can be interpreted accordingly; future studies are encouraged to use electronic timing gates or high-speed video. The full specification of the instrument is summarised in Table 1.

Table 1. Research instrument for measuring mawashi geri kick speed

Component	Description
Measured variable	Speed of the mawashi geri kick
Instrument	Mawashi geri kick-speed test using a digital stopwatch with a resolution of 0.01 s
Measurement procedure	The athlete performs one mawashi geri from the ready position to the target; each athlete takes two attempts and the fastest travel time is recorded
Unit of measurement	Seconds (s), read to 0.01 s
Validity and reliability	Based on the standardised mawashi geri speed test (Kadir & Haryanto, 2021)
Measurement control	The same operator, starting signal, and measurement setup are used for both the pretest and the posttest

The research procedure comprised preparation, pretest, treatment, and posttest. After the initial measurement, participants completed a six-week resistance band training programme, three times per week, focused on the mawashi geri kick. After the treatment, the final measurement used the same

procedure as the pretest. Data were analysed with the Shapiro–Wilk normality test; because the difference scores were not normally distributed, the Wilcoxon signed-rank test was used as the inferential test, and the effect size was computed as $r = Z/\sqrt{N}$. All tests used a significance level of $\alpha = 0.05$.

RESULTS

This study presents the data obtained after a six-week resistance band training programme on the mawashi geri kick speed of karate athletes, including pretest and posttest results, the normality test, and the hypothesis test. Before the intervention, all 15 athletes met the predetermined inclusion criteria: each trained at least three times per week, had a minimum of one year of structured karate experience, was free of any lower-limb injury, and agreed to take part for the full duration of the study. The group was therefore fairly homogeneous in training background, which lowers the chance that wide differences in baseline conditioning shaped the outcome. Demographic details such as sex, age, belt grade, and kumite experience were recorded during screening and describe a group of trained practitioners rather than beginners, which is useful context when judging how far the findings may extend to similar athletes.

Table 2. Pretest and posttest data of mawashi geri kick speed

No	Athlete	Pretest (s)	Posttest (s)	Difference (s)
1	A1	0.62	0.54	0.08
2	A2	0.60	0.52	0.08
3	A3	0.65	0.56	0.09
4	A4	0.63	0.55	0.08
5	A5	0.61	0.53	0.08
6	A6	0.64	0.55	0.09
7	A7	0.66	0.57	0.09
8	A8	0.62	0.54	0.08
9	A9	0.63	0.55	0.08
10	A10	0.65	0.56	0.09
11	A11	0.61	0.53	0.08
12	A12	0.64	0.55	0.09
13	A13	0.62	0.54	0.08
14	A14	0.63	0.55	0.08
15	A15	0.66	0.57	0.09
Average		0.63	0.55	0.08

All athletes showed a decrease in mawashi geri kick time after the training. The average kick time fell from 0.63 s at pretest to 0.55 s at posttest, an average improvement of 0.08 s, with individual improvements of 0.08–0.09 s. Because the improvements cluster tightly at the 0.01 s resolution of the timer, the change should be read together with the measurement-precision note in the Method.

Table 3. Descriptive statistics of mawashi geri kick speed

Statistic	Pretest (s)	Posttest (s)	Difference (s)
N	15	15	15
Mean	0.63	0.55	0.08
Std. deviation	0.018	0.014	0.005
Minimum	0.60	0.52	0.08
Maximum	0.66	0.57	0.09

The descriptive statistics reinforce the pattern seen in the raw scores. Kick times were tightly clustered at both time points, with a pretest standard deviation of 0.018 s narrowing slightly to 0.014 s at posttest, which suggests that the athletes not only became faster on average but also more uniform

in their performance. The gap between the fastest and slowest athlete moved from a pretest range of 0.60 to 0.66 s to a posttest range of 0.52 to 0.57 s. Because the difference scores varied by only about 0.005 s around a mean of 0.08 s, the improvement was highly consistent across the group rather than being driven by a few strong responders.

Table 4. Shapiro–Wilk normality test for the pretest–posttest difference

Variable	N	Statistic	p	Distribution
Difference (pretest–posttest)	15	0.630	< 0.001	Not normal

The difference scores had $p < 0.001$, below the 0.05 threshold, so they were not normally distributed. The normality assumption was therefore not met, and a non-parametric test was required.

Table 5. Wilcoxon signed-rank test results

Variable	N	Median Δ (s)	Z	p	r
Mawashi geri kick speed	15	0.08	-3.408	< 0.001	0.62

The Wilcoxon signed-rank test showed a significant difference between pretest and posttest kick speed ($Z = -3.408$; $p < 0.001$), with a large effect size ($r = 0.62$). The median improvement was 0.08 s. Because the data were not normally distributed, the Wilcoxon test served as the sole inferential test; a parametric paired t-test was not appropriate here and is therefore not reported. Overall, resistance band training significantly increased the mawashi geri kick speed of the athletes in this sample.

Taken together, the three analyses point in the same direction. Every one of the 15 athletes recorded a faster kick at posttest, with no exceptions and only a narrow spread of individual gains ranging from 0.08 to 0.09 s. Relative to the pretest average of 0.63 s, the mean reduction of 0.08 s amounts to an improvement of roughly 12.7 percent in kick execution time. The non-parametric test confirmed that this shift was statistically significant, and the effect size of $r = 0.62$ shows that the change was substantial rather than marginal. The descriptive pattern and the inferential result therefore reinforce one another within this sample, while the interpretation of the mechanism behind the improvement is taken up in the following section.

DISCUSSION

The main problem in developing karate athletes for kumite is the slow execution of kicking techniques, which directly affects the effectiveness of attacks and the points earned. The mawashi geri, as one of the mainstay kicking techniques, demands high speed, coordination, and explosive power, yet conventional training often develops these aspects unsystematically. This study addressed the problem by applying resistance band training as a more functional and movement-specific approach.

The findings indicate that resistance band training positively affects mawashi geri kick speed (Endrawan et al., 2023; Paulauskas et al., 2025). Theoretically, this can be explained through neuromuscular adaptation: elastic-resistance training improves motor-unit recruitment, intramuscular coordination, and the speed of nerve-impulse transmission. The band provides progressive loading that follows the kicking pattern, training key muscles such as the hip flexors, quadriceps, hamstrings, and hip rotators specifically according to the demands of the mawashi geri, which supports the principle that movement-specific training transfers more strongly to technical performance (Fang et al., 2023; Hammami & Zmijewski, 2024).

This result is in line with studies reporting that elastic-resistance training effectively increases mawashi geri and roundhouse kick speed in karate and taekwondo athletes (Indriyati & Suyoko, 2025; Paulauskas et al., 2025; Hadjarati et al., 2022). The consistency across contexts indicates a robust

effect of elastic-resistance training on kick speed. Research in other martial arts, such as pencak silat, similarly shows that elastic-resistance training improves the strength, coordination, and speed of the sabit kick (Zainul Ikhwan et al., 2023; Jalil, 2023; Ananzar & Mistar, 2022), reinforcing the view that resistance bands are an effective medium for developing the physical components that underpin kicking success.

The magnitude of the change observed here deserves attention. An effect size of $r = 0.62$ falls within the range usually regarded as large, which means the improvement was not a marginal statistical artefact but a meaningful shift in performance. Placed next to earlier reports, the result is broadly consistent in direction and comparable in strength. Studies on elastic-resistance training in taekwondo and karate have reported moderate to large gains in kick velocity over blocks of six to eight weeks, and the present six-week programme produced a change of similar order (Paulauskas et al., 2025; Indriyati & Suyoko, 2025). The convergence across different martial arts, coaches, and measurement setups suggests that the benefit of elastic loading for kick speed is reasonably robust rather than tied to one particular context.

From a physiological standpoint, several mechanisms may act together to produce faster kicks. Elastic resistance provides accommodating load that rises as the band stretches, so resistance is greatest near the end of the kicking range where the limb accelerates most. This pattern encourages a high rate of force development, that is, the ability to express force quickly rather than simply to express a large maximal force. Repeated exposure to this demand is thought to improve motor-unit recruitment and firing frequency, sharpen coordination across the hip and knee, and make fuller use of the stretch-shortening cycle during the loading and release phases of the mawashi geri. Because these adaptations are trained in a pattern that closely resembles the competitive movement, the transfer to actual kicking performance tends to be stronger than that gained from general strength work alone (Fang et al., 2023; Hammami & Zmijewski, 2024).

When linked to pedagogical approaches, the findings support a constructivist perspective in which athletes learn through active, exploratory, and meaningful experiences. Resistance band training offers varied and progressively challenging motor experiences, allowing athletes not only to imitate movements but also to develop a kinaesthetic understanding of the mawashi geri. Prior work on circuit-based and varied training reports improvements in coordination and strength that are important for mastering motor skills (Annasai et al., 2023). This approach is therefore relevant both for achievement-oriented training and for integration into physical education.

The novelty of this study lies in its specific focus on mawashi geri kick speed rather than on general strength or fitness, confirming that resistance band training improves not only physical capacity but also the quality of technical execution that is decisive in kumite. In terms of curriculum implications, resistance band training can be integrated into physical education and extracurricular self-defence programmes, since simple tools allow teachers and coaches to provide varied, challenging, and contextual learning experiences that support motor skills, coordination, and movement confidence (Fang et al., 2023).

For coaches, the practical value of these findings lies in how easily elastic-resistance work can be built into an existing programme. A band is inexpensive, portable, and quick to set up, which suits dojo sessions that have limited equipment and time. In a periodised plan, resistance band drills for the mawashi geri can be placed in the preparatory and pre-competition phases, performed two to three times per week with gradual increases in band tension or in the quality of each repetition as the athlete adapts. Sets should favour fast, technically clean repetitions over fatigue, since the aim is speed rather than endurance, and enough recovery between sets helps protect movement velocity. Pairing the band

drills with unresisted kicks in the same session may further help athletes carry the trained pattern into free execution.

It is also worth situating resistance bands among the other tools coaches use to build kicking speed. Ankle weights, medicine balls, and plyometric drills can all raise leg power, yet each carries trade-offs in specificity, safety, or cost. Ankle weights add load across the range but can disturb the natural timing of the kick, while heavier implements are not always available in a training hall. Elastic bands occupy a useful middle ground, offering movement-specific and adjustable resistance at low cost and with a modest injury risk when technique is supervised. This accessibility matters most in school and community settings, where budgets are tight and where a single set of bands can serve a whole group, making the method attractive for competitive coaching and physical education alike.

This study has several limitations. The relatively small sample and the absence of a control group limit the generalisability and causal strength of the results, so improvements cannot be fully separated from maturation, practice, or testing effects. The outcome relied on hand-operated stopwatch timing, whose resolution and reaction-time error are non-trivial relative to the observed 0.08 s change, so the effect size should be interpreted cautiously. The study also examined a single technique, one training method, and a limited intervention period. Future research should use a controlled design with a larger sample, electronic timing, and a broader range of techniques and performance variables.

Overall, the study reinforces the view that specific, active, and experiential training meaningfully supports motor-skill improvement. Resistance band training proved relevant not only for fitness but also for improving the quality of the mawashi geri kick, contributing to coaching science, physical education, and karate athlete development.

CONCLUSION

Resistance band training was effective in increasing mawashi geri kick execution speed in this sample of karate athletes. The novelty of the study lies in its specific focus on mawashi geri speed using a structured elastic-resistance approach, adding to a body of karate coaching knowledge that has previously emphasised general strength. Methodologically, a one-group pretest–posttest design with direct measurement of kick travel time offers an applicable, if preliminary, way to evaluate a training method, though it cannot establish causality on its own. Practically, the results support integrating resistance band training into self-defence skill development and physical education, provided that coaches attend to progression, safety, and precise measurement. Future research is encouraged to use a controlled design, a larger sample, electronic timing, and additional techniques and performance variables to strengthen and broaden the findings.

ACKNOWLEDGEMENTS

The authors thank all parties who supported this study, particularly the coaches, athletes, and the dojo that provided access for data collection.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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