Analysis of Athlete Endurance: A Study on Female Volleyball Athletes

Analisis Daya Tahan Atlet: Studi pada Atlet Bola Voli Putri

Original Article

Yolanda
Universitas Tanjungpura, INDONESIA

Mimi Haetami
Universitas Tanjungpura, INDONESIA

Novi Yanti*
Universitas Tanjungpura, INDONESIA

Athraa Abdulelah Abdulsatar
University of Zakho, IRAQ

Musab Mohammed Abdullah
University of Zakho, IRAQ

Abstract.

Background Endurance plays a crucial role in determining an athlete's performance, especially in high-intensity sports such as volleyball, which requires repeated bursts of activity, rapid directional changes, and sustained physical effort. VO2max, an indicator of aerobic capacity, is a key factor influencing endurance levels. However, many volleyball clubs lack structured monitoring and training programs to optimize VO2max development.

Objectives This study aims to analyze the VO2max endurance levels of female volleyball athletes from the Nomen Nascio and Brojomusti clubs in Pontianak.

Methods A quantitative research approach was employed, utilizing a survey method with Yo-Yo Intermittent Recovery Test Level 1 as the primary instrument for measuring VO2max. The study involved 55 female volleyball athletes, consisting of 40 athletes from Nomen Nascio and 15 from Brojomusti. Data were analyzed using descriptive statistics to interpret the VO2max levels among participants.

Results The results indicated that 57.5% of Nomen Nascio athletes fell into the poor category, while only 10% were classified as good. In contrast, the Brojomusti club exhibited better endurance levels, with 40% categorized as good and 6.7% as excellent. The findings emphasize the need for targeted endurance training programs to improve VO2max, particularly for clubs with lower endurance levels.

Conclusion Coaches and sports practitioners can utilize these insights to design structured, sport-specific training regimens that enhance overall athletic performance and long-term player development. This study contributes to the field of sports science by providing empirical evidence on the endurance levels of female volleyball athletes and highlighting the disparities in VO2max between different clubs.

Keywords: VO2max, endurance, female volleyball, athletes.

Abstrak.

Latar belakang Daya tahan memainkan peran penting dalam menentukan performa atlet, terutama dalam olahraga berintensitas tinggi seperti bola voli, yang membutuhkan aktivitas berulang, perubahan arah yang cepat, dan upaya fisik yang berkelanjutan. VO2max, sebuah indikator kapasitas aerobik, adalah faktor kunci yang mempengaruhi tingkat ketahanan. Namun, banyak klub bola voli yang tidak memiliki program pemantauan dan pelatihan yang terstruktur untuk mengoptimalkan perkembangan VO2max.

Tujuan Penelitian ini bertujuan untuk menganalisis tingkat daya tahan VO2max atlet bola voli putri dari klub Nomen Nascio dan Brojomusti di Pontianak.

Metode Pendekatan penelitian kuantitatif digunakan, dengan menggunakan metode survei dengan Yo-Yo Intermittent Recovery Test Level 1 sebagai instrumen utama untuk mengukur VO2max. Penelitian ini melibatkan 55 atlet bola voli putri, yang terdiri dari 40 atlet dari Nomen Nascio dan 15 atlet dari Brojomusti. Data dianalisis menggunakan statistik deskriptif untuk menginterpretasikan tingkat VO2max di antara para peserta.

Hasil Para pelatih dan praktisi olahraga dapat memanfaatkan wawasan ini untuk merancang program latihan yang terstruktur dan khusus untuk olahraga tertentu yang dapat meningkatkan performa atletik secara keseluruhan dan pengembangan pemain dalam jangka panjang. Penelitian ini berkontribusi pada bidang ilmu olahraga dengan memberikan bukti empiris tentang tingkat daya tahan atlet bola voli wanita dan menyoroti perbedaan VO2max antara klub yang berbeda.

Kesimpulan Hasil penelitian ini membuktikan bahwa latihan pliometrik efektif dalam meningkatkan kekuatan dan kecepatan lemparan bola dalam handball. Oleh karena itu, latihan pliometrik dapat diterapkan sebagai metode latihan untuk mengembangkan performa atlet dalam cabang olahraga ini.

Kata kunci: VO2max, daya tahan, bola voli putri, atlet.

Received: January 5, 2025. Accepted: March 28, 2025
*Correspondence: noviyanti@fkip.untan.ac.id
Novi Yanti
Department of Physical Education, Universitas Tanjungpura; Pontianak City, West Kalimantan 78124, Indonesia

How to Cite: Yolanda, Haetami, M., Yanti, N., Abdulsatar, A. A., & Abdullah, M. M. (2025). Analysis of Athlete Endurance: A Study on Female Volleyball Athletes. *Khatulistiwa Journal of Sport Science, 1*(1), 18–24. **https://journals.khatec.id/index.php/kajoss/article/view/5**

INTRODUCTION

Sports are a common activity undertaken to improve quality of life and can be performed by people of all ages, from children to the elderly (Suryadi et al., 2022). The more frequently a person engages in sports, the better their endurance. Good endurance allows an individual to perform activities for a relatively long duration without experiencing significant fatigue and still be able to continue with other tasks. According to Solissa (2016), endurance in the world of sports refers to an athlete's optimal physical condition to resist fatigue during sports activities. Meanwhile, Tengkudung and Puspitorini (2012) define endurance as the ability to continue working over a sufficiently long period. Bompa & Michael (2015) add that maintaining physical activity over an extended period is often referred to as endurance. Based on these expert opinions, endurance can be concluded as the ability of an individual to withstand fatigue despite engaging in repeated activities over a prolonged period.

Aerobic endurance is crucial in the sport of volleyball, given that it involves jumping movements and rapid directional changes, necessitating excellent endurance. A study by Suryadi, Samodra, & Purnomo (2021) found that endurance is one of the most critical aspects in enhancing an athlete's performance. Not only for athletes, but endurance is also essential for the general population to maintain physical and mental health. Aerobic endurance refers to an energy system that relies on oxygen to generate energy. Tengkudung & Puspitorini (2012) state that aerobic means "with oxygen," so aerobic endurance refers to muscle work that involves oxygen in the energy-releasing process. This aligns with the statement by Bompa & Haff (2009), who describe aerobic endurance, often called low-intensity endurance training, as the ability to sustain continuous activity over an extended period. Therefore, improving aerobic endurance can be achieved through continuous running at low intensity for a prolonged duration, helping to expand lung capacity and increase oxygen intake.

Aerobic endurance is essential for endurance sports, provided that oxygen is consistently available to facilitate energy release from muscle resources. Therefore, individuals must have an optimal VO2max to sustain activity for extended periods. To enhance VO2max, aerobic endurance training should be developed first before transitioning to anaerobic endurance training. One effective training method for improving both aerobic and anaerobic endurance is interval training. Bompa & Haff (2009) explain that high-intensity interval training can significantly improve running economy and VO2max, contributing to enhanced endurance performance. Additionally, research by Østerås, Sigmundsson, & Haga (2017) indicates that a lack of physical activity is a risk factor for various health complaints and stress, which ultimately negatively affects an athlete's endurance (Suryadi, 2022; Suryadi & Rubiyatno, 2022). These studies further reinforce the relevance of VO2max measurement as an indicator of physical endurance.

As stated by Bompa & Haff (2009), physical training is the foundation upon which all other factors related to sports performance are developed. Physical activity also provides extensive benefits for health and well-being, including physical, psychological, and social advantages (Moreno-Quispe, Apaza-Panca, Tavara-Ramos, & Mamani-Cornejo, 2021). According to Meo et al. (2021), sports offer significant benefits in reducing disease risk and maintaining overall health. Therefore, monitoring VO2max levels is essential for athletes with demanding training and competition schedules, as increasing VO2max can positively impact their physical endurance and performance.

However, the current issue is that no VO2max endurance tests have been conducted for athletes. Based on observations and interviews with the coach of the volleyball club, it was found that the athletes' VO2max levels have not been adequately monitored. This is supported by previous studies emphasizing the importance of VO2max in sports (Yanti et al., 2022). Yanti, Gustian, Gani, & Setiawan (2022) state that physical condition, particularly VO2max, is a dominant factor supporting an athlete's performance during training and competition. Therefore, efforts should be made to conduct VO2max endurance tests and measurements on female volleyball athletes at the Brojomusti club to assess and enhance their endurance capacity.

METHOD

Participant.

The subjects of this study were female volleyball athletes from the Brojomusti and nomen nescio club in Pontianak. The sampling technique used was total sampling, meaning that all 55 female athletes in the population were included as research participants.

Research Design.

This study employed a descriptive quantitative approach using a survey method. Tests and measurements were conducted to assess the VO2max levels of the athletes. The research instrument used was the Yo-Yo Intermittent Recovery Test Level 1. According to Hutajulu (2016), the Yo-Yo Intermittent Recovery Test (YIRT) is a reliable method for measuring athletes' VO2max levels.

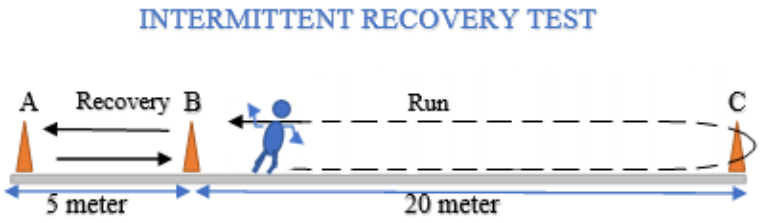

Figure 1. Yo-Yo Intermittent Recovery Test Instrument

Statistical Analysis.

The data analysis in this study utilized descriptive percentage analysis. The collected data consisted of test results and measurements obtained from the Yo-Yo Intermittent Recovery Test Level 1. The VO2max endurance calculations were performed using the formula proposed by Bangsbo, Iaia, & Krustrup (2008). The classification of physical fitness levels was then determined based on the test criteria. Data processing was assisted by Microsoft Excel 2016.

Table 1. Yo-Yo Intermittent Recovery Test Level 1 Rating Norms for Female Athletes

Rating	Level	Score Range
Elite	>17.5	>49.8
Excellent	16.6-17.5	47.5-49.8
Good	15.6-16.5	44.8-47.2
Average	14.6-15.5	42.1-44.5
Below Average	13.1-14.5	39.1-41.7
Poor	<13.1	<39.1

Source : (Bangsbo, Iaia, & Krustrup, 2008)

RESULTS AND DISCUSSION

Results

This quantitative research utilized a survey method to determine the endurance levels (VO2max) of female volleyball athletes from the Nomen Nascio and Brojomusti clubs in Pontianak. The quantitative approach in this study involved data collection through tests and measurements using the Yo-Yo Intermittent Test Level 1 as the research instrument. The study was conducted on a total of 55 female volleyball athletes, consisting of 40 athletes from Nomen Nascio and 15 athletes from Brojomusti. The research took place from December 12 to 15, 2022, at the Nomen Nascio volleyball court on Uray Bawadi Street. The data was analyzed using descriptive statistics to facilitate a clear understanding and interpretation of the research findings.

Based on the data presented in Table 2, measurements using the Yo-Yo Intermittent Test Level 1 revealed that out of 40 female athletes from Nomen Nascio, 6 athletes (15%) fell into the very poor category. Additionally, 23 athletes (57.5%) were classified as poor, while 7 athletes (17.5%) were categorized as average, and 4 athletes (10%) were in the good category. These results indicate that a significant number of female athletes from Nomen Nascio have low endurance levels. Therefore, this finding highlights the need for a specialized training program to enhance VO2max endurance among the

club's athletes. The results are further illustrated in Figure 2, which presents a bar chart of the percentage distribution of VO2max levels.

Table 2. VO2max Levels of Female Athletes from Nomen Nascio

VO2max Range	Category	Number of Athletes	Percentage
47.5 - 49.8	Excellent	0	0%
44.8 - 47.2	Good	4	10%
42.1 - 44.5	Average	7	17.5%
39.1 - 41.7	Poor	23	57.5%
< 39.1	Very Poor	6	15%
Total	-	40	100%

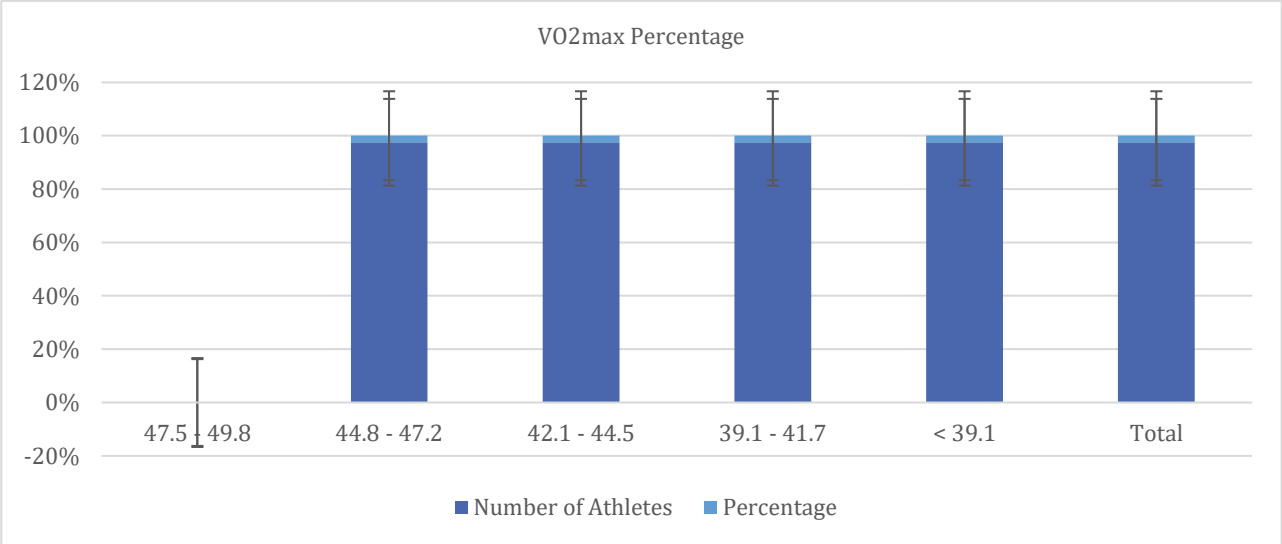

Figure 2. VO2max Percentage Distribution of Female Athletes from Nomen Nascio

Table 3. VO2max Levels of Female Athletes from Brojomusti

VO2max Range	Category	Number of Athletes	Percentage
47.5 - 49.8	Excellent	1	6.7%
44.8 - 47.2	Good	6	40%
42.1 - 44.5	Average	4	26.7%
39.1 - 41.7	Poor	4	26.7%
< 39.1	Very Poor	0	0%
Total	-	15	100%

Based on the data presented in Table 3, measurements using the Yo-Yo Intermittent Test Level 1 showed that out of 15 female athletes from Brojomusti, 4 athletes (26.7%) were in the poor category, while another 4 athletes (26.7%) were in the average category. Additionally, 6 athletes (40%) were classified as good, and 1 athlete (6.7%) was in the excellent category. These findings demonstrate that the VO2max endurance levels among Brojomusti athletes are relatively good, as 46.7% of the athletes fall into the good and excellent categories. The results are further illustrated in Figure 3, which presents a bar chart of the percentage distribution of VO2max levels.

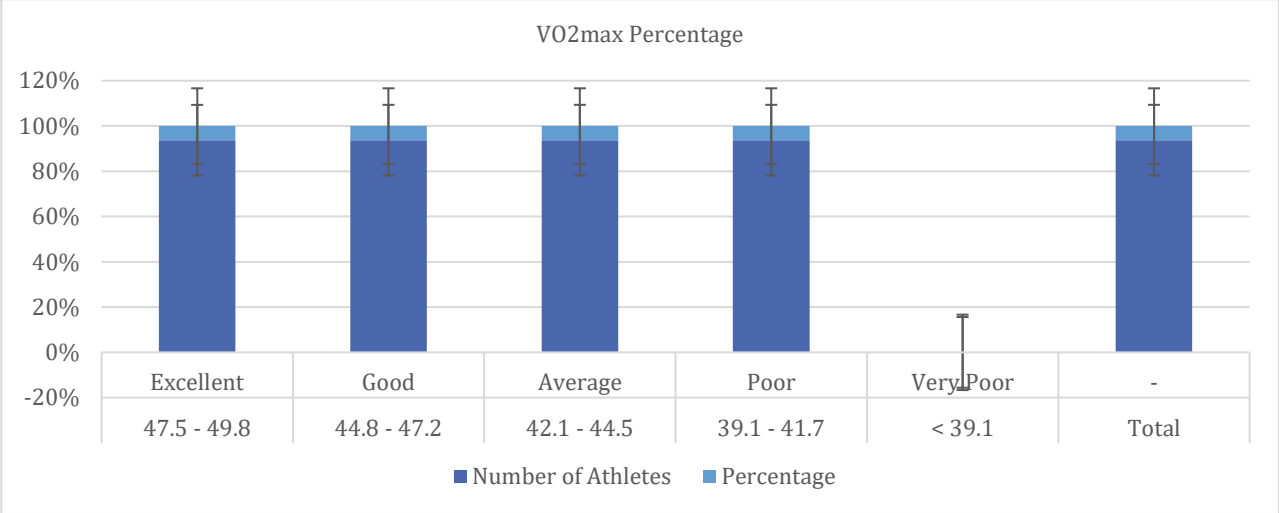

Figure 3. VO2max Percentage Distribution of Female Athletes from Brojomusti

Discussion

This study aims to determine the VO2max endurance levels of female volleyball athletes in club settings. Previous research on volleyball extracurricular activities has shown that endurance levels often fall into the very poor category (Ihsanti & Haryoko, 2022). Similarly, research on wrestling extracurricular participants found that their VO2max levels were categorized as moderate (Nesra Barus, 2020).

Based on these findings, the results can provide valuable insights for coaches in designing appropriate training programs to enhance athletes' endurance. According to Bompa & Haff (2009), training is a process in which an athlete is prepared to achieve the highest possible performance levels. Endurance training must be continuous, systematic, structured, and conducted over an extended period to maximize performance. Similarly, Bompa & Buzzichelli (2015) emphasize that organized training programs with long durations or repeated sessions can positively impact endurance development.

In addition to the training process, an appropriate training program that meets the team's needs significantly influences the results achieved. A training program is a structured process in which the coach designs suitable exercises aimed at positively impacting athletes' performance. As Suryadi et al. (2021) stated, several factors influence improvements in physical condition, including regular and structured training, proper nutrition, and adequate vitamin intake. Therefore, a well-planned training program ensures that peak performance is achieved at the intended time, provides clarity and direction in training, and ultimately optimizes performance outcomes.

There are various effective training methods to enhance aerobic endurance. According to Mylsidayu & Kurniawan (2015), exercises that can improve endurance include: (1) Controlled Speed Polygon, (2) Square Training, (3) Quad Training, (4) Triangle Run, and (5) Passing on the Right. One of the key aspects of improving aerobic endurance is selecting exercises that closely resemble real-game movements and situations. According to Pate, McClenaghan, & Rotella (1993), an ideal aerobic training activity should have the appropriate intensity, closely mimic the sport's demands, and be enjoyable.

Aerobic endurance serves as a fundamental component that every athlete must possess to support optimal performance during competition. Therefore, coaches must implement varied and effective training methods to improve aerobic endurance. As previously discussed, endurance training plays a critical role in increasing VO2max levels among athletes. Research conducted by Hardinata et al. (2021) found that endurance training using the triangle run method positively impacted endurance levels in soccer players. Additionally, the triangle running exercise also had a positive effect on the endurance of male cricket athletes in Bekasi, with improvements attributed to consistent and structured training programs (Muhamad, Kusumawati, Haqiyah, & Rosadi, 2019).

CONCLUSION

The findings of this study highlight significant variations in VO2max endurance levels among female volleyball athletes from the Nomen Nascio and Brojomusti clubs. The results indicate that a majority of Nomen Nascio athletes fall into the poor endurance category, while Brojomusti athletes demonstrate relatively better endurance, with a higher percentage classified as good and excellent.

These disparities emphasize the importance of structured endurance training programs tailored to the specific needs of each team. Given the crucial role of endurance in volleyball, coaches and sports practitioners should implement targeted training regimens to enhance aerobic capacity and overall performance. The findings reinforce that consistent, well-structured endurance training—such as interval training, triangle runs, and sport-specific conditioning—can positively impact VO2max development. Additionally, other contributing factors, such as nutrition, recovery strategies, and individualized training intensity, should be considered to optimize endurance levels.

Overall, this study provides valuable empirical data on athlete endurance levels, serving as a reference for future research and training program development. To improve performance and competitiveness, volleyball clubs should prioritize systematic endurance assessments and evidence-based training interventions that align with the physiological demands of the sport.

ACKNOWLEDGMENT

With great gratitude, I would like to express my utmost gratitude to all those who have contributed to the completion of this research.

AUTHOR CONTRIBUTION STATEMENT

Y and MH were responsible for developing the study concept and design, conducting data collection, and preparing the initial manuscript draft. AA and MMA played a key role in data analysis, interpreting the findings, and providing critical revisions to the manuscript. Additionally, NY served as the corresponding author, managing all communication and revisions throughout the publication process.

REFERENCES

Bangsbo, J., Iaia, F. M., & Krustrup, P. (2008). The Yo-Yo intermittent recovery test: A useful tool for evaluation of physical performance in intermittent sports. In *Sports Medicine* (Vol. 38, Issue 1, pp. 37–51). https://doi.org/10.2165/00007256-200838010-00004

Bompa, T., & Buzzichelli, C. (2015). *Periodization Training for Sports-3rd Edition* (Third Edit). Human Kinetics.

Bompa, T. O., & Haff, G. G. (2009). *Periodization: theory and methodology for training* (Fifth Edit). Human Kinetics.

Hardinata, R., Gustian, U., & Perdana, R. P. (2021). The Effectiveness of the Triangle Run Exercise Method in Improving Aerobic Resistance Soccer Player. *JUARA : Jurnal Olahraga*, *6*(1), 115–124. https://doi.org/10.33222/juara.v6i1.1180

Hutajulu, P. T. (2016). Pengaruh Latihan High Intensity Interval Training Dalam Meningkatkan Nilai Volume Oksigen Maksimum Atlet Sepabola Junior (U-18). *Jurnal Penjakora*, *3*(1), 1–10. https://doi.org/https://doi.org/10.23887/penjakora.v3i1.11664

Ihsanti, F. N., & Haryoko, H. (2022). Survei Daya Tahan VO2max Peserta Ekstrakurikuler Bolavoli di Sekolah Menengah Pertama (SMP). *Sport Science and Health*, *2*(12), 613–619. https://doi.org/10.17977/um062v2i122020p613-619

Meo, S. A., Abukhalaf, A. A., Alomar, A. A., Alessa, O. M., Sumaya, O. Y., & Meo, A. S. (2021). Prevalence of prediabetes and type 2 diabetes mellitus in football players: A novel multi football clubs cross sectional study. *International Journal of Environmental Research and Public Health*, *18*(4), 1763. https://doi.org/10.3390/ijerph18041763

Moreno-Quispe, L. A., Apaza-Panca, C. M., Tavara-Ramos, A. P., & Mamani-Cornejo, J. (2021). Level of physical activity of Peruvian university students during confinement. *Journal of Human Sport and Exercise*, *16*(2proc), S763–S768. https://doi.org/10.14198/jhse.2021.16.Proc2.62

Muhamad, M., Kusumawati, M., Haqiyah, A., & Rosadi, H. U. (2019). Modification of Triangle Run Exercise to Improve the Endurance of Cricket Athlete. *JETL (Journal Of Education, Teaching and Learning)*, *4*(2), 192–295. https://doi.org/10.26737/jetl.v4i2.1654

Mylsidayu, A., & Kurniawan Febi. (2015). *Ilmu Kepelatihan Dasar*. Alfabeta.

Nesra Barus, J. B. (2020). Tingkat daya tahan aerobik (vo2max) siswa ekstrakurikuler gulat di SMA Negeri 1 Barusjahe Kabupaten Karo. *KINESTETIK*, *4*(1), 108–116. https://doi.org/10.33369/jk.v4i1.10649

Østerås, B., Sigmundsson, H., & Haga, M. (2017). Physical fitness levels do not affect stress levels in a sample of Norwegian adolescents. *Frontiers in Psychology*. https://doi.org/10.3389/fpsyg.2017.02176

Pate, R. R., Mcclenaghan, B., & Rotella, R. (1993). *Dasar-dasar Ilmiah Kepelatihan.(Penterjemah: KasiyoDwijowinoto)*. IKIP Semarang Press.

Solissa, J. (2016). *Teori dan Metodologi Latihan Fisik*. PT Raja Grafindo Persada.

Suryadi, D. (2022). Analisis kebugaran jasmani siswa: Studi komparatif antara ekstrakurikuler bolabasket dan futsal. *Edu Sportivo: Indonesian Journal of Physical Education*, *3*(2), 100–110. https://doi.org/10.25299/es:ijope.2022.vol3(2).9280

Suryadi, D., Gustian, U., & Fauziah, E. (2022). The Somatotype of Martial Athletes in the Fighter Category Against Achievement. *JUARA: Jurnal Olahraga*, *7*(1), 116–125. https://doi.org/10.33222/juara.v7i1.1484

Suryadi, D., & Rubiyatno. (2022). Kebugaran jasmani pada siswa yang mengikuti ekstrakulikuler futsal. *Jurnal Ilmu Keolahragaan*, *5*(1), 1–8. https://doi.org/10.26418/jilo.v5i1.51718

Suryadi, D., Samodra, Y. T. J., & Purnomo, E. (2021). Efektivitas latihan weight training terhadap kebugaran jasmani. *Journal Respecs Research Physical Education and Sports*, *3*(2), 9–19. https://doi.org/10.31949/respecs.v3i2.1029

Tangkudung, J., & Puspitorini, W. (2012). *Kepelatihan Olahraga*. Cerdas Jaya.

Tudor, B. O., & Michael, C. (2015). *Conditioning Young Athletes*. Human Kinetics.

Yanti, N., Gustian, U., Gani, R. A., & Setiawan, E. (2022). Analysis of the vo2max physical condition of tarung derajat athletes through yoyo test: Preparation for pre-PON XX. *Journal Sport Area, 7*(1), 125–133. https://doi.org/https://doi.org/10.25299/sportarea.2022.vol7(1).6717