fizjoterapia polska

POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 1/2024 (24) KWARTALNIK ISSN 1642-0136

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nr 1/2024 (24)

Improving the performance of karate athletes: fartlek and circuit training in the increasing VO_2max

Poprawa wydajności zawodników karate: trening fartlek i trening obwodowy w zwiększaniu VO_2max

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Abstract

This research problem arises because increasing VO_2max is crucial in improving the performance of kumite karate athletes. The purpose of this study was to determine the effect of fartlek training and circuit training on increasing VO_2max of Inkanas Resmata Madiun Kota kumite athletes. This research was conducted using experimental methods. The study's population comprised 20 kumite karate athletes from the Inkanas Resmata dojo of the Madiun Kota police department. The sampling technique employed is the matched-pair method. The study sample included 17 kumite karate athletes from the Inkanas Resmata dojo at the Madiun Kota police department, each receiving the treatment 16 times. The research instrument used is the Multi-Step Fitness Test (MFT). The data analysis technique used in this study is a t-test to determine the comparison of fartlek training and circuit training exercises in increasing VO_2max. Results of the study: the first hypothesis for the fartlek group is known that the t-test value is calculated at −12,520 with a significance value of 0.000. For the circuit training group, the hypothesis is confirmed with a calculated t-test value of −9.168 and a significance value of 0.000. From the test results using the independent sample T test, it is known that the t value is calculated with a significance value of 0.000 > 0.05. The strong conclusion of this study is that both fartlek training and circuit training significantly increase the VO_2max of kumite karate athletes Dojo Inkanas Resmata Polres Madiun Kota, providing clear evidence of the effectiveness of both exercise methods in improving the physical condition of athletes.

Keywords

karate, fartlek,circuit training, VO_2max

Streszczenie

Problem badawczy wynika z faktu, że zwiększenie VO_2max jest kluczowe w poprawie wydajności zawodników karate kumite. Celem tego badania było określenie wpływu treningu fartlek i treningu obwodowego na zwiększenie VO_2max zawodników kumite Inkanas Resmata Madiun Kota. Badanie przeprowadzono przy użyciu metod eksperymentalnych. Populacja badawcza składała się z 20 zawodników karate kumite z dojo Inkanas Resmata przy komendzie policji Madiun Kota. Techniką doboru próby był metoda par dobranych. Próbka badawcza obejmowała 17 zawodników karate kumite z dojo Inkanas Resmata przy komendzie policji Madiun Kota, każdy poddany został zabiegowi 16 razy. Instrumentem badawczym używanym był Wieloetapowy Test Sprawności (MFT). Techniką analizy danych używaną w tym badaniu był test t, aby określić porównanie ćwiczeń treningu fartlek i treningu obwodowego w zwiększaniu VO_2max. Wyniki badania: dla pierwszej hipotezy grupy fartlek stwierdzono, że wartość testu t wynosi −12,520 przy wartości istotności 0,000. Dla grupy treningu obwodowego hipoteza została potwierdzona z obliczoną wartością testu t wynoszącą −9,168 i wartością istotności 0,000. Z wyników testu przy użyciu testu T dla niezależnych próbek wiadomo, że wartość t jest obliczona przy wartości istotności 0,000 > 0,05. Mocnym wnioskiem z tego badania jest to, że zarówno trening fartlek, jak i trening obwodowy znacząco zwiększają VO_2max zawodników karate kumite Dojo Inkanas Resmata Polres Madiun Kota, dostarczając jasnych dowodów na skuteczność obu metod ćwiczeń w poprawie kondycji fizycznej zawodników.

Słowa kluczowe

karate, fartlek, trening obwodowy, VO_2max

doi.org/10.56984/8ZG2EF824g

`Introduction

In order to attain peak performance during matches, it is imperative for kumite karate athletes to possess an ideal degree of physical fitness. VO_2max, also known as maximum oxygen consumption, is a significant criterion for assessing physical fitness [1, 2]. VO_2max is a measure of the body's capacity to generate energy through the utilization of oxygen during physical exertion of high intensity. Consequently, the primary emphasis in the training regimen of kumite karate athletes is the enhancement of VO_2max, as supported by the studies conducted by [3, 4].

The Madiun City Police Inkanas Resmata Dojo boasts a cohort of kumite karate practitioners who exhibit promising aptitude for attaining both national and international accolades. However, to attain such a level of performance, it is important to enhance VO_2max. At present, there exists a range of training strategies that have been employed to enhance VO_2max, such as fartlek training, which involves interval training characterized by fluctuations in speed and intensity, as well as circuit training, which encompasses a series of diverse exercises [5]. Hence, the primary objective of this research is to assess and contrast the efficacy of these two approaches in enhancing VO_2max levels among kumite karate practitioners at the Dojo Inkanas Resmata Madiun City Police. Enhancing coaches' and players' comprehension of the most efficacious training methodologies can facilitate the formulation of more precise training regimens aimed at attaining peak physical fitness levels in anticipation of kumite karate tournaments [6].

Sport is a multifaceted human endeavor with physical, spiritual, social, and economic dimensions that are interconnected and mutually influential [7, 8]. Sports activities encompass a structured and systematic set of physical actions with the objective of enhancing one's physical capabilities. Sport is a recurring phenomenon that fulfills a fundamental role in the physical development, as well as the physical, spiritual, and social well-being of individuals [9, 10]. Engaging in physical exercise not only enhances overall well-being and spiritual development, but it also provides an avenue for the cultivation and expression of personal interests and talents, such as the practice of karate. Karate, as a discipline within the realm of martial arts, presents a notable potential for attaining success [11].

INKANAS Resmata is a forum established with the purpose of nurturing and cultivating aspiring karate athletes. It is situated within the premises of the Police Office, located in Madiun City, which is part of the East Java Province. This forum has been instrumental in cultivating a number of exceptional athletes who have achieved notable success at both regional and national levels, across both kata and kumite events. Athletes have the opportunity to engage in competitive events either through the official tournaments organized by the regional government, known as PORPROV, or through regional and national level competitions that they choose to participate in at their own financial responsibility. The absence of VO_2max measurements at the INKANAS Resmata Dojo has been identified through interviews conducted with coaches. However, physical condition training has been initiated for athletes using the coaches' limited understanding of sports, thereby explaining the lack of VO_2max measurements. The coaches at the INKANAS Resmata Dojo express their approval of doing VO_2max measurements, as it allows for the implementation of circuit training and fartlek exercises. Additionally, they offer training materials to trainers and utilize these measurements as a means to assess the physical state of athletes at the INKANAS Resmata Dojo.

The importance of physical endurance for athletes to perform their activities or tasks at an ideal level is widely acknowledged in the literature [12, 13]. The concept of physical endurance refers to the body's utmost capacity to fulfill its oxygen requirements, as indicated by an augmentation in the maximal volume of oxygen consumption (VO_2max). VO_2max refers to the upper limit of oxygen consumption that an individual may utilize within a span of one minute, according to their body weight. Individuals who possess superior physical fitness have elevated VO_2max scores and demonstrate enhanced capacity to engage in demanding physical tasks compared to individuals with lower levels of physical fitness [14, 15]. VO_2max refers to the measurement of oxygen consumption during the peak level of physical effort.

The augmentation of VO_2max necessitates the implementation of a meticulously designed training regimen that is executed with caution, consistency, methodicalness, and gradual progression. In order to attain the desired objectives, it is imperative to adhere to the principles of suitable training methodologies [16, 17]. Hence, circuit training presents itself as a viable workout modality that can be employed and customized to augment VO_2max levels. Circuit training is a comprehensive training method that has the potential to enhance various components of physical fitness, including but not limited to strength, endurance, power, agility, and speed [18].

Circuit training is a comprehensive training approach that integrates various components, including strength, power, speed, and either anaerobic or aerobic endurance training. Circuit training has the potential to impact an athlete's short-term endurance performance. According to [18]. circuit training involves the simultaneous execution of various components of physical fitness in a rapid manner and within a relatively brief duration. Fartlek training is an exercise technique that involves the deliberate manipulation of running pace. The utilization of the fartlek method entails a modification of running, walking, and sprinting activities. The intensity of fartlek training is contingent upon the duration of the distance covered or the duration of the sprint time. Specifically, as the distance covered or sprint time increases, the intensity of the training also increases, and conversely, as the distance covered or sprint time decreases, the intensity decreases. The utilization of this approach is frequently employed as a means of diversifying training regimens to mitigate the risk of athletes experiencing rapid onset of boredom. Moreover, this practice is typically implemented during the preparatory phase of athletic conditioning [19].

Following the outcomes of the consultation with the coach, it was determined that a comprehensive assessment and targeted intervention should be conducted to enhance the VO_2max of the athletes from INKANAS Resmata Madiun City. The significance of VO_2max training lies in its potential to optimize the enhancement and fortification of cardiovascular endurance, hence augmenting athletic performance [20–22].

The primary aim of this research is to assess and compare the efficacy of fartlek training and circuit training activities in enhancing VO_2max among Kumite Dojo Inkanas Resmata Karate athletes affiliated with the Madiun City Police. This research makes a significant addition by addressing the existing gaps in the sports literature, as identified by [23, 24]. Numerous inve-

doi.org/10.56984/8ZG2EF824g

stigations have been conducted to explore the enhancement of VO_2max and other training modalities. However, this particular study by [25]. offers a noteworthy scholarly contribution by specifically examining kumite karate athletes, whose distinctive physical fitness requirements warrant special attention. The outcomes of this study will offer practical recommendations for coaches and athletes in terms of the optimal selection of training methods to enhance their VO_2max.

Furthermore, this study holds significant practical implications. The Madiun City Police Inkanas Resmata Dojo has promising prospects for cultivating proficient kumite karate practitioners, with the augmentation of VO_2max potentially serving as a pivotal factor in attaining notable accomplishments at both national and international levels. The understanding of optimal training methods enables coaches and athletes to develop training plans that are more efficient and focused [26, 27]. The use of this approach has the potential to yield significant benefits in terms of time efficiency, reduced exertion, and conservation of valuable resources. Moreover, it has been seen that this approach can effectively contribute to the optimization of athletes' performance at its highest level [28, 29].

This discovery holds significance within the wider domain of sports science advancement, as highlighted by previous studies [30, 31]. This research aims to provide valuable insights into the impact of fartlek training and circuit training on the enhancement of VO_2max, hence contributing to the development of more efficacious training programs across diverse sports. This study aims to integrate scientific information in order to optimize athletes' capabilities and enhance their performance, so offering a significant scholarly addition to the domain of sports and physical fitness [32, 33].

The measurement of physical fitness, particularly VO_2max, has been a significant focal point within the realm of sports, particularly with regards to enhancing athletic performance [34, 35]. Several prior research have investigated several training methodologies that possess the capacity to enhance VO_2max, such as fartlek training and circuit training. Prior research has provided evidence to support the notion that the implementation of fartlek training, characterized by fluctuations in intensity and speed, has the potential to enhance aerobic capacity and VO_2max across diverse athletic populations. Conversely, it has been demonstrated that circuit training routines, which integrate both strength and cardiovascular training, are efficacious in enhancing the physical fitness of athletes. Nevertheless, there is a dearth of material pertaining to a direct comparison between these two methodologies within the specific context of enhancing VO_2max levels in kumite karate practitioners. Hence, the primary objective of this research is to address the aforementioned knowledge deficiency and enhance comprehension regarding the most efficacious training techniques for attaining substantial enhancements in VO_2max among Kumite Dojo Inkanas Resmata Karate athletes affiliated with the Madiun City Police.

Method

The study employed an experimental research design with the objective of comparing two distinct forms of exercise, specifically circuit training and fartlek, in order to assess their effectiveness in enhancing VO_2max levels. Two distinct samples, referred to as sample 1 and sample 2, were utilized to test each exercise. The study included a population of 20 athletes from the Dojo Inkanas Resmata Madiun City Police, with a sample size of 17 athletes. The sample approach employed in this study was purposive sampling.

The research employed the Multi-Step Fitness Test (MFT), also known as the beep test. This test entails athletes engaging in continuous back-and-forth running across a distance of 20 meters, with the objective of reaching the 20-meter mark before the subsequent beep is heard. The temporal interval between successive auditory signals diminishes progressively over time, necessitating individuals to augment their velocity during locomotion.

The study was conducted within the premises of the Madiun City Police Traffic Unit office courtyard and the Madiun City Wilis Stadium. The study was conducted over the months of June and July in the year 2022. Both sample 1 and sample 2 exhibited homogeneity in their variants and were derived from a population that followed a normal distribution. Consequently, the T test was employed to conduct the comparison test.

Results

Normality test

The results of normality test from the research samples are as follows:

Table 1. Normality test

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Pretest_Fartlek	0.226	8		0.200		0.859
Posttest_Fartlek	0.206	8		0.200		0.856
Pretest_CirciutTraining	0.239	8		0.200		0.843
Posttest_CircuitTrining	0.236	8		0.200		0.823

The results of testing with Kolmogorov Smirnov on the table 1, each sample shows a significant value of 0.05 and more than 0.05, so it can be concluded that the sample data used in this research has a normal distribution value (Budi, 2018).

Homogeneity test

The homogeneity test is useful for determining whether the variance of a sample taken from a population is similar to a uniform sample or not. The goal of the homogeneity

doi.org/10.56984/8ZG2EF824g

test is to determine how closely the variances of each exercise resemble each other. (Budi, 2018). The results of the data homogeneity test in this study are presented in the table 2:

Table 2. Homogeneity test

Improvement of VO_2max	Levene Statistic	df1	df2	Sig.
Based on Mean	0.137	1	15	0.717
Based on Median	0.080	1	15	0.781
Based on Median and with adjusted df	0.080	1	11.373	0.783
Based on trimmed mean	0.160	1	15	0.695

Based on the table 2, it can be seen that the significance value based on the results of the mean value shows a value of 0.717, which means the value is greater than 0.05, so we can conclude that the data used in this study is homogeneous.

Paired sample t-test

The results of paired t-test is shown in table 3:

Table 3. Paired Sample t-test

	Paired differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pretest_Fartlek − Posttest_Fartlek	−1.5333	0.3674	0.1225	−1.8158	−1.2509	−12.520	8	0.000
Pretest_CirciutTraining − Posttest_CircuitTrining	−3.1875	0.9833	0.3477	−4.0096	−2.3654	−9.168	7	0.000

a) H_0: μ pre F = μ post F
H_1: μ pre F ≠ μ post F

From the analysis output of the SPSS program, a significance value of 0.000 was obtained, where 0.000 < 0.05.

In conclusion, there is a dominant difference between the average VO_2max level after treatment and the VO_2max level before treatment. Or it could be said that the fartlek treatment given has a significant influence on the VO_2max content.

b) H_0: μ pre CT = μ post CT
H_1: μ pre CT ≠ μ post CT

From the analysis output of the SPSS program, a significance value of 0.000 was obtained, where 0.000 < 0.05.

In conclusion, there is a dominant difference between the average VO_2max level after treatment and the VO_2max level before treatment. It could be said that the circuit training treatment given has a significant influence on the VO_2max content.

Independent t-test

To find out the differences on the increasing between the circuit training and fartlek training, it was done the sample testing with the independent t test with the results in the table 4:

Table 4. Group statistics

Group	N	Mean	Std. Deviation	Std. Error Mean
Increasing of VO_2Max with fartlek	9	1.533	0.3674	0.1225
Increasing of VO_2Max with circuit training	8	3.188	0.9833	0.3477

Table 5. Independent t-test

Improvement of VO_2max	Levene's Test for Equality of Variances F	Sig.	t-test for Equality of Means t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Lower	Upper
Equal variances assumed	−1.5333	0.3674	0.1225	−1.8158	−1.2509	−12.520	8	0.000	
Equal variances not assumed	−3.1875	0.9833	0.3477	−4.0096	−2.3654	−9.168	7	0.000	

doi.org/10.56984/8ZG2EF824g

It can be seen in table 5 that the calculated F value variable is at 2.967 with a significant value of 0.000 which is greater than 0.05, so it is concluded that H_0 cannot be rejected. Thus, the T-test analysis must use the assumption of equal variances assumed with a t value of 4.706 and 4,488 with a significant value of 0.00 < 0.05. Hence, it can be concluded that there is a difference in increasing VO_2max levels between fartlek and circuit training so that H_1: μ CT μ F.

Discussion

Theres is some effect of fartlek training towards the increasing of VO_2Max of kumite athletes of INKANAS Resmata Madiun City Police.

Based on the findings of the hypothesis testing conducted on the fartlek group, it has been determined that the computed t-test statistic is –12,520, yielding a significance level of 0.000. This study demonstrates the alteration in VO_2max values following a training regimen using fartlek therapy. The mean VO_2max value prior to undergoing the fartlek intervention was recorded as 30.487. Following the administration of the medication, the mean VO_2max exhibited a significant alteration, resulting in a value of 32.088. The mean VO_2max exhibited a 1.6% increase subsequent to the implementation of fartlek training, as compared to the baseline measurements. The observed rise in performance is also impacted by the training regimen implemented, wherein fartlek training is employed as a form of exercise that entails exerting effort at an intensity level ranging from 75% to 85% of an individual's maximal heart rate. Fartlek training is characterized by ATP-PC energy system use at a rate of 20, lactate accumulation (LA) and oxygen (O_2) consumption both at a rate of 40. Based on the aforementioned description, it can be inferred that the implementation of fartlek training has the potential to enhance the VO_2max levels of INKANAS Resmata Kumite athletes affiliated with the Madiun City Police.

Regarding the aspect of comparison, an examination of the outcomes of the hypothesis test conducted on the fartlek group reveals a statistically significant augmentation of 1.6% in VO_2max levels. This finding can be juxtaposed with the outcomes of prior research that investigated alternative training approaches among kumite karate competitors. The findings of this investigation demonstrate noteworthy advancements, indicating the potential efficacy of fartlek training in enhancing VO_2max [36, 37]. However, it is crucial to acknowledge that the observed influence of fartlek training on VO_2max augmentation can be characterized as moderately substantial. Hence, additional investigation may elucidate the variables that have the potential to optimize the efficacy of fartlek training, including the duration and frequency of training sessions, as well as the quantifiable measures of training intensity. Furthermore, conducting a comparative analysis between fartlek training and alternative training approaches that prioritize the enhancement of VO_2max, such as highly intense interval training or high-level interval training (HIIT), can offer additional understanding regarding the optimal training strategies for attaining significant enhancements in VO_2max among kumite karate athletes [38].

There is some effect of circuit training on the increasing of VO_2max of kumite athletes of INKANAS Resmata Madiun City Police.

From the results of hypothesis testing for the circuit training group, it is known that the calculated t test value is –9.168 with a significance value of 0.000. This shows a change in VOvax levels after training using circuit training treatment.

The mean VO_2max prior to undergoing the circuit training intervention was 29.8. Following the administration of the medication, the mean VO_2max exhibited a notable alteration, reaching a value of 32,988. The mean VO_2max following the implementation of farltek training shown a 3.9% enhancement in comparison to the pre-intervention values observed during circuit training. Circuit training has the potential to enhance cardiovascular fitness and reduce blood pressure, similar to the effects observed with aerobic exercise. Fartlek training is characterized by ATP-PC levels of 20, lactate accumulation (LA) and oxygen consumption (O_2) levels of 10, and oxygen consumption levels of 70. Based on the aforementioned description, it can be inferred that the implementation of circuit training intervention has the potential to enhance the VO_2max The findings from the hypothesis testing indicate a statistically significant decrease in VO_2max levels following circuit training (–9.168, p < 0.001). These results offer valuable insights when compared to previous studies examining different training methods in the existing scientific literature. The observed improvement of VO_2max by 1.6% in the current study's fartlek group can be regarded as a favorable outcome. However, it is noteworthy that the circuit training approach exhibited more substantial alterations, which could potentially attract greater attention from coaches and athletes [39, 40]. This finding suggests that circuit training may be a more effective choice for enhancing VO_2max in kumite karate competitors. It is important to note that each training approach possesses distinct merits and drawbacks. Therefore, when choosing the most suitable training method to maximize VO_2max improvements, aspects such as athlete preference, initial fitness level, and training goals must be meticulously taken into account. Additional research that explicitly compares different training methods and examines their long-term impact on athlete performance will offer a more comprehensive understanding for determining the most effective training approach [41].

There is some difference in the comparation of fartlek and circuit training on the increasing of VO_2max of kumite athletes of INKANAS Resmata Madiun City Police.

From the test results using the independent sample T test, it shows that the calculated t value has a significance value of 0.000 > 0.05. Based on this, it shows that there are differences between fartlek and circuit training treatments. This shows that there are significant differences in fartlek and circuit training treatments. The research results show that training using fartlek and circuit training both provide improvements, but in comparison between fartlek and circuit training, the biggest improvement is circuit training. Because this type of circuit training has a comprehensive application including endurance, strength, power, muscle endurance, there is another factor: the relatively high intensity of the training.

The results of the comparative analysis between the fartlek group and the circuit training group showed a significant diffe-

doi.org/10.56984/8ZG2EF824g

rence in increasing VO_2max which is an important aspect in the context of improving the performance of kumite karate athletes. This comparison highlights that both training methods have a positive impact in improving the athlete's physical condition, but circuit training seems to provide a greater increase in VO_2max levels. Factors that influence the success of circuit training include comprehensive training, including endurance, strength, and muscle endurance, as well as relatively high training intensity [42]. However, it should be noted that the choice of training method should be based on the athlete's individual needs, training goals, and other factors that may influence training effectiveness. Therefore, while circuit training may be more effective in increasing VO_2max, consideration of athlete preferences and training context remains important in the development of a successful training program. Further studies involving larger groups and looking at the long-term effects of these two methods could provide a more holistic view of the most effective training methods in improving the performance of kumite karate athletes [43].

Conclusion

The implementation of fartlek training and circuit training demonstrated a notable enhancement in VO_2max among the athletes of Kumite Dojo Inkanas Resmata Karate, affiliated with the Madiun City Police. This study demonstrates that both training methodologies possess the capacity to optimize the physical fitness of kumite karate athletes, effectively attaining desired performance benchmarks. The findings of this study offer vital insights for coaches and athletes in the formulation of efficacious training programs aimed at enhancing physical fitness. Furthermore, these results make a significant contribution to the advancement of sports science and the enhancement of athletic performance in subsequent endeavors.

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Piśmiennictwo/ References

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