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The Effect of Interval Training on Anaerobic Capacity Improvement related to Pencak Silat Athlete Performance

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Abstract

The achievement of a Pencak Silat athlete is expected to increase if it is supported by a good anaerobic capacity and provided with an effective program according to their needs, namely the interval training program. This study aimed to determine the effect of interval training on increasing anaerobic capacity related to the performance of Pencak Silat athletes. This research used the ex post facto method with correlation research. The sample of this study was Pencak Silat Athletes of West Java regional training center facing the XX PON 2020 in Papua, totaling 20 athletes (age 26.25±4.2, height 170.70±3.6, weight 64.50+11.04, practice experience 8.35±3.6). The sampling technique used was total sampling. The test instrument used the Running Anaerobic Sprint Test (RAST) to measure the anaerobic capacity of a 6-week exercise. The data analysis technique used statistical analysis with t-test and r-test employing SPSS 25. The results showed an effect of interval training on anaerobic capacity related to the performance of Pencak Silat athletes. The t-test shows that the anaerobic capacity value has a sig (2-tailed) 0.029<0.05. The results of the r-test showed a significance value of 0.000<0.05, meaning that there was a significant relationship between the anaerobic capacity of Pencak Silat athletes and their performance after interval training. Interval training can increase the athlete's Vo2Max and can be used as an exercise method to increase the athlete's Vo2Max without a high risk of injury for the athletes.

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INTRODUCTION

The energy requirement system in Pencak Silat, for a 2-minute competition in 3 rounds involving a 1-minute break, mostly uses anaerobic capacity (Lubis & Wardoyo, 2014; Lubis et al., 2021). In this case, resistance training becomes the main foundation in the preparation phase (Bompa & Buzzichelli, 2019; Lubis et al., 2021). Furthermore, this case shows the importance of a combination of speed, power, and strength (Puspitasari, 2019).

An athlete's achievement is expected to increase if they are supported by a good physicality and a program that meets their needs. A good training program is sure, a methodical, tiered, continuous, and applicable for the sports specialization (Lubis & Wardoyo, 2014). One of the programs carried out is an exercise to improve the athlete's physical condition, where the coach is responsible for the preparation of the programs and the implementation of the exercises to improve physical condition based on sports science prioritizing specific programs and reducing the risk of injury (Lukina et al., 2019).

The results of studies show that Pencak Silat athletes in the match category, also known as the "Tanding" category, have not reached the desired achievement target. Many athletes feel tired at the last minute of the match. Excellent physical capacities do not support several fighters having good techniques; thus, at the end of the match round, they get tired and suffer a defeat (Dimyati et al., 2020), (Sumetry et al., 2021). Furthermore, movement coordination, attack accuracy, and attack patterns are not maintained stably in the final minutes of the match, so their concentration is difficult to control due to athletes' decreased endurance. Therefore, they should have an excellent anaerobic capacity.

To meet the energy system needed by Pencak Silat athletes for achieving maximum performance, a special program containing relevant training and suitable for the character of Pencak Silat sport is essential to produce the desired effect. Exercise programs to increase anaerobic capacity include 300 meter running (Saputro & Siswantoyo, 2018), (Saifullah et al., 2020), High-Intensity Interval Training (HIIT), and Training Method using Elevation Training Mask (ETM) (Nurjaya et al., 2021), where the training process must be developing from general conditioning to specific exercises targeted for the needs needed in Pencak Silat activities, such as SIT (Sprint Interval Training) (Hazell et al., 2010). It is in line with the research findings stating that interval training is effective in increasing the anaerobic capacity of Pencak Silat athlete's kick endurance as well as physical strength related to their performance (Sumetry et al., 2021), (Lubis et al., 2021), (Hendarsin et al., 2020), (Ooi & Anowar, 2018).

High-intensity interval training is a viable alternative to moderate-intensity continuous training, whereas sprint interval training (SIT) is an intense and effective exercise. Meanwhile, high-intensity interval training is usually characterized by 4-6 repeat attempts of 30 seconds separated by 4 minutes of active recovery (such as walking) per training session (Gillen & Gibala, 2014). On the other hand, Sprint interval training (SIT) involving 30 seconds of "all-out" efforts has resulted in significant improvements in skeletal muscle oxidative capacity, maximal oxygen uptake, and endurance performance (Gist et al., 2014). Interval training is an exercise characterized by variations in the load duration (distance/series of exercises), variations in load intensity (speed/excess load), variations in load intervals (rest time), and the form of rest against loading components of the load. (Edwarsyah et al., 2017).

SIT is a part of the High Interval Training (HIT) method. High-intensity interval training (HIT) is a well-known and time-efficient training method for improving cardiorespiratory and metabolic function and, in turn, the physical performance of athletes. HIT involves short (<45 seconds) to long (2-4 minutes) repetitive exercise of moderately high intensity interspersed with recovery periods. Athletes have used the 'classic' HIT format for almost a century (such as 30-second repetitions of exercise interspersed with 30 seconds of rest or 2–4 minute interval repetitions of high-intensity in submaximal running (Buchheit & Laursen, 2013). Several expert findings state that HIT affects athlete performance (Tabata et al., 1996), (Foster et al., 2015), (Arezzolo et al., 2020), (Atakan et al., 2021).

The HIT program used in this study was Low Volume Sprint Interval Training (LVSIT). (Hazell et al., 2010). Low Volume Sprint Interval Training (LVSIT), as a part of interval training with high-intensity intervals, short duration, and relatively long recovery periods between intervals, can induce improvements in aerobic strength and metabolic function similar to tradi-

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tional endurance training and increase anaerobic capacity (Gibala et al., 2006; Burgomaster et al., 2008). LVSIT is an exercise involving a short duration (10-30 seconds) and all-out effort interspersed with long recovery periods (2-4 minutes) at a low volume (8-12 Reps). Expert findings indicate that the specific exercise, training structure, resistance, volume (reps and sets), rest interval between sets, and training frequency of LVSIT is manipulated to form the best strength training program to meet the athlete's goals.

Interval training is a time-efficient exercise strategy to improve cardiometabolic health (Gillen & Gibala, 2014), where interval training using SIT is to improve the aerobic capacity of soccer players (Macpherson & Weston, 2015), physiological response and performance of sprint interval training and resistance training in soccer players (Kelly et al., 2021), and efficacy of anaerobic capacity interval training on kick endurance of Pencak Silat athletes (Sumetry et al., 2021). In contrast to previous studies and findings, in this study, interval training with LVSIT was used as a training program to increase the anaerobic capacity related to Pencak Silat athlete performance. Therefore, this study aimed to determine the effect of Low Volume Sprint Interval Training on Anaerobic Capacity Improvement related to the Performance of Pencak Silat Athletes.

METHODS

This study employed correlation research's ex-post facto method (Widarto, 2013). In this case, the increase of anaerobic capacity related to the performance of Pencak Silat athletes was examined after joining training using interval training.

Participants

The participants of the study were 20 Pencak Silat athletes living in the West Java regional training center facing the XX PON in 2020 in Papua with age (26.25 years old±4.2), height (170.7cm±3.6,), weight (64.5± 11.04), and exercise experience (8.35± 3.6).

Sampling Procedures

The samples consisted of 20 athletes, including 13 male athletes and 7 female athletes as test-takers who would participate in the study. Total sampling technique was taken. None of the athlete's used illicit drugs, such as steroids, and pharmacological drugs, such as antibiotics and anti-inflammatory. The athletes were not under any injury that would affect their performance during the test. All athletes were instructed not to consume alcohol and caffeinated beverages and engage in strenuous exercise 24 hours prior to the test. They were also instructed not to consume heavy food two hours prior to the test.

Materials and Apparatus

The test was carried out using the Running Anaerobic Sprint Test (RAST) (Andrade et al., 2015). The indicators for assessing anaerobic capacity related to the performance of Pencak Silat athletes after interval training are presented in Table 1.Meanwhile, the artistic category assessment indicators are presented in table 2.

Table 1. Assessment Indicators for the Match Category

Item	Description
1	Aggressiveness in the Match
2	Powerful Kick
3	Powerful Punch
4	Clean Punch/Kick
5	Hand & Foot Quick Attack Combination
6	Attack Tempo Setting
7	Dropping Category
8	Punch/Kick to the Opponent Motion
9	Press the opponent in a depressed position
10	Attack Variation

Table 2. Assessment Indicators for the Artistic Category

No	Description
Single	
Item	**Description**
1	Movement details
2	Movement order
3	Movement not shown
4	Sequence of moves
5	Appreciation/Stability/Stamina
Double	
Item	**Description**
1	Defense attack technique
2	Stability and compactness
3	Harmony and appreciation
Team	
Item	**Description**
1	Movement details
2	Movement order
3	Movement not shown
4	Sequence of moves
5	Compactness/stability/solidarity

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The assessment criteria used in the match category were the categories used by the coach, namely a Likert scale scaled 1-4. For the artistic category, the assessment scale used by the judges at the match was 10-100.

Intervention

The LVSIT exercise was carried out in the final phase of the special preparatory phase. LVSIT is an exercise containing a short duration (30 seconds) and all-out efforts interspersed with long recovery periods (4 minutes) at a low volume (8 repetitions). The exercise was conducted two times/a weeks. The exercise was administered in the morning training session from 07.00 – to 09.00 in the same place; before the anaerobic program, the athlete warmed up as usual, and the intervention program duration took six weeks (MacDonald et al., 2012). The intervention time was in line with the results of the LVSIT study showing a significant increase in the average power after eight weeks of intervention. The exercise program is detailed in Table 3. Moreover, The RAST protocol carried out is described in Table 4. The training program was filled with technical training, physical conditions, and match simulations. The centralization began in January 2020. The athletes were tested during the Pre-Competition period.

Table 3. Training Program

No	Week	Duration	Reps	Rest Interval
1	Week 1-3	45 Seconds	8-12	90 Seconds
2	Week 4-6	30 Seconds	8-12	4 Minutes

Procedures

The pre-test was carried out for all the prepared test items. After the LVSIT training program was completed, they were prepared to take a post-test. Pre-test and post-test were carried out with the same treatment, where each athlete was invited to a data collection location designed on two different days. All tests were performed in the morning at approximately the same time of day to avoid the influence of the circadian cycle on an athletic track field, with temperatures maintained between the first and second testing day.

Table 4. RAST Protocol

Components	
The components needed to carry out the test are a 50-meter track, two cones, two stopwatches, and two assistants.	
Test Procedure	
1	This test requires the athlete to perform six 35-meter sprints with a 10-second recovery between each sprint.
2	Assistant 1 weighs and records the athlete's weight
3	Athletes warm-up for 10 minutes
4	The Assistant marks 35 meters straight on the track with a cone
5	Every Assistant has a stopwatch
6	Athletes complete six 35-meter runs at a maximum speed with 10 seconds allowed between each sprint for the following turnaround: • Athlete, using a standing start, prepares to run • Assistant 2 gives the GO command for the athlete to start, and assistant 1 starts the stopwatch • When the athlete completes the 35 meters • Assistant 1 stops the stopwatch, records the time, and resets the stopwatch. • Assistant 2 starts the stopwatch to calculate the 10 second completion time

Data Analysis

Data analysis of this study used inferential statistics. The analysis steps started with calculating the average value or mean and standard deviation. The following tests included a normality test, homogeneity test, and mean difference test (t-test) using Paired Sample T-Test to determine the significance of interval training on the anaerobic capacity of Pencak Silat athletes. To see the relationship between the increase of anaerobic capacity and performance, the r-test was carried out using Product Moment. The test criteria were conducted by comparing the significance value (Sig.) with an Alpha value of 0.05. When the significance value (Sig.) was <0.05, there was a correlation between variables. On the other hand, when the significance value (Sig.) was > 0.05, there was no correlation between variables. The data processing was carried out with the help of the SPSS 25 application.

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RESULT

The Based on descriptive statistical analysis, the results of the LVSIT pre-test and post-test data showed that the anaerobic capacity pre-test data included a mean of 44.62, the standard deviation of 7.78, and the Std Error Mean of 1.78. Meanwhile, the post-test data analysis results showed that Anaerobic Capacity involved a mean of 45.74, the standard deviation of 6.91, and Std Error Mean of 1.59. It showed an increase in the anaerobic capacity of Pencak Silat athletes after interval training, where the post-test mean value was greater than the pre-test mean value. To test the normality of the data distribution of this study, the Kolmogorov-Smirnov method was used. The results of the normality test found Sig. > 0.05 at the Anaerobic Capacity data Sig. 0.29 < 0.05. It indicated that the data were normally distributed. The homogeneity test results showed Sig. > 0.05 at the Anaerobic Capacity data Sig. 0.29 <0.05. It indicated that the data were homogeneous to meet the requirements for a t-test. After the normality and homogeneity test, the t-test was carried out to determine if there was a significant effect of LVSIT on increasing the anaerobic capacity of Pencak Silat Athletes. The details are presented in Table 5.

Table 5. T-Test Result

	t	df	Sig.
KA1-KA2	-2.370	18	0,029

Based on Table 5, it can be seen that the anaerobic capacity value has a sig (2-tailed) of 0.029. This value is smaller than 0.05. Besides that, the calculated t value is -2.37, smaller than the t table value at df = 18 (-2.10). Therefore, there was an effect of LVSIT on increasing the anaerobic capacity of Pencak Silat Athletes. To determine the correlation between the increase of the anaerobic capacity of Pencak Silat athletes and their performance after LVSIT, a correlation test was carried out using the r product moment test.

The results of the r test showed a correlation coefficient value of 0.910. Because the value was close to 1, the relationship between the anaerobic capacity of Pencak Silat athletes in the competition category and their performance was stated to be strong. It means that if the anaerobic capacity of the Pencak Silat athlete is high, the performance is also declared high or good. A significance test was carried out to determine the effect of the relationship between the two variables. The significance test results showed a significance value of 0.000 < 0.05, so the null hypothesis was rejected. Therefore, there was a significant relationship between the anaerobic capacity of Pencak Silat athletes in the match category and their performance after interval training using LVSIT.

The correlation test between the increase of anaerobic capacity of Pencak Silat athletes in the artistic category and performance after LVSIT found that the r test showed a correlation coefficient value of 0.941. Because the value was close to 1, the relationship between the anaerobic capacity of the martial arts athletes and their performance was stated to be strong. It means that if the anaerobic capacity of the Pencak Silat athlete is high, the performance is also declared high or good. A significance test was carried out to determine the effect of the relationship between the two variables. The significance test results showed a significance value of 0.000 < 0.05, so the null hypothesis was rejected. Therefore, there was a significant relationship between the anaerobic capacity of the Pencak Silat athletes in the artistic category and their performance after interval training using LVSIT.

DISCUSSION

Interval training using LVSIT increase the anaerobic capacity of Pencak Silat athletes shown by the anaerobic capacity value of a-sig (2-tailed) 0.029. The value is less than 0.05. The data indicated an effect of LVSIT to increase the anaerobic capacity of Pencak Silat athletes. Recent studies utilizing SIT (repeated 30-second maximum attempts with a 4 minutes recovery) have reported significant improvements in anaerobic strength (Hazell et al., 2010). It is believed that the optimal stimulus to elicit maximal cardiovascular and peripheral adaptation is where the athletes spend at least a few minutes per session in their 'red zone,' which generally means achieving at least 90% of their maximal oxygen uptake (VO2max) (Buchheit & Laursen, 2013; Foster et al., 2015), (Gist et al., 2014).

The impact of LVSIT mostly refers to the impact of training sessions on anaerobic development (Sumetry et al., 2021). Interval training involves intensity at or above oxygen availability during physical activity, usu-

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ally lasting between 30 seconds and five minutes (Ito, 2019), performed on power output or speed related to VO2max (Rosenblat et al., 2020), serving as an effective alternative to traditional endurance-based training, and encouraging similar or even superior physiological adaptations in healthy individuals (Gibala et al., 2012). Continuous training intensity is required (Gibala, 2015). Previous research has shown that interval training can improve the performance of water polo athletes (Botonis et al., 2019). The positive impact of SIT on cardiorespiratory fitness has far-reaching health implications (Gist et al., 2014), where SIT can increase Max and aerobic performance (Sloth et al., 2013).

Interval training employing LVSIT effectively improves the anaerobic capacity of Pencak Silat athletes because Pencak Silat athletes must have extraordinary capacities seen from certain components to achieve maximum performance (Syaifullah & Doewes, 2020). Hariono (2006) in (Subekti et al., 2019) explains that, in a Pencak Silat match, the competition category requires an anaerobic/alactic/phosphocreatine energy system of around 73.75% and an anaerobic lactate energy system of 16.25%, and anaerobic system for about 10%, so that the energy system during a Pencak Silat matches dominantly uses the phosphocreatine energy metabolism system (ATP-PC). This is in line with Kriswanto et al. (2019) finding that anaerobic is a sport that emphasizes muscle strength with high explosive power and usually lasts for a short time. The movements performed in this sport require speed, strength, and power. Anaerobic performance is influenced by many factors, such as body composition, age, gender, muscle fiber composition, strength, and training (Kln-Isler & Kosar, 2006; Subekti et al., 2019).

Athletes who are trained anaerobically will release more lactic acid (80%) than athletes who do aerobic exercise (75%), so the athletes taking anaerobic exercise will not feel significant fatigue (Green et al., 2014.p.329-338; Kriswanto et al., 2019). It is relevant to the capacities that must be possessed by a Pencak Silat athlete to have a good performance.

A good anaerobic capacity supports a good performance. It is related to the power possessed by the athlete. Power is the ability to convert physical energy into strength quickly and depends on ATP (Susanto et al., 2020). The best training programs to improve the athlete's anaerobic capacity are various aspects of endurance training, volume (repetitions and sets), rest intervals between sets, and training frequency.

CONCLUSION

There was an effect of interval training using LVSIT on anaerobic capacity related to the performance of Pencak Silat Athletes in the West Java regional training center facing PON XX – 2020 in Papua. Interval training using the LVSIT method could increase VO2MAX capacity. LVSIT could also be used as an exercise method to increase VO2MAX capacity without worrying about the athlete's bone growth and the high risk of injury. However, it must be noted that fatigue is relatively high.

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CONFLICT OF INTEREST

The authors declared no conflict of interest.

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