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THE EFFECT OF HIGH INTENSITY INTERVAL TRAINING ON INCREASING ENDURANCE IN KARATE ATHLETES IN BONANG DEMAK

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Abstract Karate is a martial art that focuses on empty-handed combat, involving techniques like punches, kicks, and blocks. Endurance refers to the body's ability to supply oxygen to muscles during prolonged activity. High-Intensity Interval Training (HIIT) consists of short, intense exercise cycles (85%-95% of HR max) followed by rest periods of light activity. This study aims to examine the effect of HIIT on improving endurance in karate athletes in Bonang, Demak. Using a quasi-experimental method, the research applied a Pretest-Posttest with Control Group design to assess the impact on two groups. The study revealed that 65% of participants were male, and 70% were aged 15-19 years. The data analysis technique used in this research is analytical description, which aims to analyze and process data in order to obtain the expected results. A Non-Parametric Test was used to assess the effect of the intervention. The results showed a significant improvement in endurance before and after the intervention. After a 4-week program, the research demonstrated that HIIT positively influences endurance in karate athletes in Bonang, Demak.

Keywords: *High Intensity Interval Training, Karate, VO2max, Endurance*

INTRODUCTION

Sport is a systematic process of all activities that lead to the development and development of physical and spiritual potential as an individual or member of society. Sports can consist of games, matches or competitions, and peak achievements based on Pancasila with various forms and methods of implementation. (Aguss *et al*., 2022; Maryani et al., 2023).

One of the martial arts sports that is in great demand by people in Indonesia is karate. Based on data from the World Karate Federation (WKF) and FORKI Central Java in 2023, as many as 396 Indonesian karate athletes were active in international events and there were 12 Pelatda karate athletes (FORKI, 2023; WKF, 2023). Karate is an empty-handed martial art, which means fighting without weapons. The techniques used include repetitive offensive and defensive movements, such as punches, kicks, and parries (Pal *et al*., 2020). Karate consists of two categories: movement (kata) and fighting (kumite). Kata involves various forms of pre-established offensive and defensive techniques and movements, while kumite is a direct fight between two athletes according to pre-established rules (Izzo *et al.*, 2023).

A karate athlete must have good technique to win the match, therefore athletes will train as much as possible to be able to have good technique. However, many karate athletes have weak endurance because they concentrate on muscle strength and rarely do exercises that require endurance. As a result, athletes who only use muscle strength when competing will quickly tire and be easily defeated by their opponents (Maryani et al., 2023).

In the martial sport of karate there are several biomotor components which generally consist of flexibility, flexibility, speed, balance, strength and endurance (Hadi & Yudhistira, 2023). Endurance abilities in athletes function to increase cardiovascular capacity, strength, flexibility and stamina so that athletes will not suffer easily experience fatigue during training and competition and with good physical condition it is hoped that athlete performance can increase (Anam *et al*., 2022; Arjuna, 2019). In the martial sport of karate, the competition lasts for one day with many participants, which lasts from the preliminary round to the final.

Therefore, endurance ability is very important for a karate athlete to avoid fatigue and maximize performance during the match (Balun & Wijono, 2021).

Athletes with good endurance also have a high VO2max. In aerobic activity, VO2max is the greatest measure of oxygen that can be burned during extreme active activity to the point of exhaustion. Meanwhile, endurance is a person's ability to maintain physical activity for a long period of time. A high VO2max indicates that the body has a greater ability to deliver oxygen to the muscles, which is very important for endurance performance. Someone with a higher VO2max can usually do endurance activities without easily experiencing fatigue, this means there is a strong relationship between VO2max and endurance (Buttar *et al*., 2019; Poonam & Sangwan, 2018; Umar & Fadilla, 2019).

High Intensity Interval Training (HIIT) is a form of exercise that is carried out using high intensity in each movement but interspersed with rest phases between sessions. HIIT can be done through various types of high-intensity physical exercise, such as cycling, walking, swimming, aqua training, elliptical cross-training, and others. HIIT can be done in a relatively short time, more effective in improving body metabolism and does not require special equipment (Putra & Wandik, 2017). HIIT is useful in improving athletes' physical abilities, strength, endurance, flexibility, coordination and metabolism. HIIT also increases VO2max, which can increase endurance and speed up the recovery phase during competition. In addition, HIIT can increase an athlete's ability to perform explosive movements such as punching, kicking and slamming and can increase stroke volume and oxygen delivery to muscles (Festiawan *et al.,* 2020; Franchini *et al.,* 2019).

In research conducted by Prana *et al* (2019) on karate athletes, the results showed that giving HIIT could increase aerobic capacity (endurance). Furthermore, similar to research conducted by Rosenblat *et al* (2020), the results showed that giving HIIT was better than giving Sprint Interval Training (SIT). Sprint interval training (SIT) is an intermittent training method that involves a training period followed by a recovery period, which allows anyone to increase the intensity of the

training workload. To enter the high intensity category, training must start from 85% VO2Max. Sprint interval training involves 1 minute of intense exercise for 10 minutes (Gillen *et al*., 2016). As an efficient training strategy, it is most commonly done 4-6 sprints with a maximum of 30 seconds, rest between sets for 4 minutes, training time is around 30 minutes each session. This sprint training can be done over short distances, done repeatedly and there is a recovery phase to restore the energy that has been used to return to normal and not experience fatigue before doing the next exercise or repetition (Vollaard & Metcalfe, 2017). Then the supporting media used in this sprint training model are also easy to find, including requiring a cone, stopwatch and meter. The advantage of this training model is that it is simple to carry out and produces significant benefits for increasing an athlete's endurance capacity (Firmansah & Jatmiko, 2021).

High Intensity Interval Training is an effective training protocol for increasing maximum aerobic capacity (Syamsudin *et al*., 2021). Sprint Interval Training itself plays a role in improving several important health problems, including increasing VO2max, insulin sensitivity, blood pressure, cardiovascular function and body composition (Vollaard & Metcalfe, 2017). The role of physiotherapy in this case is to provide physical training that can improve the physical fitness of athletes, especially karate athletes. Apart from that, physiotherapy has a very important role in improving movement and function by providing screening measures for prevention and through preventive, promotive, curative and rehabilitative approaches to assess VO2max levels in adolescents. This has been regulated in PERMENKES NO 65 of 2015 concerning Physiotherapy Service Standards article 1 paragraph 2 which reads "Physiotherapy is a form of health service aimed at individuals and/or groups to develop, maintain and restore body movement and function throughout the life span using treatment manual, movement enhancement, equipment (physical, electrotherapeutic and mechanical) functional and communication training". This can be done by providing training using the High Intensity method Interval Training (HIIT). HIIT is an exercise that can provide benefits in increasing VO2max capacity, cardiac output, endurance ability, reducing heart rate at rest and

increasing stroke volume at rest which is very useful for an athlete (Tang & Thahir, 2020). In this study, researchers used High Intensity Interval Training (HIIT) to determine the effectiveness of increasing endurance abilities in karate athletes. Based on the problems described above, the author is interested in conducting research "The Effect of High Intensity Interval Training on Increasing Endurance in Karate Athletes in Bonang Demak".

METHOD

Research Design

This research uses a quasi-experimental approach, which is a type of experiment to determine the effect on two groups given certain treatment. The research design used was Pretest and Posttest With Two Groups Design (White & Sabarwal, 2014). In this research design there were 2 groups, namely the treatment group which was given High Intensity Interval Training, while the control group of respondents was only given conventional training.

Quasi-experimental research involving two groups, namely the intervention group and the control group, with the aim of comparing the effect of High-Intensity Interval Training (HIIT) training and conventional training on the endurance of karate athletes. In the intervention group, before being given treatment, an initial test or pre-test was carried out using the bleep test (Q1) to measure the athlete's endurance. Next, this group was given treatment in the form of HIIT training (T1), which was the main intervention in this study. After treatment, a follow-up test or post-test (Q2) was carried out to see whether there was an increase in endurance after participating in HIIT. Meanwhile, in the control group, a pre-test bleep test (X1) was also carried out as an initial measurement of endurance. However, this group was not given HIIT, but rather conventional training (T2) according to a standard training program. After conventional training is completed, a post-test (X2) is carried out to measure the results of the training.

Participants

Population is a generalization area consisting of objects or subjects with certain qualities and characteristics that have been determined by researchers to be studied and conclusions drawn (Garaika & Darmanah, 2019). In this study, the

population taken was karate athletes in Bonang District, Demak, Central Java, with a total of 20 athletes.

A sample is a part of a population that has similar characteristics to that population. The sample selection in this study used the quota sampling method, namely a sampling technique from a population that has certain characteristics until the desired number or quota is reached. In this technique, the researcher first prepares a table or matrix containing the characteristics of the population to be achieved in accordance with the research objectives, then determines a sample that meets these characteristics.

The sample taken in this study was 20 people, selected based on inclusion and exclusion criteria. Inclusion criteria include: 1) Respondents are senior karate athletes, 2) Aged between 12-25 years, 3) Do not have comorbidities such as asthma or heart disease, and 4) Willing to take part in the entire research series from start to finish. Meanwhile, exclusion criteria include: 1) Respondents who have experienced injury or trauma in the last six months, and 2) Are currently participating in other sports activities. Drop out criteria apply if: 1) The respondent does not continue the exercise until the end, or 2) The respondent leaves suddenly without providing information.

Intervention

High Intensity Interval Training

High Intensity Interval Training (HIIT) is a type of exercise used to increase endurance capacity (VO2max). The HIIT training concept combines high intensity exercise alternated with low intensity exercise (Khapipudin *et al.,* 2021). The training dosage applied in this study was as follows: the training frequency was carried out 3 times a week for 4 weeks, with an intensity of 85% of the maximum heart rate (HR max). The exercise consists of 3 sets, each with 10 intervals, and a rest period of 4 minutes in each set. The training session begins with a warm-up and ends with a cool-down, each for 10 minutes. HR max measurement to determine an athlete's training intensity uses the formula: HR max = 220 – age.

Control Group Exercise

The training given to the control group included simple physical exercises and karate techniques. Physical training consists of static and

dynamic stretching, followed by warm-up such as jogging to increase heart rate and activate muscles, which aims to prevent injury and prepare the body's condition before core training (Bompa & Buzzichelli, 2019). After warming up, athletes continue with core training, namely kihon (basic movements), kata, or kumite training. The training session closes with a cool down, which aims to prevent the deposition of lactic acid, as well as relax the muscles and joints to avoid muscle stiffness and pain (Asnaldi, 2015).

Multistage Fitness Test (Bleep Test)

The Multistage Fitness Test (Bleep Test) is an instrument or measuring tool used to determine an athlete's endurance ability as demonstrated by measuring maximum oxygen uptake (Sepdanius *et al*., 2019).

Data Analysis

The data analysis technique used in this research is analytical description, which aims to analyze and process data in order to obtain the expected results. The normality test is carried out to determine whether the data is normally distributed or not, using the 2-tailed significance value, and if the value is >0.05, the data is considered normal. Researchers used the Shapiro-Wilk test because the sample numbered <50 respondents (Hastono, 2014). In addition, a homogeneity test is carried out to ensure that two or more sample groups have the same variance. This test is important to find out whether the sample data taken comes from a homogeneous population. The test used is the Levene test, where if the value is >0.05, the data is declared homogeneous, and if <0.05, the data is declared inhomogeneous (Hartini et al., 2019).

RESULT AND DISCUSSION

Result

Table 1 Shapiro Wilk Normality Test Results

Variable	*p-value*	α = 0.05	Description
Pretest Intervension	0,068	>0.05	Normal
Postest Intervension	0,055	>0.05	Normal
Pretest control	0,004	<0.05	Not Normal
Postest control	0,005	<0.05	Not Normal

Based on the SPSS calculations and Shapiro-Wilk test results, the p-value for the intervention pretest is 0.068 (>0.05), indicating a normal distribution. The posttest p-value is 0.055 (> 0.05), also showing normal distribution. In contrast, the control group's pretest p-

value is 0.004 (< 0.05) and the posttest p-value is 0.005 (< 0.05), both indicating the data is not normally distributed.

Table 2 Homogeneity Test Results

Variable	*p-value*	α = 0.05	Description
Pretest Intervension	0,735	>0.05	Homogeneous
Postest Intervension	0,735	>0.05	Homogeneous
Pretest control	0,995	>0.05	Homogeneous
Postest control	0,995	>0.05	Homogeneous

Based on the calculations and results from SPSS from the homogeneity test above, it is known that the p-value is > 0.05, namely in the pretest and posttest the intervention has a homogeneity score of 0.735, so the data results in the pretest and posttest intervention are 0.735 > 0.05 homogeneity data, while in the pretest and the posttest control has a homogeneity score of 0.004, so the data results on the pretest and posttest control are 0.995 > 0.05 homogeneous data.

Table 3 Effect Test Results with the Wilcoxon Test

Variable	*p-value*	α = 0.05	Description
HITT	0.005	<0.05	Significant
Control Group	0.109	>0.05	Not Significant

Based on the SPSS calculations above, the results show that there is a significant effect of providing High Intensity Interval Training on increasing endurance in karate athletes with a p value <0.05.

Discussion

Based on the research carried out, the results showed that there was an increase in endurance in karate athletes, this is in line with research conducted by Sinaga *et al* (2019), where it was found that the significance value between the High Intensity Interval Training variable and the endurance variable in karate athletes showed a result of p < 0.05 which can be concluded that there is a significant influence between giving High Intensity Interval Training to increase endurance in karate athletes. This increase in endurance can occur because, among other things, there is a physiological adaptation in the myocardium which causes an increase in stroke volume and the supply of oxygen-rich blood. In addition, the combination of high lactate values and hypoxia will cause regeneration of mitochondria and peripheral blood vessels, thereby leading to increased capillaryization. Then, by administering High Intensity Interval Training (HIIT) along with intense exercise, it can produce cardiological adaptations and can produce aerobic fitness adaptations and increase aerobic capacity by around 6%. Apart from that, if done routinely, programmed and

continuously, karate athletes will have better endurance abilities, which are useful for supporting the athlete's performance when competing later (Bossmann *et al*., 2022).

Apart from that, according to research conducted by Franchini *et al* (2019), he stated that providing High Intensity Interval Training (HIIT) has been proven to have a positive effect on combat sports athletes. This exercise can increase aerobic strength ranging from 4.4% to 23.0% within four to seven weeks. During exercise using the HIIT method, movement of the body parts will cause an increase in heart contractions, which results in an increase in blood volume and blood flow due to higher stimulation of the sympathetic nerves, which ultimately causes an increase in stroke volume and heart rate and causes a gradual increase in cardiac output, so that the respiratory system will respond to this by increasing oxygen intake to active muscle tissue. With this, the blood vessels of the muscles will widen and the blood vessels of other organs will constrict, so that more oxygen enters the tissues. In addition, active body movements during exercise using the HIIT method will increase oxygen demand, which will result in an increase in the diffusion process which can increase lung ventilation, then increase inspiration and depth of breathing, so that in the end it will cause a maximum increase in VO2max which results in an increase aerobic capacity, which is important for a martial arts athlete (Triyulianti *et al*., 2023).

CONCLUSION

Based on the results of research conducted for four weeks, it was found that there was a significant effect of giving High Intensity Interval Training on increasing endurance in karate athletes in Bonang Demak before and after being given the intervention.

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