

# High-intensity interval training method in karate athletes: Can it improve power, agility, and endurance in the Kumite category?

*by Hadi Hadi*

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# High-intensity interval training method in karate athletes: Can it improve power, agility, and endurance in the Kumite category?

Hadi<sup>abcde\*</sup> , Dewangga Yudhistira<sup>abcd</sup> 

Universitas Negeri Semarang, Indonesia

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## ABSTRACT

During a special period, physical exercise for Kumite athletes is targeted at developing the dominant physical condition. Arm muscular power, leg muscle power, agility, and anaerobic endurance are the dominant physical conditions in Kumite. The high-intensity interval training (HIIT) technique of physical exercise is in agreement with the characteristics of the energy system in Kumite. However, there are issues and contradictions in past research on its implementation. As a result, the purpose of this research was to put the HIIT training method to the test to develop muscle power in the arms and legs, agility, and anaerobic endurance in karate athletes in the Kumite category during the special preparatory periodization stage. This study employed an experiment using a one-group pretest-posttest design. The sample included 15 male and female Kumite athletes aged 20-25 years, weighing 50-80 kg, and standing 155-180 cm tall. Standing broad jump, two-handed medicine ball put, agility t-test, and running anaerobic sprint test were the instruments used. Interviews, questionnaires, and field tests were utilized to collect data. The data analysis technique employed descriptive analysis and the Wilcoxon nonparametric test. The overall value of Asymp.sig (2-tailed) was 0.001 to 0.009, according to the study's findings. The HIIT training method was found to have a significant effect on improving arm muscle strength, leg muscle power, agility, and anaerobic endurance in karate athletes in the Kumite category. Research has contributed to the sport of karate in the Kumite category through the application of training programs and models that correspond to the characteristics of the specific periodization. Subsequent research, of course, does not only focus on the special periods because other periods are also important.

**Keywords:** HIIT method; power; agility; endurance; kumite



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**Corresponding Author:** Hadi, Department of Sport Sciences, Faculty of Sport Science, Universitas Negeri Semarang, Semarang, Indonesia

Email: hadi\_pabbsi@mail.unnes.ac.id

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

## INTRODUCTION

Karate is a physical contact martial art with two categories: movements (kata) and combat (Kumite) (Bok et al., 2022). Since Kumite demands more physical contact than kata, physical factors are one of the most essential factors for Kumite athletes' success (Chaabène et al., 2015; Purba et al., 2022). According to some

literature, karate, particularly in the Kumite category, requires extreme physical fitness to win competitions (Pion et al., 2014; Yudhistira et al., 2021a; Yudhistira et al., 2021b). As a result, a coach must recognize that the efforts made to reach peak performance necessitate the development of an exercise program based on the characteristics of the dominant physical condition.

Karate's biomotor components include flexibility, endurance, flexibility, speed, balance, and power (Suprayitno et al., 2020). Those are biomotor components in karate in general; nevertheless, there is a difference in the biomotor component in karate between kata and Kumite. Karate's dominant biomotor component, particularly Kumite, emphasizes dynamic balance, power, anaerobic endurance, and agility (Chaabène et al., 2015; Kusworo et al., 2018). According to a literature study, recognizing the dominant biomotor component is vital since it allows the coach to design an appropriate training program (Berrezokhy et al., 2020).

Of course, the dominating biomotor component is directly tied to the energy system and movement characteristics in particular sports (Prima, 2021). The dominant biomotor component is improved and developed in a special periodization (Hausswirth & Mujika, 2013). As a bridge between general periodization, pre-competition, and competition, special periodization is used (Lloyd & Oliver, 2013). The trainer needs to understand the characteristics of the exercises at a specific periodization to adjust the dominant energy system, by understanding that the coach becomes more confident and precise in dosing the exercises (Arjuna et al., 2022).

At the special periodization stage, physical exercise is more focused on the dominant biomotor component, which includes the energy system employed in competition, muscle contraction, motion characteristics, and competition strategies (Hausswirth & Mujika, 2013). However, discussing this subject is not as simple as turning the palm of one's hand; there are still issues in preparing the training program at the Kumite category of karate's special periodization stage (Yudhistira et al., 2021a; Yudhistira et al., 2021b; Yudhistira & Tomoliyus, 2020).

Based on several interviews with several karate coaches, they stated that they still did not understand the power exercises of the arm and leg muscles that were converted into techniques, and then the coaches stated that they still did not understand the recovery and interval settings in training. According to interviews with several karate athletes, coaches' exercises are still relatively common only as endurance training, and sometimes the exercises combine sprint and jogging exercises but do not understand the dosage of the exercise (Gronwald et al., 2020; Maslov et al., 2018). Based on the results of the needs analysis, it can be the basis for rationalizing the problem in research that, in the training period, the coach needs to understand the regulation of intensity, volume, and suitability of the technique in the match. Some experts state that regulating exercise doses is important for an athlete's successful performance. It is analogous that the dose of exercise is like a drug, so that when the drug given to the patient exceeds the dose, of course it causes an overdose, but on the contrary, when the dose of the drug is less, it certainly cannot cure the patient (Gronwald et al., 2020; Maslov et al., 2018). The issues in the field were discovered to be more centered on determining exercise doses and variants of an exercise model based on the issues that have been discussed concerning needs analysis through interviews and questionnaires. Additionally, there are discrepancies in the analysis of several earlier studies that use the HIIT approach as a way to improve physical attributes like power, agility, and anaerobic endurance. According to previous research studies, the martial arts branch has a strong and quick nature with technical movements that include pauses (Yudhistira et al., 2021b). High-intensity interval training (HIIT) is one of the appropriate training methods (Chaabène et al., 2015; Franchini & Takito, 2019b; Franchini et al., 2019a; Herrera-valenzuela et al., 2018; Nakamura et al., 2016). However, the method of high-intensity interval training in martial arts is the subject of empirical controversy.

According to Bounty et al. (2011), the interval training method did not give a meaningful stimulus to power after 4 weeks. Similarly, Ojeda et al. (2021) also stated that the HIIT method with a unique technique used for 4 weeks had no significant effect on leaping ability. Of course, this is tied to power. According to Navickaitė & Thomas (2022) research, 6 to 7 weeks of HIIT training performed twice a week can boost power. Power training is essential in the martial arts branch, but so is muscle endurance, strength, and cardiovascular endurance training (Bounty et al., 2011).

Agility is indeed essential in karate (Yudhistira & Tomoliyus, 2020). Agility is the result of the interaction of numerous biomotors, including flexibility, strength, and speed (Yudhistira et al., 2021b). According to a related study, not all martial arts trainers are aware of the various workouts available to develop agility (Akhmad et al., 2021). Furthermore, HIIT activities paired with certain approaches in a precise periodization might improve agility abilities (Yudhistira & Tomoliyus, 2020).

The HIIT exercise method has been shown to improve aerobic and anaerobic endurance (Kinnuen et al., 2019). Previous research, however, stated that research on the influence of special physical exercise on martial arts physical ability is still limited (Saputra, 2022). Therefore, the goal of this study was to evaluate the effectiveness of HIIT training on kumite karate athletes at a specific periodization stage for improving power, agility, and endurance.

**METHOD**

A field testing experiment using a quasi-experimental one-group pretest-posttest design was used in this study (Saifu et al., 2021; Rizka et al., 2022; Sulistiyo, 2021; Wardianti et al., 2022; Yulianto & Yudhistira, 2021). The sample in this study were karate athletes in the Kumite category who would be prepared at the regional sports week (PORDA) of Yogyakarta Province at FORKI, Kulonprogo Regency, in September 2022. The sample included 15 athletes aged 20 to 25 years old, with heights ranging from 155 to 180 cm and weights ranging from 50 to 80 kilograms. Outside of the number of treatments, the treatment was delivered 18 times for pretest and posttest data collection meetings. From March through May 2022, the treatment was given. Data was collected through interviews, questionnaires, and direct field testing. The agility t-test is the agility test instrument, the standing broad jump is the leg muscle power test, the two-handed medicine ball put is the arm muscle power test, the anaerobic endurance test is the agility t-test, and the RAST is the running anaerobic sprint test. The data analysis technique used descriptive analysis followed by Wilcoxon nonparametric analysis to provide the pretest-posttest comparison results. The rationale for utilizing Wilcoxon’s nonparametric analysis is that the sample size is smaller than 30, hence the normality and homogeneity tests are skipped. According to the study, less than 30 participants used the nonparametric test (Arintina, 2020). The SPSS version 23 application aids with data processing. The training program has been validated by ten material specialists and has content validity ranging from 0.8 to 1.00, indicating that it has good content validity (Yudhistira et al., 2021b).

**Table 1. High-Intensity Interval Training Program**

Week	Meeting	Exercise Material	Exercise Dosage
1-2	1-6	Post 1: Explosive pushup Post 2: Long jump Post 3: V sit up Post 4: Punch technique Post 5: Superman twist Post 6: Diamond pushup Post 7: Box Cross-over jump Post 8: Crunch Post 9: Kick technique Post 10: Burpee	Frequency: 3 Intensity: High Set: 2-3-4-5 Work time: 10-15-20-25 seconds Interval: 10-15-20-25 seconds Recovery: 5 minutes (Description: working time and interval settings adjust as 1:1, 1:2, 1:3)
3-4	7-12	Post 1: Pushup Clapping Post 2: Lateral hurdle jump Post 3: Supine Medicine Ball Core Pass Post 4: Kick technique Post 5: Backup Post 6: Triceps Dip on Chair Post 7: Split jump Post 8: Leg raises Post 9: Punch technique	Frequency: 3 Intensity: High Set: 2-3-4 Work time: 10-15-20-25 seconds Interval: 10-15-20-25 seconds Recovery: 5 minutes (Description: working time and interval settings adjust as 1:1, 1:2, 1:3)



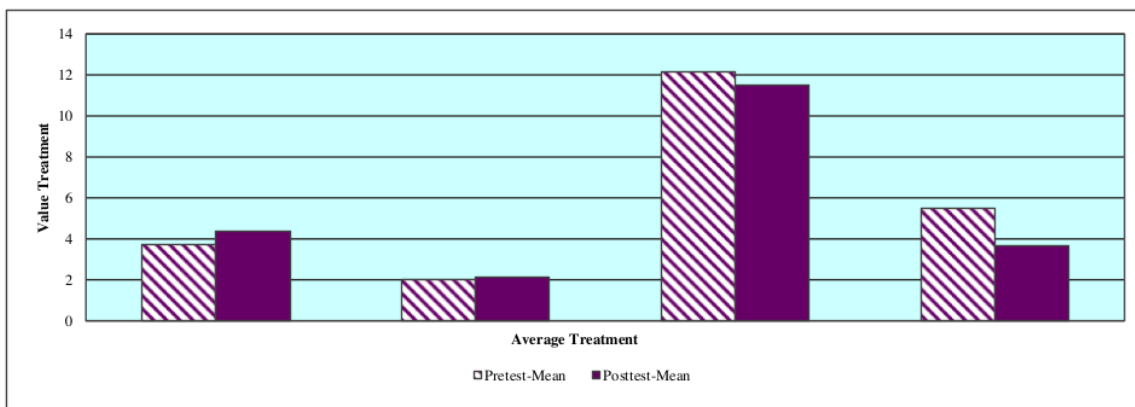
Week	Meeting	Exercise Material	Exercise Dosage
5-6	13-18	Post 1: Medicine Ball Chest Pass in Wall Post 2: Hurdle Jump Post 3: Punch and kick techniques Post 4: Medicine Ball situps chest pass Post 5: Box-off and long Post 6: Punch and kick techniques Post 7: Resistance Band Row Post 8: Resistance Band Squat Jump Post 9: Punch and kick techniques	Frequency: 3 Intensity: High Set: 2-3 set Work time: 10-15-20-25 seconds Interval: 10-15-20-25 seconds Recovery: 5 minutes (Description: working time and interval settings adjust as 1:1, 1:2, 1:3)

**RESULTS AND DISCUSSION**

The purpose of this study is to examine the use of high-intensity interval training (HIIT) to develop muscle power in the arms and legs, agility, and anaerobic endurance in Kumite karate athletes. The data for this study comprises descriptive data from the pretest and posttest, followed by comparison results from the Wilcoxon nonparametric test. The findings of the study are as follows:

**Table 2. Results of Pretest and Posttest Descriptive Analysis**

Variable	N	Min	Max	Mean	Std. Deviation
Pretest-arm muscle power	15	2.40	5.20	3.7260	.63409
Posttest-arm muscle power	15	3.76	5.80	4.3487	.55816
Pretest-leg muscle power	15	1.53	2.45	2.0013	.28342
Posttest-leg muscle power	15	1.70	2.55	2.1307	.25181
Pretest-agility	15	10.84	13.67	12.1540	.99570
Posttest-agility	15	10.14	13.00	11.4847	.87419
Pretest-Anaerobic endurance	15	1.11	10.63	5.4893	2.81644
Posttest-Anaerobic endurance	15	1.55	8.81	3.6967	2.43155



**Graph 1. Diagram of the average pretest-posttest results**

According to the table and figure above, the mean value of the arm muscle power pretest is 3.7260, and the posttest is 4.3487. The mean value for leg muscle power is 2.0013 before the test and 2.1307 after the test. The mean agility pretest value is 12.1540, and the posttest value is 11.4847. The pretest mean value for anaerobic endurance is 5.4893, and the posttest mean value is 3.6967. In conclusion, the posttest value is higher than the pretest value based on the findings of the physical components of the arm and leg, including muscular power, agility, and endurance.

Table 3. Comparative Test Results of Pretest and Posttest

Variable	Asymp. sig (2-tailed)
Pretest-arm muscle power	0.001
Posttest-arm muscle power	
Pretest-leg muscle power	0.001
Postes- leg muscle power	
Pretest-agility	0.001
Posttest-agility	
Pretest-Anaerobic endurance	0.009
Posttest-Anaerobic endurance	

The asymp.sig (2-tailed) value for the arm muscle power variable is 0.001-0.05, according to the table above. This value suggests a considerable increase in arm muscle power between the pretest and posttest. This is demonstrated by a rise in the average value of the pretest value of 3.7260, which afterward increased to 4.3487. In this case, the higher the result obtained, the better the arm muscle power.

The asymp.sig (2-tailed) value for the leg muscle power variable is 0.001-0.05 based on the aforementioned table. In other words, there was a noticeable improvement in leg muscular power between the pretest and posttest. The average value increased from 2.0013 in the pretest to 2.1307 in the post-test, providing further support for this. In this instance, the stronger the leg muscles are, the bigger it gets.

Based on the aforementioned data in the table above, the asymp.sig (2-tailed) value for the agility variable is 0.001-0.05, indicating a statistically significant increase in agility between the pretest and posttest. This judgment is supported by the rise in the average score from 12.1540 on the pretest to 11.4847 on the post-test. In this case, the smaller the value obtained, the better the agility.

According to the aforementioned table, the anaerobic endurance variable's asymp.sig (2-tailed) value is 0.009-0.05. These findings show a considerable improvement in senior Kumite karate competitors' anaerobic endurance between the pretest and posttest. The average pretest score increased from 5.4893 to 3.6967 after the posttest, supporting this finding. In this case, the fatigue index is improved by a smaller value.

High-intensity interval training (HIIT) is an exercise method with the complex goal of boosting the physical component of athletic accomplishment (Buchheit & Laursen, 2013). The HIIT training method involves performing high-intensity physical activities with short recovery periods before resuming high-intensity exercises (Sabag et al., 2021). This corresponds to the energy system utilized by Kumite athletes. When athletes attack with punches and kicks or defend, they use high-intensity motions. When the referee is dismissed or when doing static movements, the movements are performed with a low to moderate intensity. This suggests that the energy system is inherently compatible with kumite competition.

As explained in the prior research, Kumite has the characteristics of forceful and fast motions, as well as movements that are performed sporadically, and then there are pauses (Yudhistira et al., 2021b). This is an anaerobic energy system. The anaerobic energy system plays a crucial role in Kumite attack and defense; therefore, aerobic, anaerobic combination training, and special methods are essential in building Kumite athletes' physical fitness, particularly in special periodization that concentrates on the dominant biomotor component (Yudhistira et al., 2021b).

Anaerobic power, agility, and endurance are the dominant biomotor components that are used in Kumite competitions (Yudhistira et al., 2021b). Of course, the training program is tailored to the method to be utilized and the prominent biomotor component. According to the movement pattern, Kumite has a very fast movement with a brief pause and is adjusted to the actual match technique, however, it is not as comparable to the technique in the match, physical exercise must refer to muscle contraction and the essential needs in Kumite athletes (Beneke et al., 2004; Chaabène et al., 2015). Therefore, the HIIT method adapted to the movement pattern of the competition to improve anaerobic power, agility, and endurance in Kumite athletes in a special period is important to apply.

According to the test results, the HIIT method, which was performed three times a week for six weeks and included medicine balls, resistance bands, and plyometric movements, had a significant effect on improving arm and leg muscle power, agility, and anaerobic endurance. According to prior research, a combination of high-intensity plyometric exercises performed sequentially or by moving posts has a substantial influence on

speed, muscle endurance, flexibility, agility, explosive power, aerobic endurance, and anaerobic endurance (Anitha et al., 2018).

Other research has found that the HIIT exercise method that includes plyometric exercise movement improves physical performance more than the HIIT method that does not include plyometric exercise movement (Racil, 2015). Relevant studies have shown that specific physical exercises combining plyometrics, medicine ball, and resistance band movements with high intensity and moderate and low volume settings performed three times per week for four weeks have a significant impact on aerobic endurance and anaerobic power (Kostikiadis et al., 2018). As a result, the HIIT approach has a substantial impact on boosting arm muscular strength, leg muscle power, agility, and anaerobic endurance in karate athletes in the periodized Kumite category.

## CONCLUSION

Based on the findings and discussion in this study, it is likely to be concluded that the HIIT approach has a significant effect on improving arm muscular strength, leg muscle power, agility, and anaerobic endurance in karate athletes in the special periodized Kumite category. It is demonstrated that the value of asymp.Sig (2-tailed) ranges from 0.001 to 0.009, implying that H<sub>0</sub> is acceptable. As a result, this study can be utilized as a reference in future studies with larger sample sizes. By changing the needs in the kata or kumite category, the HIIT training approach combined with physical activity and technique could be used as an alternative to improving the physical component of karate. This study has limitations, one of which is that the sample used is relatively small, and there is no control group for comparison. Therefore, future researchers are advised, when replicating this study, to use a larger sample and provide a control group as a comparison.

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## CONFLICT OF INTEREST

All authors declare no conflict of interest.

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