12 weeks OPT method for enhanching anearobic and aerobic capacity in elite Indonesian female beach volleyball athletes

Método OPT de 12 semanas para mejorar la capacidad anaeróbica y aeróbica de las atletas de voleibol de playa de élite de Indonesia

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Abstract

Introduction: There hasn't been a lot of research done on how the OPT method affects the anaerobic and aerobic capacity of beach volleyball players. Objective: The objective of this study is to investigate the impact of OPT on anaerobic and aerobic capacity among elite female beach volleyball players in Indonesia.
Methodology: The research employed a pre-test and post-test format, including six elite female players from the Indonesian National Beach Volleyball Team. An all-inclusive sampling method was utilized with participants N=6, aged between 19 and 27, weighing 52 to 77 kg, standing between 168 and 180 cm tall, and having BMIs ranging from 18.40 to 24.60. The duration of the training program was 12 weeks, consisting of three intensive sessions every week, adding up to a total of 36 sessions. Anaerobic capacity was assessed utilizing the Running-based Anaerobic Sprint Test (RAST), whereas aerobic capacity was evaluated with the Multistage Fitness Test. Analysis of data was performed utilizing SPSS 24 and Microsoft Excel.
Results: The findings demonstrated significant improvements in both capacities, with Anaerobic Capacity before at 4.50 ± 0.61 and after at 0.79 ± 0.11, and Aerobic Capacity before at 39.23 ± 1.91 and after at 50.88 ± 0.74. Statistically significant variances were observed ($p < 0.05$).
Conclusions: The research findings indicate a notable rise in anaerobic and aerobic capabilities after completing the OPT training program. It is advised to conduct more research to investigate the wider impacts of the OPT technique on the overall physical abilities of beach volleyball players.

Keywords

OPT; anaerobic; aerobic; beach volleyball; elite female athletes.

Resumen

Introducción: No se han realizado muchas investigaciones sobre cómo el método OPT afecta la capacidad anaeróbica y aeróbica de las jugadoras de voleibol de playa. Objetivo: El objetivo de este estudio es investigar el impacto de OPT en la capacidad anaeróbica y aeróbica entre las jugadoras de voleibol de playa de élite en Indonesia.
Metodología: La investigación empleó un formato de prueba previa y posterior, que incluyó a seis jugadoras de élite del Equipo Nacional de Voleibol de Playa de Indonesia. Se utilizó un método de muestreo integral con participantes N=6, de entre 19 y 27 años, con un peso de 52 a 77 kg, una altura de entre 168 y 180 cm y un IMC de entre 18,40 y 24,60. La duración del programa de entrenamiento fue de 12 semanas, que consistió en tres sesiones intensivas cada semana, sumando un total de 36 sesiones. La capacidad anaeróbica se evaluó utilizando la Prueba de Sprint Anaeróbica Basada en Carrera (RAST), mientras que la capacidad aeróbica se evaluó con la Prueba de Aptitud Física Multietapa. El análisis de los datos se realizó utilizando SPSS 24 y Microsoft Excel.
Resultados: Los hallazgos demostraron mejoras significativas en ambas capacidades, con Capacidad Anaeróbica antes de 4,50 ± 0,61 y después de 0,79 ± 0,11, y Capacidad Aeróbica antes de 39,23 ± 1,91 y después de 50,88 ± 0,74. Se observaron variaciones estadísticamente significativas ($p < 0,05$).
Conclusiones: Los hallazgos de la investigación indican un aumento notable en las capacidades anaeróbicas y aeróbicas después de completar el programa de entrenamiento OPT. Se recomienda realizar más investigaciones para investigar los impactos más amplios de la técnica OPT en las habilidades físicas generales de los jugadores de voleibol de playa.

Palabras clave

OPT; anaeróbico; aeróbico; voleibol de playa; atletas femeninas de élite.

Introduction

Beach volleyball for women shows rapid development in the world (Bozzini et al., 2021). In volleyball having a powerful anerobic and aerobic capacity is crucial for maximizing performance (Miguel-Ortega et al., 2023). Anaerobic capacity is the ability to repeatedly carry out intense tasks (Purnamasari et al., 2024). Volleyball highlights the importance of having good aerobic capacity, particularly in matches with multiple sets where players need to sustain high levels of performance for long periods of time (Martin et al., 2024). So, beach volleyball athletes need to enhance their anaerobic and aerobic capacity during their training routines (Novia Eka Putri et al., 2024). But the required training levels have not been defined yet realm (Bozzini et al., 2021).

Cycle ergometer exercises improve anaerobic capacity in teenage volleyball players (Naczk et al., 2006). Earlier studies on female rugby players who underwent the HIIT Progressive Sprint-Release Model showed enhancements in anaerobic and aerobic capacity (Jatmiko et al., 2024). High intensity interval training method improves endurance in volleyball (Wu, 2023). Prior research suggests that volleyball training primarily utilizes the HIIT model. Hence, it is crucial to consistently improve training programs in the sport of volleyball, especially in the discipline of beach volleyball. Hence, it is crucial to enhance the anaerobic and aerobic capacity of beach volleyball athletes.

Beach volleyball teams consist of just two players (Nasrulloh et al., 2023) and are played on the sand (Bahauddin et al., 2023), leading to more frequent and intense jumping for each player (Nikolaidis et al., 2016). The game is prolonged, requiring anaerobic and aerobic endurance for maximum performance (Nasrulloh et al., 2023). Anaerobic and aerobic capacity are important parameter for monitoring athletic performance (Chatterjee et al., 2022; Vikestad & Dalen, 2024).

According to assessments and discussions with top female beach volleyball players in Indonesia, there is a requirement for a training approach that can enhance both anaerobic and aerobic capacity in order to get them ready for international competitions on behalf of Indonesia. It is crucial to have a thorough training model in order to improve these abilities (Novia Eka Putri et al., 2024). Hence, based on both the coach's suggestions and the researcher's literature review, it is recommended that the OPT model is an efficient training model for beach volleyball athletes.

The OPT model consists of five unique training phases and is considered an innovative approach. This model is based on principles that help clients reach peak levels of physiological, physical, and performance improvements in a gradual and organized way (Bıyıklı, 2018). The OPT model improves the power endurance of female futsal players (Wahyu Setyanto, 2024). Working out with the OPT model resulted in a notable improvement in the physical performance of tennis players (Bian, 2024). Previous studies have shown that the OPT model has not been applied to beach volleyball training to improve aerobic and anaerobic capacity. This study presents a unique component by using the OPT technique instead. However, the effect of OPT on anaerobic and aerobic capacity of beach volleyball players has not been studied. Therefore, this study seeks to investigate how OPT affects anaerobic and aerobic capacity in elite female beach volleyball athletes in Indonesia.

Method

Study design and Participant

This research utilized a design with both pre-test and post-test. The individuals in the study were women who are members of Elite Indonesian Female Beach Volleyball Athletes. All six female athletes from the team were included in the study using the total sampling technique. Table 1 displays the features of the participants, such as their age, weight, height, and BMI.

Table 1. Characteristic Participants

	Minimal	Maximal	Mean ± Standard Deviation
Age	19	27	23,17±2,93
Weight	52	77	61,83±9,13
Height	168	180	172,33±4,93
BMI	18,40	24,60	20,77±2,317

Data Collection

The study's training program lasted for a duration of 12 weeks for Elite Beach Volleyball Players (Sebastia-Amat et al., 2020). This research utilizes a sophisticated training regimen and OPT training plan with beach volleyball players. The intensive training program was held three times weekly. Stabilization endurance is done at a low to moderate intensity, while strength endurance is done at a moderate intensity, hypertrophy at moderate to high intensity, maximum strength at very high intensity, and power training at high intensity. The time needed for recovery in stabilization endurance can vary from 0 to 90 seconds, whereas strength endurance and hypertrophy need 0 to 60 seconds of recovery. On the other hand, when it comes to maximum strength and power training, it is important to take longer breaks for recovery, usually ranging from 3 to 5 minutes. During the training period, the athletes finished a combined total of 36 sessions. In this study, the phases of the OPT model involve comparing stabilization endurance to strength endurance, stabilization endurance to hypertrophy, stabilization endurance to maximum strength, stabilization endurance to power, strength endurance to hypertrophy, strength endurance to maximum strength, strength endurance to power, hypertrophy to maximum strength, hypertrophy to power, and maximum strength to power. Stabilization endurance is the initial phase that focuses on improving the ability of the stabilizer muscles to maintain balance and posture during physical activity, while strength endurance is often used in the next phase to improve muscle endurance in producing strength over a long period of time. Stabilization endurance involves improving body stability by performing multiple repetitions with low weights and slow speeds, whereas hypertrophy targets muscle growth through the use of medium to heavy weights. Stabilization endurance focuses on enhancing body control and steadiness during workouts, while maximum strength is geared towards building maximal muscle strength with intense loads and minimal repetitions. Stabilization endurance emphasizes balance and control through slow, intentional movements, whereas power training emphasizes explosive speed and strength by utilizing moderate to heavy weights, low repetitions, and fast, dynamic movements. Strength endurance focuses on maintaining muscle output for long durations by doing high repetitions with moderate weights, whereas hypertrophy prioritizes muscle growth over endurance. Strength endurance helps to sustain strength with high reps and moderate weights over time, while maximum strength is focused on boosting muscle power with heavy weights and low reps. Strength endurance involves performing many repetitions with moderate weights to increase muscular endurance, while power training emphasizes generating explosive strength in short bursts with moderate weights, low repetitions, and quick movements. Hypertrophy training focuses on increasing muscle size with moderate repetitions and weights, and short rest intervals, while maximum strength training targets peak strength with heavy weights and low reps, without emphasizing muscle size. Hypertrophy training focuses on increasing muscle size using moderate reps and heavy weights, while power training aims to produce maximal power in quick bursts with heavy weights and fast, explosive movements. Maximum strength aims to reach the highest muscle strength possible through few repetitions and heavy loads, while power requires using maximum strength rapidly by combining heavy loads with speed for explosive power output.

Anaerobic capacity can be measured with the Running-based Anaerobic Sprint Test (RAST) (Bayer et al., 2022; Calle-Jaramillo et al., 2023; Jauregui et al., 2023). The University of Wolverhampton in the United Kingdom developed the Running-based Anaerobic Sprint Test (RAST) (Bayer et al., 2022; Chatterjee et al., 2022). The RAST test is a useful tool for evaluating anaerobic capacity in athletes and active people, promoting better circumstances for physical and sports training regimes (Nara et al., 2022). RAST is one of the tests in which the natural field of play can be used for the evaluation of the power of anaerobic capacity and the estimation of the fatigue indeks (Chatterjee et al., 2022). The RAST required individuals to perform six 35-meter sprints at maximum effort, resting for 10 seconds between each sprint. The length of each race was timed with two photocells, and the beginning of each dash was initiated by a beep from the photocell device after 10 seconds (Calle-Jaramillo et al., 2023). Aerobic capacity was evaluated in this research utilizing VO2max (Carrier et al., 2025), which was obtained from data collected from the Multistage Fitness Test. This includes running back and forth between two lines that are 20 meters apart, following the pace set by beeps emitting tones at specified times (Festiawan et al., 2021).

Statistical Analysis

The methods of analysis in this research utilized SPSS version 24 and Microsoft Excel. SPSS was utilized

for conducting descriptive analysis, normality testing (p>0.05), and paired sample testing (p<0.05), whereas Microsoft Excel was employed to create diagrams for comparing anaerobic and aerobic capacity results mean before and after the test.

Results

The descriptive statistics for Anaerobic and Aerobic Capacity variables will be presented in the results section of this study. Next, the results of the normality test and Paired Sample Test will be examined. Finally, a graph showing the findings of anaerobic and aerobic capacity will be shown.

Table 2. Descriptive Anaerobic and Aerobic Capacity

	N	Std. Error Mean	Mean ± Standard Deviation	Cohen's d	Confidence Intervals (CI)
Pre ANC	6	0,61	4,50±0,61	8.46	3.30-5.70
Post ANC	6	0,11	0,79±0,11		0.57-1.01
Pre AC	6	1,91	39,23±1,91	8.04	49.43-52.33
Post AC	6	0,74	50,88±0,74		35.49-42.97

Information: ANC (Anaerobic Capacity), AC (Aerobic Capacity).

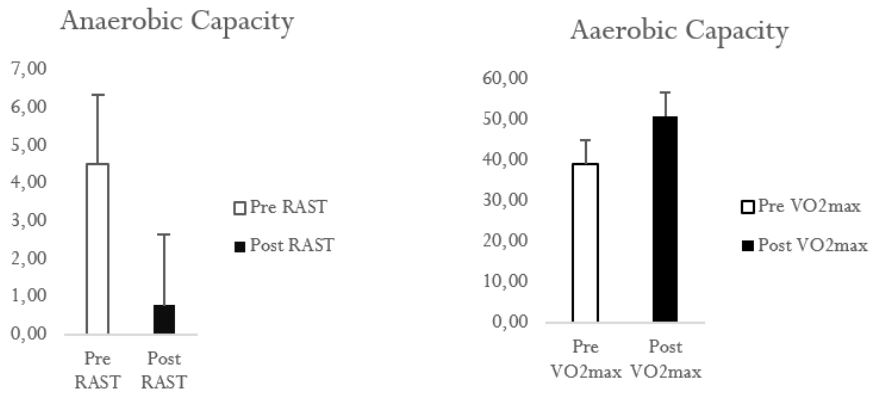
Table 2 reveals discrepancies in the Mean ± Standard Deviation values for the anaerobic capacity variable between the pre-test and post-test. Likewise, there is a discrepancy in the Mean ± Standard Deviation values for the aerobic capacity variable before and after the tests. The results of Cohen's d for both variables showed a large effect size. The measurements had 95% confidence intervals in the following ranges: Pre ANC (3.30–5.70), Post ANC (0.57–1.01), Pre AC (49.43–52.33), and Post AC (35.49–42.97).

Table 3. Normality Test and Paired Sample Test

	Shapiro-Wilk	Paired Samples Test
Pre Anaerobic Capacity	0,697	0,001
Post Anaerobic Capacity	0,754	
Pre Aerobic Capacity	0,186	0,001
Pre Aaerobic Capacity	0,839	

Table 3 shows that each group has a data distribution that is within the normal range (p > 0.05). As a result, a paired samples test was carried out. The findings show notable discrepancies in both anaerobic and aerobic capacity factors (p < 0.05).

Figure 1. Comparison of pre-test and post-test results for anaerobic and aerobic capacity



The graphic demonstrates enhanced anaerobic capacity with a reduction in RAST post-test outcomes. In the same vein, there was an increase in aerobic capacity, shown by the higher post-test VO2max results.

Discussion

The results of this research indicate that the OPT model enhances anaerobic and aerobic capacity in elite female beach volleyball athletes from Indonesia. The results of previous research support the results of this study. Based on the results of previous research that the OPT model improves the power endurance of female futsal players (Wahyu Setyanto, 2024). Working out with the OPT model resulted in a notable improvement in the athletic abilities of tennis players (Bian, 2024). Prior studies showed that the OPT Model and EMS-trained group displayed notable performance discrepancies with exercises like push-ups, squats, crunches, planks, and Max VO2. On the other hand, the PT group only showed notable enhancements in their left-hand grip strength and performance on the plank test (Bıyıklı, 2018).

Volleyball demands high physical performance (Hernández-Landa et al., 2024), depend on both aerobic and anaerobic capacity for optimal performance (Nikolaidis et al., 2016). As a dynamic team sport, volleyball involves vigorous maneuvers that require players to execute vertical and horizontal movements, often with short rest intervals. During a typical live-set match, each player may perform over 250 jumps, underscoring the necessity for quick recovery to sustain strength and power, which are essential for success in competition. In addition to vertical jumps, players must engage in various explosive horizontal movements that involve frontal and lateral actions characterized by rapid changes in direction and speed. The ability to maintain these explosive actions throughout a match relies on factors such as intramuscular buffering capacity and both anaerobic and aerobic capacities. Thus, designing effective training interventions to enhance these metabolic pathways is vital for optimizing athletic performance in volleyball players (Guo & Wang, 2024). Volleyball is a sport that demands quick reaction movements, high agility, and speed in performance, necessitating exceptional physiological capabilities, particularly in anaerobic and aerobic capacity (Nooruldeen Issa, 2022). The volleyball players must have a strong anaerobic phosphagen system as it is crucial for many necessary technical skills in the game. Furthermore, the efficiency of players is greatly improved by the proper functioning of the heart. The increased amount of blood pumped by the heart each minute results in a higher supply of energy to the muscles in use. Cardiac output, defined as the amount of blood pumped by the heart per minute from the ventricle, usually hovers around 5 liters per minute in normal situations, but can surge to 36-40 liters per minute when undergoing vigorous exercise. A clear connection exists between cardiac output and stroke volume, demonstrating the varying abilities of athletes and non-athletes (Nooruldeen Issa, 2022). Research suggests that physiologically female volleyball players undergo unique hormonal changes and respond to stress in specific ways (Miguel-Ortega et al., 2023).

Based on the principles of human movement science, the OPT model defines distinct aims for every phase, providing a systematic method for individuals to progress towards their personal objectives and cater to their individual requirements (Bıyıklı, 2018). Moreover, the OPT model is designed to develop training programs for individuals who are potentially structurally imbalanced and prone to injuries. The focal points of its principles are on improving athletic performance systematically and progressively, reaching the best physiological condition (Bian, 2024). The OPT model increases anaerobic capacity by multiplying the anaerobic energy system. Anaerobic capacity, which can be understood as the maximum energy that can be produced per unit time by the anaerobic system and is essentially dependent on the initial concentration of phosphocreatine (CP) in the muscle. This training promotes an increase in the ATP-CP system through increasing the reserves of adenosine triphosphate (ATP) and CP in the muscle and the activity of the main enzymes that work in this system. This increase can contribute to greater resistance to muscle fatigue, thus improving performance in sports. Anaerobic capacity is a very important component for some sports that feature high-intensity efforts in a short period of time (Nooruldeen Issa, 2022). The OPT model contains a cardio exercise element that requires a substantial amount of oxygen, enabling extended periods of physical activity. This can improve the body's ability to transport oxygen in muscles, allowing it to mix with nutrients and produce energy for different tasks (Bahtra et al., 2023. Anaerobic capacity is an essential factor in many individual sports that rely on explosive power, especially in the case of volleyball players who depend on this specific type of power. Hence, possessing a strong anaerobic capacity can greatly boost the burst power of volleyball athletes (Nara et al., 2022).

Consistent and dedicated training is crucial for improving athletic performance in sports (Umaran et al., 2023). Good performance is characterized by high aerobic capacity in female volleyball players (Bilici &

Kızılet, 2022). Aerobic capacity athletes are constantly seeking more effective ways to improve their per-formance (Vikestad & Dalen, 2024). Aerobic capacity describes an endurance athlete's ability to sustain sustained physical activity at low to moderate intensity. Good aerobic capacity allows them to use oxygen efficiently, thereby increasing endurance and slowing fatigue during training or competition (Bahtra et al., 2023; Purnamasari et al., 2024). It is probable that the increase in aerobic capacity is due to the OPT model, which triggers metabolic alterations in skeletal muscle such as higher mitochondrial density and capillary development. This boost in mitochondrial and capillary density is essential for improving the aerobic performance of athletes (Bilici & Kızılet, 2022).

The improvement in anaerobic and aerobic capacity following the application of the OPT model may also be influenced by menstrual factors. The training implemented may not disrupt the menstrual cycle (Laske et al., 2024), thereby allowing for increases in anaerobic and aerobic capacity among female beach volleyball athletes.

Beach volleyball trainers may introduce a 12-week OPT workout plan to improve athletes' anaerobic and aerobic abilities as preparation for the competition. However, additional research is needed with bigger sample sizes to assess the effectiveness of OPT training in various beach sports and its potential for enhancing athletic performance on a larger scale.

Conclusions

The results of this research show that elite Indonesian female beach volleyball players experience improved anaerobic and aerobic capacity after following the OPT model for 12 weeks based on the statistical results of the average value. One constraint of this research is that only elite Indonesian female beach volleyball players were trained in OPT in 2024. Coaches have the option to incorporate a 12-week OPT training regimen during the pre-competition stage to adequately ready athletes for impending obstacles. This method enhances both aerobic and anaerobic capabilities, giving athletes the strength and stamina needed for optimal performance. Further examination of how it can be used in different sports may enhance our comprehension of its wider advantages and flexibility.

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