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The Effectiveness Of Circuit Training On The Accuracy Of Mawashi Geri Kicks In Karate Athletes

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ABSTRACT

Kicking accuracy is a crucial factor in successful striking techniques in karate, particularly in kumite, which demands high speed, precision, and movement control. However, preliminary observations of FORKI Sungai Penuh karate athletes revealed that the accuracy of Mawashi Geri kicks remains relatively low, especially during intensive training and match simulations. This situation highlights the need for training methods that effectively integrate physical conditioning and technique. Therefore, this study aimed to determine the effectiveness of circuit training in improving Mawashi Geri kick accuracy in FORKI Sungai Penuh karate athletes. The research method used was an experimental one-group pretest-posttest design. The sample consisted of 15 brown belt karate athletes selected using purposive sampling. The research instrument used a 30-second Mawashi Geri kick accuracy test targeting kicking pads. The circuit training program was implemented throughout the study period, incorporating several variations of exercises integrating strength, agility, coordination, and kicking technique. Data analysis was performed using a paired sample t-test with a significance level of 0.05. The results showed that the average pretest score of 6.73 increased to 12.20 in the posttest, representing a 5.47-point increase. The statistical test showed a t-value of 12.364 with a significance level of 0.000 (<0.05). These results indicate a significant improvement after circuit training. Therefore, it can be concluded that circuit training is effective in improving the accuracy of Mawashi Geri kicks in FORKI Sungai Penuh karate athletes.

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INTRODUCTION

Karate is one of the most widely practiced martial arts in the world and continues to develop rapidly in many countries, including Indonesia. The sport is contested in two main disciplines, namely kata and kumite, each requiring different technical, tactical, and physical competencies (Chaabene et al., 2019; Slimani et al., 2017). Kata emphasizes the aesthetic and technical perfection of movement sequences, whereas kumite focuses on direct combat between athletes where speed, timing, and accuracy determine competitive success (Tabben et al., 2018). In kumite competitions, scoring is

largely influenced by the effectiveness of attacks delivered to valid target areas such as the head (jodan), body (chudan), and other permitted zones according to the regulations of the World Karate Federation (WKF) (Chaabene et al., 2019). Among the various offensive techniques used in kumite, kicking techniques generally receive higher scoring values than punches due to their complexity, risk, and potential impact. One of the most frequently used kicking techniques in competitive karate is the Mawashi Geri, a circular kick directed to the opponent's body or head (Chan & Candra, 2024). This technique is widely applied because of its versatility, speed, and ability to penetrate defensive positions. However, executing an effective Mawashi Geri requires not only explosive muscular strength but also high levels of neuromuscular coordination, dynamic balance, reaction speed, and movement accuracy (Gaweł et al., 2025).

From a biomechanical perspective, the Mawashi Geri kick involves a complex kinetic chain movement that begins with pelvic rotation, followed by rapid knee extension and controlled ankle movement to direct the foot precisely toward the intended target (Dlis et al., 2020). This sequence of movements requires synchronized activation of multiple muscle groups including the hip flexors, quadriceps, hamstrings, gluteal muscles, and core stabilizers (Bachtiar et al., 2025). If the coordination between these muscle groups is not optimal, the kick may lose accuracy or power, reducing its effectiveness in competition. Movement accuracy in sports is closely associated with the efficiency of motor control processes within the central nervous system. Motor control theory suggests that accurate movement execution depends on the integration of sensory feedback, neural processing, and coordinated muscle activation (Schmidt et al., 2018). Athletes who demonstrate superior motor control are better able to maintain precise movement patterns even under conditions of fatigue or external pressure. In martial arts, the development of movement accuracy is considered a marker of advanced technical mastery that emerges through systematic training and repeated movement practice (Magill & Anderson, 2010).

Despite the importance of accuracy in kicking techniques, practical observations often reveal inconsistencies between athletes' technical knowledge and their performance during training or competition. Based on preliminary observations conducted on 30 karate athletes of FORKI Sungai Penuh, several issues related to the execution accuracy of Mawashi Geri kicks were identified. First, some athletes showed a decline in kick accuracy when experiencing physical fatigue during intensive training sessions. Second, the coordination between pelvic rotation and leg extension appeared suboptimal, resulting in kicks that frequently deviated from the intended target. Third, during sparring and match simulation sessions, kicks often failed to reach the designated scoring zones, particularly the jodan (head) target.

In addition, the training program previously implemented within the athlete development program primarily emphasized increasing kick frequency and muscular power rather than improving movement accuracy and technical control. While physical strength and speed are important performance determinants in martial arts, an excessive focus on these elements without integrating technical precision may reduce

the effectiveness of techniques during competition (Bompa & Buzzichelli, 2019). Consequently, athletes may possess adequate strength and speed but still struggle to deliver accurate kicks under dynamic match conditions.

These conditions indicate the existence of a performance gap between the mastery of basic techniques (kihon) and their application in dynamic competitive situations (kumite). Without an appropriate training strategy that integrates both physical conditioning and technical accuracy, athletes may encounter difficulties translating training improvements into effective competitive performance. Therefore, identifying training methods capable of simultaneously improving physical and technical aspects of kicking techniques becomes an important issue in karate training science.

In recent years, sports scientists and coaches have increasingly emphasized the integration of physical conditioning and sport-specific skills in training programs to improve athletic performance. Modern training approaches highlight the importance of combining strength, coordination, agility, and technical execution within structured training systems (Suchomel et al., 2018; Bompa & Buzzichelli, 2019). Within this framework, training methods that replicate competition demands are considered more effective in developing functional sport skills.

One training method widely used in performance development is circuit training. Circuit training is a structured training system consisting of several exercise stations performed sequentially with controlled intensity and limited recovery periods (Elba, 2016). This method allows athletes to perform multiple exercises targeting different physical components such as muscular strength, endurance, agility, balance, and coordination within a single training session (Wilmore et al., 2004).

Circuit training has gained increasing attention in sports performance research because of its efficiency and adaptability across various sports disciplines. Studies have demonstrated that circuit training can significantly improve multiple physiological parameters including muscular strength, aerobic capacity, and neuromuscular coordination (Almeida et al., 2021; Hammami et al., 2018). Furthermore, the continuous nature of circuit training creates training conditions that mimic competitive fatigue, enabling athletes to maintain performance quality even under physically demanding situations (Wallace, 2024).

In the context of martial arts, circuit training is particularly relevant because combat sports require athletes to perform complex technical movements repeatedly while experiencing high levels of fatigue. Research on taekwondo and karate athletes indicates that integrated training methods combining technical drills with conditioning exercises can significantly enhance kicking performance and reaction speed (Chaabene et al., 2019; Tabben et al., 2018). Empirical evidence also shows that the accuracy of kicking techniques in martial arts is strongly influenced by several physical factors such as balance, explosive leg power, and coordination (Bachtiar et al., 2025). Athletes with better balance and neuromuscular control tend to demonstrate higher levels of movement precision and stability when executing kicks. These findings highlight the importance of developing physical attributes that support technical accuracy.

Several previous studies have examined the effects of circuit training on athletic performance in martial arts. For example, Pramana Sastra (2025) reported that circuit training significantly improved kicking speed and overall technical performance among karate athletes. Similarly, Yoga (2025) found that circuit-based conditioning programs enhanced both muscular endurance and technical consistency during repeated kicking tasks. These findings suggest that circuit training has the potential to improve the quality of kicking techniques by simultaneously enhancing physical capacity and technical execution.

Despite these promising findings, most previous research has primarily focused on kick speed, power, or general physical fitness, while relatively few studies have specifically examined the role of circuit training in improving kick accuracy, particularly for the Mawashi Geri technique. Given the importance of accuracy in scoring during kumite competitions, further investigation is needed to explore training strategies that specifically target this aspect of performance.

Although numerous studies have investigated the physical and physiological demands of martial arts performance, several limitations remain in the current body of literature. First, most existing studies emphasize the development of strength, speed, or endurance as primary determinants of kicking performance (Chaabene et al., 2019; Slimani et al., 2017). While these variables are important, they do not necessarily guarantee improved movement accuracy during technical execution.

Second, previous studies examining kicking techniques in karate often focus on biomechanical analysis or performance evaluation, rather than exploring training interventions designed to improve movement accuracy (Dlis et al., 2020). Consequently, there is limited empirical evidence regarding training methods that effectively integrate physical conditioning and technical accuracy in martial arts training programs.

Third, although circuit training has been widely recognized as an effective method for improving physical fitness components, its application in martial arts training has mostly been oriented toward conditioning improvements rather than technical precision. Few studies have specifically investigated how circuit training can influence the accuracy of complex kicking techniques such as Mawashi Geri.

Fourth, the majority of previous studies have been conducted in controlled laboratory environments or with elite athletes in developed countries. Research involving regional or developing athlete populations, such as karate athletes in Indonesian training centers, remains relatively limited. Considering the rapid growth of karate participation in Indonesia and the increasing competitiveness of national athletes, empirical research examining training methods within local athlete populations is highly necessary.

These limitations highlight a clear research gap regarding the effectiveness of integrated training methods particularly circuit training in improving the accuracy of Mawashi Geri kicks among karate athletes. Addressing this gap is important not only for advancing scientific understanding of martial arts training but also for providing practical recommendations for coaches and athlete development programs.

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Based on the problems identified in the Sungai Penuh FORKI karate athletes, as well as the theoretical and empirical foundations discussed above, the present study aims to analyze the effectiveness of circuit training in improving the accuracy of Mawashi Geri kicks in karate athletes. Specifically, this study seeks to: Evaluate the level of Mawashi Geri kick accuracy among karate athletes before and after the implementation of a circuit training program. Determine whether circuit training produces significant improvements in kick accuracy compared to conventional training methods. Examine the potential role of integrated physical conditioning in enhancing technical performance in martial arts athletes.

The novelty of this research lies in its integration of circuit training with sport-specific technical accuracy training, focusing specifically on the Mawashi Geri kick in karate athletes. Unlike previous studies that primarily emphasize physical performance variables such as strength or speed, this research investigates how a structured circuit training program can directly influence the precision of a complex martial arts technique.

Furthermore, this study contributes empirical data derived from Indonesian karate athletes, providing valuable insights into the application of evidence-based training methods within local athlete development programs. The findings of this research are expected to enrich the scientific literature on martial arts training and offer practical recommendations for coaches seeking to improve athletes' technical performance through integrated training strategies.

In summary, Mawashi Geri is one of the most important kicking techniques in karate kumite, requiring a combination of explosive strength, coordination, balance, and movement accuracy. However, practical observations among FORKI Sungai Penuh karate athletes reveal several issues related to the consistency and precision of this technique during training and competition. Existing training programs tend to emphasize strength and kick frequency rather than technical accuracy and motor control. Although circuit training has been widely recognized as an effective method for improving physical fitness and athletic performance, limited research has explored its potential to enhance the accuracy of specific martial arts techniques. This gap highlights the need for empirical investigation into training strategies that integrate physical conditioning and technical skill development. Therefore, this study investigates the effectiveness of circuit training in improving the accuracy of Mawashi Geri kicks in karate athletes. The findings are expected to contribute to the development of more effective training programs that combine physical and technical components in martial arts performance development.

METHODS

This study employed an experimental research method using a one-group pretest–posttest design to examine the effectiveness of circuit training on improving the accuracy of Mawashi Geri kicks in karate athletes. Experimental methods are widely used in sports science to evaluate the causal relationship between training interventions and

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performance outcomes because they allow researchers to observe measurable changes before and after treatment (Thomas et al., 2015; Chaabene et al., 2019). The one-group pretest–posttest design was selected because it enables the comparison of athletes' performance levels prior to and following the training intervention, thereby identifying the magnitude of improvement resulting from the applied training program (Gratton & Jones, 2019). The population of this study consisted of 30 karate athletes registered in the Indonesian Karate Federation (FORKI) Sungai Penuh training center. From this population, 15 athletes holding brown belt rank were selected as the research sample using a purposive sampling technique. This sampling method was chosen to ensure that the selected participants possessed sufficient technical mastery of basic karate techniques and were actively involved in regular training programs, thereby reducing variability caused by differences in skill level (Etikan & Bala, 2017). The inclusion criteria included athletes aged between 16 and 20 years, having at least three years of karate training experience, and regularly participating in kumite training sessions. Such criteria are commonly used in martial arts performance studies to ensure participant homogeneity and training familiarity (Chaabene et al., 2019; Tabben et al., 2018).

The research instrument used to measure the dependent variable was a 30-second Mawashi Geri kick accuracy test using a kicking pad as the target. In this test, athletes were instructed to perform Mawashi Geri kicks repeatedly for 30 seconds toward a designated target area on the kicking pad. The score was determined based on the number of kicks that accurately struck the target area according to predetermined assessment criteria. Accuracy-based performance tests are widely used in martial arts research because they objectively quantify technical skill execution under controlled conditions (Slimani et al., 2017; Dlis et al., 2020). Prior to data collection, the test procedure was demonstrated to all participants to ensure consistent understanding and standardized execution of the movement.

The research procedure consisted of three main stages: pretest, training intervention, and posttest. The pretest was conducted to determine the baseline accuracy of Mawashi Geri kicks among the athletes. During this stage, all participants performed the kick accuracy test under standardized conditions including identical equipment, distance, and target position. Standardization of testing conditions is essential to ensure the reliability and validity of performance measurements in sports science research (Hopkins et al., 2019). Following the pretest, the athletes participated in a circuit training program lasting four weeks, with a training frequency of three sessions per week. Circuit training is recognized as an effective training method for simultaneously improving strength, muscular endurance, agility, coordination, and sport-specific movement performance (Hammami et al., 2018; Suchomel et al., 2018). The training program consisted of several exercise stations integrating physical conditioning and kicking techniques designed to simulate the movement patterns required in karate kumite.

Each training session included several exercise combinations, such as push-ups followed by explosive Mawashi Geri kicks, hurdle jumps followed by kicks, sprints combined with backward running followed by kicks, and sit-ups combined with lateral jumps followed

by kicks. These exercises were selected to develop the kinetic chain involved in kicking movements, including core stability, hip rotation, leg power, and neuromuscular coordination. Previous studies have demonstrated that training programs integrating explosive strength and technical execution can significantly improve martial arts kicking performance (Loturco et al., 2016; Wallace, 2024). After completing the four-week circuit training program, a posttest was administered using the same Mawashi Geri kick accuracy test protocol used in the pretest. Using identical procedures for pretest and posttest ensures the comparability of results and allows researchers to accurately determine the effect of the training intervention (Hopkins et al., 2019).

The collected data were analyzed using descriptive and inferential statistical techniques. Descriptive statistics were used to summarize the mean, standard deviation, and distribution of Mawashi Geri kick accuracy scores before and after the intervention. To determine whether the circuit training program produced a statistically significant improvement in kick accuracy, an inferential analysis using a paired sample t-test was conducted with a significance level of $\alpha = 0.05$. The paired sample t-test is commonly applied in experimental sports science research to compare two related measurements obtained from the same group of participants before and after an intervention (Field, 2018).

RESULTS AND DISCUSSION

Result

This study was conducted on 15 FORKI Sungai Penuh karate athletes, ranging from brown to black belts, who participated in all stages of the study, including a pretest, circuit training program, and posttest. The study used a one-group pretest–posttest design, so the effectiveness of the treatment was analyzed by comparing results before and after the training program.

Descriptive Analysis Results

The initial stage of the study began with a pretest to measure the athletes' basic Mawashi Geri kicking accuracy skills. Measurements were conducted using a 30-second kicking accuracy test with a predetermined kicking pad target.

The descriptive analysis results showed an average pretest score of 6.73, which falls into the fair to low category. Variation in scores among athletes also indicates that kicking accuracy is still unstable. This is evident in several athletes who still experience difficulty maintaining body balance, coordinating hip rotation, and controlling kick direction during repetitive movements. This condition indicates that motor control, dynamic stability, and neuromuscular coordination still need to be improved through a more systematic training program.

After a one-month circuit training program with a training frequency of three times per week, a posttest was conducted using the same procedures and instruments as the pretest. The analysis showed a significant improvement in ability. The average posttest score increased to 12.20, which falls within the good to excellent category.

This improvement indicates that the athletes experienced improvements in their ability to control the direction of their kicks, maintain body balance, and maintain movement consistency when performing Mawashi Geri repeatedly. Practically speaking, the average difference between the pretest and posttest was 5.47 points, indicating a significant improvement in ability after the circuit training treatment.

Table 1.
Descriptive Statistics of Mawashi Geri Accuracy Pretest and Posttest Results

Variabel	N	Mean	SD	Kategori
Pretest Accuracy	15	6.73	1.41	Fair–Poor
Posttest Accuracy	15	12.20	1.65	Good–Excellent

The diagram shows that the posttest scores were significantly higher than the pretest scores, indicating an increase in kicking accuracy after the athletes participated in the circuit training program.

Inferential Statistical Test Results

To determine whether the improvement was statistically significant, a paired sample t-test was conducted with a significance level of $\alpha = 0.05$. This test is used to compare two measurements from the same group before and after treatment. The analysis results showed a calculated t-value of 12.364 with degrees of freedom (df) = 14 and a significance value (Sig. 2-tailed) of 0.000. This value is less than 0.05, indicating a significant difference between the pretest and posttest scores. Furthermore, the calculated t-value (12.364) is also greater than the t-table (2.145) at the 5% significance level. Therefore, it can be concluded that the circuit training program significantly improved the accuracy of Mawashi Geri kicks in karate athletes.

Table 2.
Paired Sample t-Test Results and Effect Size

Variable	Pretest Mean	Posttest Mean	Mean Difference	t-value	df	Sig. (2-tailed)	Cohen's d	Effect Magnitude
Mawashi Geri Accuracy	6.73	12.20	5.47	12.364	14	0.000	3.19	Very Large

A significance value of $p < 0.05$ indicates a statistically significant difference between the pretest and posttest scores. This study obtained a Cohen's d value of 3.19, which falls into the very large effect category. This indicates that circuit training not only has a statistically significant effect but also has a very strong practical impact on improving the accuracy of Mawashi Geri kicks in karate athletes.

Overall, the results of this study indicate that the circuit training program can significantly improve the accuracy of Mawashi Geri kicks. This improvement likely occurs because circuit training integrates several important physical components such as leg muscle strength, dynamic balance, neuromuscular coordination, and movement control, all of which are key factors in producing accurate kicks. Therefore, it can be concluded that circuit training is an effective training method for improving the accuracy of Mawashi Geri kicks in karate athletes, both statistically and practically in the context of improving sports performance.

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Discussion

The results of this study indicate that circuit training significantly improved the accuracy of Mawashi Geri kicks in FORKI Sungai Penuh karate athletes. Descriptively, there was an increase in the average score from 6.73 in the pretest to 12.20 in the posttest, representing a difference of 5.47 points. The inferential statistical test results showed a t-value of 12.364 with a significance level of 0.000 ($p < 0.05$), indicating that the increase was significant and not due to chance. Furthermore, the effect size (Cohen's d = 3.19) falls into the very large effect category, indicating that circuit training has a very strong practical impact on improving Mawashi Geri kick accuracy. These findings indicate that a training approach that integrates physical conditioning and technique can improve the quality of technical performance in karate.

Theoretically, the improvement in Mawashi Geri kick accuracy can be explained through motor learning theory. According to Schmidt and Lee (2018), motor skills develop through systematic, repetitive training accompanied by consistent feedback. In the context of martial arts, structured repetition of movements allows for neuromuscular adaptation, namely increased coordination between the central nervous system and the muscular system, resulting in more precise movements. This adaptation leads to increased efficiency of motor control, enabling athletes to direct kicks more accurately at the intended target. Other studies have also shown that repeated technical training with varying physical loads can improve motor control and movement stability in martial arts athletes (Chaabène et al., 2019; Slimani et al., 2017).

From a sports physiology perspective, circuit training is known as an effective training method for simultaneously improving various components of physical fitness, such as muscle strength, muscular endurance, coordination, and agility (Hammami et al., 2018; Suchomel et al., 2018). In the Mawashi Geri technique, kicking success is greatly influenced by the synergy between explosive leg muscle strength, dynamic balance, core stability, and pelvic rotational control. The circuit training exercises designed in this study combined elements of strength and technique, for example, push-ups followed by explosive kicks, hurdle jumps followed by kicks, sprints followed by kicks, and sit-ups combined with lateral jumps and kicks. This combination of exercises trains the body's kinetic chain involved in the kicking movement, thereby increasing the efficiency of energy transfer from the lower body to the kicking movement (Loturco et al., 2016; Dlis et al., 2020).

In addition to improving strength and coordination, circuit training also stimulates neuromuscular endurance, enabling athletes to maintain technical quality under conditions of fatigue. In kumite competitions, athletes are often required to execute repeated attacks in a relatively short period of time, making the ability to maintain movement precision while experiencing fatigue a crucial factor (Tabben et al., 2018). Wallace (2024) explains that circuit training can simulate competition conditions because the training is conducted at a relatively high intensity with minimal rest periods. This allows athletes to maintain technical quality even when physically depleted.

The findings of this study also align with the concept of training periodization proposed by Bompa and Buzzichelli (2019), who stated that improving technical

performance in competitive sports cannot be separated from the development of progressively programmed physical conditioning. An effective training program must be able to integrate technical training with physical conditioning components such as strength, endurance, and coordination. In this study, a circuit training program was systematically designed to combine physical training and kicking technique in a single training series. This approach allows for a direct transfer from physical ability to technical performance, so that improved physical conditioning can directly support increased kicking accuracy.

In the context of martial arts, several previous studies have also shown that physical ability is closely related to the quality of kicking technique. Chaabène et al. (2019) explained that the performance of karate athletes is influenced by a combination of physical ability, technical skill, and psychological factors. Athletes with good leg muscle strength and optimal body coordination tend to be able to produce faster and more accurate kicks. Research by Bachtiar et al. (2025) also showed that dynamic balance and explosive leg muscle power are significantly related to kicking accuracy in karate athletes, so training that improves both components has the potential to improve kicking technique quality. These results are also supported by other research showing that training methods that integrate physical and technical training can improve technical performance in martial arts. Research by Pramana Sastra (2025) found that a circuit training program can increase kicking speed and power in karate athletes, while research by Yoga (2025) showed that circuit-based training can improve the consistency of technical movements under conditions of fatigue. These findings reinforce the findings of these studies, which demonstrate that circuit training not only improves physical components but also enhances the overall quality of technical execution.

From a sports biomechanics perspective, the Mawashi Geri technique is a complex movement involving pelvic rotation, knee extension, and ankle control to direct the kick toward the target (Dlis et al., 2020). Coordination between agonist and antagonist muscles in the body's kinetic chain significantly determines the accuracy of the kicking movement. If this coordination is not optimal, the kick's direction can deviate from the intended target. Circuit training, which combines strength, coordination, and technique training, allows for increased biomechanical efficiency, resulting in more precise kicking. Biomechanical research in martial arts athletes also shows that increased core muscle strength and pelvic stability can improve body rotational control and stability during kicking (Turner et al., 2019; Loturco et al., 2016).

In addition to biomechanical and physiological factors, improved technical performance is also related to the adaptation of the nervous system in controlling movement. Repeated and structured training can improve the nervous system's ability to coordinate muscle activity more efficiently (Schmidt et al., 2018). This neuromuscular adaptation causes movements to become more automatic and stable, allowing athletes to execute techniques more quickly and accurately. In this study, circuit training simultaneously stimulated the nervous and muscular systems, thereby improving the motor control skills necessary for producing precise Mawashi Geri kicks.

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From a practical perspective, the very large increase in the effect size (d = 3.19) indicates that the implemented training program had a very strong impact on improving athletes' abilities. The large effect size indicates that the changes were not only statistically significant but also had important practical implications in the context of sports training. This suggests that circuit training can be an effective training method for improving technical performance in karate, particularly in Mawashi Geri kicks.

The findings of this study also provide important implications for coaches in designing training programs. Training programs that overemphasize kick frequency or power alone without considering coordination and movement control can result in techniques that lack precision. Conversely, a training approach that integrates physical and technical elements, such as circuit training, can improve overall movement quality. This approach is in line with the concept of training specificity, which states that training must be designed according to the movement demands of the sport being trained (Suchomel et al., 2018).

Overall, the results of this study indicate that circuit training designed systematically and specifically to the needs of karate is proven effective in improving the accuracy of Mawashi Geri kicks. The significant increase in posttest scores and the very large effect size indicate that this training method not only improves statistical abilities but also has a strong practical impact on athletes' technical performance. Thus, circuit training can be recommended as an alternative effective training method to improve kicking accuracy in karate, especially for athletes who focus on kumite events.

CONCLUSION

Based on the research results and data analysis, it can be concluded that circuit training is effective in improving the accuracy of Mawashi Geri kicks in FORKI Sungai Penuh karate athletes. Descriptive analysis results showed a significant increase in kicking accuracy after athletes participated in the training program. The average pretest score of 6.73 increased to 12.20 in the posttest, representing a 5.47-point increase. This improvement indicates that after participating in the circuit training program throughout the study period, athletes were able to execute Mawashi Geri kicks with more precise direction, improved movement control, and more consistent technique.

Inferential statistical analysis using a paired sample t-test also demonstrated statistical significance. A significance value of 0.000 (<0.05) indicates a significant difference between pretest and posttest scores after the circuit training treatment. Furthermore, the effect size (Cohen's d = 3.19) falls within the very large effect category, indicating that the training program was not only statistically significant but also had a very strong practical impact on improving the accuracy of Mawashi Geri kicks in karate athletes.

Conceptually, the findings of this study confirm that systematically and structured circuit training can improve athletes' motor skills, particularly in terms of accuracy, movement control, and consistency of kicking technique. Training that integrates elements of muscle strength, neuromuscular coordination, agility, balance, and kicking

technique has been shown to provide significant physical and technical adaptations. This integrated training approach allows for the direct transfer of physical abilities into kicking performance in karate.

The practical implication of this study is that circuit training can be used as an effective alternative training method in karate training programs, particularly to improve kicking accuracy in kumite events, which require precision, speed, and technical consistency. Furthermore, this training method can be implemented periodically in training programs because it simultaneously develops physical condition and technical skills.

For further research, it is recommended that researchers develop a more comprehensive research design, such as using a control group, a larger sample size, and a longer training duration, so that it can provide a more in-depth picture of the effectiveness of circuit training in improving technical performance in karate athletes.

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Finally, the author hopes that the results of this study can make a scientific contribution to the development of sports coaching, particularly in the area of kicking technique training in karate. Furthermore, this research is expected to serve as a reference for coaches in designing more effective training programs to improve athlete performance, particularly in enhancing the accuracy of Mawashi Geri kicks in kumite.

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