Physical Activity Journal (PAJU)
Volume 6, Number. 1, October 2024
e-ISSN : 2686-5807 | p-ISSN : 2686-5793

Correlation of Training Intensity and Taekwondo Athlete's Physical Fitness Level

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: https://doi.org/10.20884/1.paju.2024.6.1.11863

Abstract

The research investigates the physiological responses correlated with varying training intensities. This research determines the correlation between routine taekwondo training intensity and physical fitness in achievement class athletes at the Satria Taekwondo Academy Club, Purwokerto. The quantitative correlational research method uses a single-group experimental pre-test and post-test design method without posing any particular threat to the research sample. This research involved athletes' achievement development classes at the Satria Academy Taekwondo Club Purwokerto as samples. The research involves 30 respondents. Physical fitness was examined using the Multistage Fitness Test (running to the rhythm). The results reveal that while the majority of respondents are in the "Average" category, there is a concerning prevalence of individuals classified as "Poor" and "Bad." The examination of aerobic fitness levels among the 30 Taekwondo athletes reveals significant insights into the correlation between specialized training and cardiovascular performance.

Keywords : Training Intensity, Physical Fitness, Taekwondo, Athletes

INTRODUCTION

The development of Taekwondo in Indonesia has illustrated a dynamic trajectory, reflecting both cultural integration and competitive ambition. Introduced in the late 1960s, Taekwondo quickly gained popularity, primarily due to its martial arts heritage and the establishment of various clubs and training centers across the country (Arridlwany et al., 2023). The Indonesian Taekwondo Association (Pengurus Besar Taekwondo Indonesia, PB TI) was formed to oversee the sport's organization and promote its growth. Indonesia's participation in international competitions began to gain momentum in the late 1980s, with athletes representing the nation in regional and global events. The country achieved

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notable success at the Southeast Asian Games, where Indonesian taekwondo practitioners consistently secured medals, enhancing the sport's visibility and credibility.

Including Taekwondo as an Olympic sport further galvanized interest and investment in athlete development (Apollaro, 2023). Training programs evolved, incorporating scientific approaches to enhance performance, including strength conditioning, technique refinement, and psychological preparation. As a result, Indonesian athletes began to excel at higher levels, earning recognition in prestigious tournaments such as the Asian Games and the World Taekwondo Championships (Simakov, 2019).

Recent studies have highlighted that higher training intensities are associated with significant improvements in strength, endurance, and overall athletic performance (Bridge, 2007; Fong, 2013; Song, 2024; Torrealba, 2020). For instance, a study published in the last five years demonstrated that athletes who engaged in high-intensity interval training (HIIT) exhibited enhanced cardiovascular fitness and muscular power compared to those who followed moderate-intensity regimens (Quindry et al., 2020; Seo, 2022).

Adapting to intense training stimuli leads to physiological changes, such as increased muscle hypertrophy and improved neuromuscular coordination, which are essential for executing complex taekwondo techniques effectively (Apollaro, 2024; J. S. Wang, 2020). The balance between training intensity and recovery is also critical, as inadequate recovery can lead to overtraining, negatively impacting performance and increasing injury risk (C. Wang, 2020).

Programmed and continuous training will foster the achievement of optimal physical fitness conditions. Practicing Taekwondo with a specific frequency and intensity will benefit fitness (Ojeda-Aravena, 2021). Moreover, this excellent physical fitness can increase the level of productivity and achievement of athletes (Arridlwany et al., 2023). Meanwhile, to achieve maximum achievement, it would be nice if the level of physical fitness starts at an early age. It is known that physical exercise will be effective if the exercise is within the threshold of ability so that adaptation becomes optimal. A person's physical fitness degree determines physical abilities (Monteiro et al., 2019). The higher a person's degree of physical fitness, the higher their physical work ability. This real-time analysis can help athletes identify their strengths and weaknesses, enabling them to adjust and improve their performance. Coaches can use this information to tailor training programs and techniques to individual athletes, thus maximizing their potential.

https://doi.org/10.20884/1.paju.2024.6.1.11863
e-ISSN : 2686-5807 | p-ISSN : 2686-5793

Recent studies have highlighted that Taekwondo requires a combination of aerobic and anaerobic fitness, making it essential to understand how varying training intensities can optimize performance outcomes (Hulme et al., 2020; Taati, 2020). High-intensity training has significantly enhanced cardiovascular endurance and muscular strength, which is critical for executing effective techniques during competition. The competitive nature of Taekwondo necessitates that athletes maintain peak physical condition, which can be achieved through tailored training programs that incorporate varying intensities. Research indicates that athletes who engage in high-intensity interval training (HIIT) experience substantial improvements in their overall fitness levels, including increased VO2 Max and reduced fatigue during matches (Hassan, 2024b; Quindry et al., 2020). It is particularly relevant given the intermittent bursts of activity characteristic of Taekwondo bouts, where athletes must quickly recover between high-intensity efforts.

Specifically, the study explores how intensity training regimens influence athletes' strength, endurance, and agility. Additionally, it seeks to examine the physiological adaptations that occur in response to these training intensities, such as changes in VO2 Max. By systematically analyzing different intensities, the study aims to determine how each level contributes to strength, endurance, and agility improvements, which are critical for competition success. Additionally, the research seeks to investigate the physiological responses associated with varying training intensities, thereby elucidating the mechanisms underlying performance enhancement. Another significant goal is to assess the impact of training intensity on recovery and injury rates, ultimately contributing to safer training practices.

METHOD

This study uses a single-group experimental pre and post-test design method, where the researcher intervenes without using a control group (Marsden & Torgerson, 2012). The research aims to determine whether there is a correlation between Taekwondo training methods and the level of physical fitness in achievement class athletes at Satria Academy Taekwondo Club Purwokerto. This research measures physical fitness using the Multistage Fitness Test (running to the rhythm).

Multistage Fitness Test (MFT) determines aerobic endurance by measuring VO2Max ability at the level and reversal. Suharjana revealed that the Multistage Fitness Test (MFT) aims to measure heart and lung function efficiency by measuring maximum

https://doi.org/10.20884/1.paju.2024.6.1.11863
e-ISSN : 2686-5807 | p-ISSN : 2686-5793

oxygen consumption (Kusuma et al., 2019). The figure below demonstrates the setup for the Beep/ Multistage fitness test. MFT norms are presented in Table 1.

Table 1. MFT Norms for Men and Women

Category	Age	*Bad*	*Poor*	*Intermediate*	*Good*	*Excellent*	*Spesial*
Man	13-19	<35	35-37	38-44	45-50	51-55	>55
Women	13-19	<25	25-30	31-34	35-38	39-41	>41

Table 1 presents the MFT (Modified Fitness Test) norms for men and women aged 13 to 19. This table categorizes fitness levels into five classifications: Bad, Poor, Intermediate, Good, and Excellent. For males, the classification begins with a score of less than 35, indicating a "Bad" fitness level, while scores ranging from 35 to 37 fall under "Poor." The "Intermediate" category encompasses scores from 38 to 44, suggesting basic fitness proficiency. A "Good" rating is assigned to those who score between 45 and 50, and scores above 51, reaching up to 55 or more, are classified as "Excellent."

In contrast, the norms for females indicate a slightly different scoring system. A score below 25 is categorized as "Bad," while scores between 25 and 30 fall into the "Poor" range. Women's "Intermediate" level comprises scores from 31 to 34, with "Good" assigned to scores from 35 to 38. Scores exceeding 39, up to 41 or more, are classified as "Excellent."The data analysis method used in this study is correlational analysis.

The correlational analysis is a statistical analysis used to compare the results of measuring two variables to determine the relationship level between these variables (Arikunto, 2002). Researchers used bivariate statistics to calculate the magnitude of the correlation between the two variables associated with the taekwondo training method.

RESULT

The data analysis method used in this study is correlational analysis. The correlational analysis is a statistical analysis used to compare the measurement results of two different variables to determine the level of relationship between these variables (Suharsimi Arikunto, 2010). Researchers used bivariate statistics to calculate the magnitude of the correlation between the two variables associated with the taekwondo training method. The result of the data normality test is represented in Table 2.

https://doi.org/10.20884/1.paju.2024.6.1.11863
e-ISSN : 2686-5807 | p-ISSN : 2686-5793

Data Normality Test

Table 2. Normality Test Results

Data	Shapiro-Wilk	Sig.	Description
Intensity	0.955	0.232	Normal Data
VO2Max	0.946	0.130	Normal Data

The results of the data normality test in Table 2 show that the Intensity data obtained Shapiro-Wilk value = 0.955 and significance (Sig.) = 0.232> 0.05, so the data is declared normally distributed. VO2Max data obtained Shapiro-Wilk value = 0.946 and significance (Sig.) = 0.130 > 0.05, so it is stated that the data is normally distributed. Table 1 summarizes the results of the Shapiro-Wilk test, which assesses the normality of two distinct datasets: Intensity and VO2Max. The Shapiro-Wilk test is a statistical method utilized to determine whether a dataset follows a normal distribution, an essential assumption in many parametric statistical analyses.

The Shapiro-Wilk statistic is reported as 0.955 for the Intensity data, with a significance value (p-value) of 0.232. This p-value indicates that the data does not significantly deviate from a normal distribution, as it exceeds the conventional alpha level of 0.05. Consequently, the Intensity data can be classified as "Normal Data." Similarly, the VO2 Max data yields a Shapiro-Wilk statistic of 0.946 and a significance value of 0.130. Like the Intensity data, the p-value for VO2 Max also exceeds the 0.05 threshold, supporting the conclusion that this dataset also adheres to a normal distribution. The findings suggest that both datasets meet the assumptions of normality, which is crucial for subsequent analyses that rely on these statistical properties. Overall, the results affirm the appropriateness of parametric tests for further investigation of these variables.

Frequency Distribution Based on Age

The respondents' age range in this study ranged from 11-19 years. The data on the distribution of respondents based on age is presented in Table 3:

Table 3. Frequency Distribution of Respondents' Age

Age Category	***Frequency***	***Percentage***
11-13 Year	16	53,30%
14-16 Year	8	26,70%

https://doi.org/10.20884/1.paju.2024.6.1.11863
e-ISSN : 2686-5807 | p-ISSN : 2686-5793

15-19 Year	6	20,00%
Amount	30	100%
Average Age	13 Year	

Table 2 presents the frequency distribution of respondents' ages, categorizing them into three distinct age groups: 11-13, 14-16, and 15-19. The table provides a detailed account of the frequency and percentage of respondents within each age category, offering insights into the demographic composition of the sample.

The largest group comprises individuals aged 11 to 13 years, with a frequency of 16 respondents, representing 53.30% of the total sample. This value indicates that more than half of the respondents fall within this younger age bracket, suggesting a significant presence of early adolescents in the study. The second category, encompassing ages 14 to 16 years, includes 8 respondents, accounting for 26.70%. This group reflects a moderate representation of middle adolescents. Lastly, the age group of 15 to 19 years contains 6 respondents, corresponding to 20.00% of the sample.

The total number of respondents is 30, with an average age of 13. This distribution highlights the predominance of younger participants, which may influence the study's findings and implications, particularly in understanding developmental trends and age-related differences in the investigated context.

Physical Fitness Data Description

Physical activity data from the MFT (Multistage Fitness Test) has been translated. Distribution The results of the classification of physical activity levels are divided into 6 categories, namely: (1) Excellent, (2) Extremely Good, (3) Good, (4) Average, (5) Fair, and (6) Poor. The calculation of VO2 Max using the MFT (Multistage Fitness Test) test for male athletes can be seen in Table 4.

Table 4. Bleep Test Males

Age	Bad	Poor	Average	Good	Extremely Good	Excellent
12 – 13 yrs	3/4	5/2	6/5	7/6	8/9	10/9
14 – 15 yrs	4/7	6/2	7/5	8/10	9/9	12/2
16 – 17 yrs	5/1	6/9	8/3	9/10	11/4	13/7
18 – 25 yrs	5/2	7/2	8/6	10/2	11/6	13/10
26 – 35 yrs	5/2	6/6	7/10	8/10	10/7	12/9

https://doi.org/10.20884/1.paju.2024.6.1.11863
e-ISSN : 2686-5807 | p-ISSN : 2686-5793

36 – 45 yrs	3/8	5/4	6/5	7/8	8/10	11/3
46 – 55 yrs	3/6	4/7	5/6	6/7	7/8	9/5
56 - 65 yrs	2/7	3/7	4/9	5/7	6/9	8/4
>65 yrs	2/2	2/6	3/8	4/9	6/2	7/2

Table 4 provides a comprehensive overview of the Bleep Test results for males across various age categories, highlighting their aerobic fitness levels. The Beep Test, a widely used assessment for measuring cardiovascular endurance, categorizes performance into five classifications: Bad, Poor, Average, Good, Extremely Good, and Excellent.

The age categories range from 12 to over 65 years, with specific benchmarks for each level of performance. For instance, in the 12-13-year-old age group, a score of 3/4 is considered "Bad," while reaching 8/9 or 10/9 is classified as "Extremely Good." As the age groups progress, the standards for performance generally increase, reflecting the natural variations in aerobic capacity associated with maturation and age-related physiological changes.

In the 26-35 years category, the scores indicate a slight decline in performance compared to younger individuals, with the highest "Good" score reaching 8/10. Interestingly, as age increases beyond 36 years, the performance levels gradually decline, with the "Bad" and "Poor" classifications becoming more frequent. This trend highlights the impact of aging on aerobic endurance, emphasizing the necessity for tailored fitness programs that accommodate the physiological changes experienced throughout the lifespan. The calculation of VO2 Max using the MFT (Multistage Fitness Test) test for female athletes can be seen in Table 5.

Table 5. Bleep Test Females

Age	*Bad*	*Poor*	*Average*	*Good*	*Extremely good*	*Excellent*
12 – 13 yrs	2/6	3/6	5/2	6/2	7/5	9/3
14 – 15 yrs	3/4	5/3	6/5	7/6	8/8	10/7
16 – 17 yrs	4/2	5/7	7/2	8/5	9/8	11/11
18 – 25 yrs	4/5	5/8	7/3	8/7	10/2	12/7
26 – 35 yrs	3/8	5/3	6/6	7/8	9/5	11/5
36 – 45 yrs	2/7	3/8	5/4	6/3	7/5	9/5

https://doi.org/10.20884/1.paju.2024.6.1.11863
e-ISSN : 2686-5807 | p-ISSN : 2686-5793

46 – 55 yrs	2/5	3/6	4/5	5/4	6/3	8/1
56- 65 yrs	2/2	2/7	3/6	4/5	5/7	7/2
>65 yrs	1/5	2/2	2/7	3/5	4/4	5/7

Table 4 presents the results of the Bleep Test for females, categorized by age groups, to assess their aerobic fitness levels. The Beep Test is an essential tool for measuring cardiovascular endurance, and this table outlines the performance classifications ranging from "Bad" to "Extremely Good and Excellent." The age categories span from 12 to over 65 years, with specific performance scores defined for each classification. For instance, in the 12-13-year-old age group, a score of 2/6 is deemed "Bad," while a score of 7/5 or 9/3 qualifies as "Extremely Good." As one progresses through the age groups, the performance benchmarks tend to shift, reflecting physiological development and age-related changes in fitness capacity.

Notably, the 18-25 years category demonstrates a relatively high fitness level, with scores indicating a transition from "Average" to "Good." However, as age increases, particularly beyond 36 years, the frequency of lower performance classifications, such as "Bad" and "Poor," becomes more pronounced. This trend underscores the need for targeted fitness interventions to maintain and enhance aerobic capacity in older populations.

The level achieved is the most common and standard way to score the Beep Test. It is calculated by the level reached and the number of shuttles within that level. For example, if an athlete reached level 7 and completed two 20-meter shuttle runs at that level, their score would be noted as 7.2. *The total distance covered* – To calculate the total distance covered, multiply the total number of successful shuttles completed by 20 meters. For example, if an athlete achieves a level of 7.2, they will have completed 64 shuttles, so their total distance covered would be 1,280 meters (64 x 20 = 1,280 meters). However, take caution as there has been debate about its capability to provide a valid estimate of VO2 max. The result of comparing VO2 Max percentage is presented in Table 6.

Table 6. V02 Max Percentage

Status	Male Norms	Female Norms	Frequency	%
Excellent	≥ 10,9	≥ 9.3	0	0,0
Extremely Good	≥ 8,9	≥7,5	4	13,3

https://doi.org/10.20884/1.paju.2024.6.1.11863
e-ISSN : 2686-5807 | p-ISSN : 2686-5793

Good	≥ 7,6	≥ 6,2	8	26,7
Average	≥ 6,5	≥ 5,2	15	50,0
Poor	≥ 5,2	≥ 3,6	2	6,7
Bad	≥ 3,4	≥ 2,6	1	3,3
			30	100

Table 6 compares VO2 Max percentages for males and females, categorizing participants into various fitness levels based on their aerobic capacity. The classification begins with the "Excellent" category, where the norms for males are set at ≥10.9 and for females at ≥9.3. Notably, no individuals were in this category, indicating a significant challenge in achieving high aerobic capacity.

In the "Extremely Good" category, four participants, representing 13.3% of the total sample, met the required thresholds, with norms of ≥8.9 for males and ≥7.5 for females. The "Good" category saw eight individuals, accounting for 26.7% of the sample, reflecting a moderate fitness level with norms of ≥7.6 for males and ≥6.2 for females.

The largest group falls into the "Average" category, comprising 15 participants, or 50% of the total, indicating a satisfactory aerobic fitness level with norms of ≥6.5 for males and ≥5.2 for females. Conversely, only two individuals (6.7%) were classified as "Poor," and one participant (3.3%) fell into the "Bad" category, with norms of ≥5.2 and ≥3.4 for males, respectively. Overall, the data underscores the varying levels of aerobic capacity within this cohort, emphasizing the need for regular physical activity to improve cardiovascular health.

DISCUSSIONS

The examination of aerobic fitness levels among the 30 Taekwondo athletes reveals significant insights into the correlation between specialized training and cardiovascular performance. The data, derived from assessments such as the Beep Test and VO2Max measurements, indicate that these athletes generally exhibit higher aerobic capacity than non-athletic populations. This observation is consistent with findings from Taati, (2020) which suggest that athletes engaged in high-intensity sports, like Taekwondo, develop superior cardiovascular efficiency due to their rigorous training regimens.

The results from the Beep Test demonstrate that a substantial proportion of the athletes fall into the "Good" and "Extremely Good" categories, reflecting their ability to

https://doi.org/10.20884/1.paju.2024.6.1.11863
e-ISSN : 2686-5807 | p-ISSN : 2686-5793

sustain high-intensity efforts over time. It aligns with the assertion by Tapia, (2020) that aerobic conditioning is crucial for combat sports, where athletes must perform repeated bouts of high-intensity activity interspersed with brief recovery periods. However, the absence of athletes in the "Excellent" category raises concerns about the potential for further enhancement of their aerobic fitness, suggesting that current training protocols may require optimization. The VO2Max data indicate that while many athletes are classified as "Average" to "Good," a notable percentage are categorized as "Poor" or "Bad." This finding highlights the need for individualized training programs that specifically target aerobic development, as emphasized by Song (2024), who noted that tailored interventions can significantly improve performance outcomes in athletes.

The importance of training intensity in Taekwondo cannot be overstated, as it directly influences athletes' performance and physical fitness levels. Recent studies have highlighted that high-intensity training regimens are essential for developing the specific physiological attributes required in Taekwondo, such as explosive strength, agility, and cardiovascular endurance (Hassan, 2024a; Mischenko, 2021). For instance, research indicates that athletes who engage in high-intensity interval training (HIIT) demonstrate significant improvements in their aerobic and anaerobic capacities, which are critical for sustaining performance during competitions (Hassan, 2024b).

The nature of Taekwondo, characterized by intermittent bursts of high-intensity activity followed by brief recovery periods, necessitates a training approach that mirrors these demands (Matsushigue et al., 2009). By incorporating high-intensity drills and sport-specific exercises, athletes can enhance their ability to recover quickly and maintain peak performance throughout bouts. It is supported by findings that suggest a direct correlation between training intensity and improvements in VO2 Max, a key indicator of cardiovascular fitness (Rusdiana et al., 2020).

The psychological benefits of high-intensity training should not be overlooked. Challenging workouts can boost athletes' confidence and mental resilience, vital for success in competitive environments (Sant'Ana, 2017). Overall, integrating high training intensity into Taekwondo training programs is crucial for optimizing athletic performance and ensuring that athletes are well-prepared for the physical demands of their sport. The physical fitness training for Taekwondo athletes reveals a multifaceted approach essential for optimizing performance in this demanding sport (Ojeda-Aravena, 2023). Recent studies

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e-ISSN : 2686-5807 | p-ISSN : 2686-5793

emphasize the importance of incorporating various training modalities, including strength, endurance, flexibility, and agility exercises, to enhance overall athletic performance (Mathunjwa, 2021; Son, 2015). For instance, a study focusing on junior Taekwondo athletes highlighted that a well-rounded training program significantly improved their physical condition, explicitly focusing on strength and endurance metrics.

Integrating sport-specific drills that simulate competition scenarios is crucial for developing the skills and physical attributes required in Taekwondo. These drills enhance technical proficiency and improve cardiovascular fitness as athletes engage in high-intensity bouts that mimic the demands of actual matches (Quindry et al., 2020). Research indicates that such training regimens lead to substantial improvements in VO2Max and other fitness indicators, vital for sustaining performance during competitions.

Strength training is essential for Taekwondo athletes, significantly enhancing their performance by improving power, stability, and injury prevention (Koshcheyev, 2021). A well-structured strength training regimen focuses on developing upper and lower body strength, which is crucial for executing powerful kicks and strikes.The lower body, in particular, requires targeted exercises such as squats and lunges to build the quadriceps, hamstrings, and gluteal muscles. These muscle groups are vital for generating explosive power during kicking techniques and maintaining endurance throughout matches.

Upper body strength is equally important, contributing to effective punching and blocking. Exercises such as bench presses, push-ups, and pull-ups enhance the strength of the shoulders, chest, and arms, enabling athletes to perform strikes with greater force and control (Chen et al., 2018). Moreover, core stability is a key focus, as a strong core facilitates balance and coordination during dynamic movements. Exercises like planks, medicine ball rotations, and rotational kettlebell swings can significantly improve athletes' ability to stabilize their bodies while executing techniques (Ouergui, 2020, 2023).

Functional strength training is also critical, as it simulates the specific movements encountered in Taekwondo. Resistance bands, kettlebells, and agility drills can help athletes develop strength relevant to their sport. Furthermore, periodization is necessary to optimize training outcomes, allowing athletes to systematically vary their intensity and volume.

https://doi.org/10.20884/1.paju.2024.6.1.11863
e-ISSN : 2686-5807 | p-ISSN : 2686-5793

CONCLUSION

This study concludes that it can be identified that the subject of achievement class Taekwondo athletes at the Satria Taekwondo Academy Club Purwokerto has an average intensity at the routine level of following technical training so that it must be maintained to be able to support in improving athlete performance, while VO2 Max in achievement class athletes is at an average fitness level. The findings indicate that while the majority of respondents fall within the "Average" category, there is a concerning prevalence of individuals classified as "Poor" and "Bad." A substantial portion of the population may be at risk for health complications associated with low aerobic fitness.

The absence of participants in the "Excellent" category for VO2Max raises questions about the overall fitness culture and accessibility of effective training programs. Adopting a multifaceted approach that promotes physical activity to improve public health outcomes through community programs, education, and policy initiatives is imperative. These strategies should encourage lifelong physical activity engagement, fostering a healthier, more active population. Overall, this analysis reinforces the need for continued research and intervention strategies to enhance aerobic fitness, vital for improving quality of life and reducing the burden of chronic diseases associated with sedentary behaviors.

Future research could focus on longitudinal studies that examine the effects of specific exercise interventions on aerobic fitness across different age groups and genders, thereby providing a clearer understanding of optimal training regimens. Additionally, exploring the psychosocial factors that influence physical activity adherence could enhance the effectiveness of health promotion strategies.

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