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Somatotype Analysis and the Association between Body Fat Percentage, Aerobic and Anaerobic Performances in Silat Olahraga Athletes

Abdul Kadir Mahmod [1], Muhammad Zulqarnain Mohd Nassir [2], Jajat Darajat Kusumah Negara[3] & *Sharifah Maimunah Syed Mud Puad [4]

[1,2,4] Fakulti Sains Sukan dan Rekreasi, Universiti Teknologi MARA Cawangan Negeri Sembilan, Kampus Seremban, Malaysia

[3] Department of Sport Education, Faculty of Sport Education and Health, Universitas Pendidikan Indonesia, Bandung, 40154, West Java, Indonesia

*Corresponding author's email: shari0971@uitm.edu.my

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ABSTRACT

The unique nature of Silat Olahraga as a sport demand the development of both aerobic and anaerobic fitness. There is interconnection of these fitness components with individuals' body composition. The objective of this study is to investigate the prevalence of somatotype and examine the relationship between body fat percentage towards aerobic and anaerobic performances among Silat Olahraga athletes. Thirty-three (n=33) well-trained male athletes from UiTM Negeri Sembilan, SUKMA Negeri Sembilan, Universiti Teknikal Malaysia (UTEM) and SUKMA Melaka were participated in this study. Body composition tests consisted of skinfold measurement, weight, height, girth measurement, and bone breadth were used to measure body fat percentage and somatotype. Aerobic test was conducted by using 20m multistage fitness test and anaerobic test was conducted by using running anaerobic sprint test (RAST). The data were analysed using frequency test and Pearson correlation test. The findings demonstrated that the body fat percentage was significantly correlated with aerobic VO2max performance (p=0.001, r=-0.568), peak anaerobic power (p=0.002, r=0.519) and average anaerobic power (p=0.003, r=0.504). However, no significant relationship was found with fatigue index (p>0.05). Findings of the present study also showed that 15.2% of the Silat athletes were endomorph, 66.7% were mesomorph and 18.2% were ectomorph. This study confirmed that there was a significant relationship between body fat percentage on aerobic and anaerobic performances. Most of the athletes in this study were mesomorphs.

Keywords: *Somatotype, Body Fat Percentage, Aerobic Anaerobic Performance, Silat*

INTRODUCTION

Silat is a type of martial art, and it is recognized as a combat sport in competitive sport. According to Shapie (2011), the movements demonstrated by Silat Olahraga athletes during competitive events encompasses various actions such as punching, kicking, blocking, sweeping, dodging, and many other techniques. It has been observed that in Silat competition, athletes execute movements in various directions such as forward, backward, sideways, diagonally, and in circular patterns, incorporating multiple techniques and skills (Saputra, Mulyana, Komarudin & Sartono, 2017). Each match in Silat olahraga consists of three rounds of 2-minutes bouts, followed by 1-minute recovery (Shapie, Oliver, O'Donoghue, & Richard, 2013). In competitive Silat, weight categories are used to ensure fair and equitable matchups between athletes of comparable build and weight (Pelana, 2017). Body composition plays a significant role in determining a Silat athlete's weight class (Aziz, Tan & Teh, 2002).

Body composition refers to the percentage division of human body, primary focusing on fat free mass and fat mass (Adams & Beam, 2007). Body composition can be assessed with various type of tests including anthropometric measurements, bioelectrical impedance, underwater weighing absorptiometry and many more. Most of the techniques measure or estimate the fat mass first and use the result to measure another composition of fat free mass (Adams & Beam, 2007). Body composition and stature are closely associated with Silat performances. High fat mass affects the athlete's body weight, posture and movement during Silat performances (Narruti, Kandarina, Farmawati & Penggalih, 2014). The ideal physique in Silat, a combat sport with weight categorization, is to maximize muscle mass and minimize fat due to the significant performance advantage offered by well-developed muscles (Narruti et al., 2014; Tooth, 2007). Higher body fat percentage lead to endomorphy, result in a reduction of a Silat athlete's agility (Naruti et al., 2007; Norton, Olds, Olive & Cray; 2004).

Athletes with the appropriate physique and somatotype for their sport have a competitive advantage. Somatotype refers to the classification of the human body based on three essential elements: endomorphy, or relative adiposity, mesomorphy or relative musculoskeletal development, and ecthomorphy or relative human linearity (Samodra, Gustian, Seli, Riyanti, Suryadi & Fauziah, 2023; Carter & Heath, 1990). Previous studies have highlighted the influence of lifestyle and training on somatotype (Drywien, Gornicki & Gornicka, 2021; Noh, Kim & and Kim, 2013; Andreato, Franchini, Moraes, Esteves & Vieira, 2012; Lewandowska, Buśko., Pastuszak, & Boguszewska, 2011). A study done by Noh et al. (2013) revealed that elite boxing athletes have higher levels of mesomorphy compared to non-athletes. Combat sport athletes such as judo, wrestling and jujitsu tend to have a mesomorphic somatotype while football players tend to exhibit a balanced mesomorphic somatotype (Noh et al., 2013; Andreato et al., 2012). The endomorphic component of football player is also less than combat sport (Noh et al., 2013; Lewandowska et al., 2011). These findings indicate that the type of sport has an impact to the somatotype levels, which can be attributed the specific physical training involved.

In addition to ideal somatotype, the distinctive nature of Silat Olahraga as a combat sport demand the enhancement of both aerobic and anaerobic fitness. In three rounds of Silat matches, the athletes record an average heart rate of 80% of their maximal heart rate (MHR) (Patah, Jumareng, Setawan, Aryani & Gani, 2021; Nugroho, 2020). This indicates that Silat is a high intensity sport (Nugroho, 2020). A good physical fitness is required for Silat athletes to perform their skills and techniques optimally especially at high intensity effort. Anaerobic strength and explosive power are important in Silat as this sport emphasizes on quick and powerful strikes, kicks, and takedowns (Ooi & Anowar, 2018; Aziz et al., 2002). The close combat situations in Silat requires anaerobic power and muscular strength in executing powerful throws and joint locks to overpower opponents. The ability to sustain full-time high intensity effort requires certain degree of endurance component. Silat training involves prolonged bouts of sparring that demands aerobic fitness (Ooi & Anowar, 2018).

The aerobic and anaerobic fitness components are interconnected with an athlete's body composition. According to Samodra et al. (2023), somatotype serves as a measure of body composition. Despite the importance of aerobic, anaerobic fitness and good body composition in Silat, to our knowledge, there is limited published data on the association between aerobic and anaerobic fitness, as well as body

composition, specifically in Malaysian Silat athletes. In addition, the complete understanding of an athlete's potential towards specific somatotype has yet to be fully explored. Therefore, the present study was proposed to examine the association between body composition, aerobic and anaerobic performances, and to analyse the somatotype of young Silat athletes.

METHODOLOGY

Participants

Total of thirty-three (N=33) male Silat Olahraga athletes from UiTM Negeri Sembilan, SUKMA Negeri Sembilan, Universiti Teknikal Malaysia (UTEM) and SUKMA Melaka, age 20.06 ± 1.87 years old, mean weight 65.30 ± 13.09 kg and height 169.10 ± 1.06 cm, were recruited for this study. All Silat athletes involved in the present study were junior athletes with at least three years' experience in the sport. The inclusion criterion for the participants were include healthy and free form injury. Written informed consent was obtained from all participants prior to the commencement of the study with detailed explanation on the study objective, experimental protocol, associated risk and potential benefits of participation. All procedures were conducted in accordance with the Declaration of Helsinki and approved by the Institution's Ethics Committee (REC/213/2022).

Research Design

This study was a cross-sectional study. The sampling technique used is purposive sampling. All participants performed anthropometric assessments, running anaerobic sprint test (RAST) and 20-meter multistage fitness test.

Measurements

Body Fat Percentages and Somatotype

The body fat percentages and somatotype were measured using manual anthropometric measurements, including weight (weight scale), height (stadiometer), skinfold measurement (Harpenden calliper) at eight sites (triceps, biceps, subscapular, iliac crest, supraspinal, abdominal, thigh and medial calf), arm girth, calf girth (measurement tape), femur and humerus width (sliding calliper). ISAK technique was utilized to perform skinfold measurement. The data obtained from the anthropometric testing were used to estimate somatotype using Heath-Carter method.

Running Anaerobic Sprint Test (RAST)

The RAST test involves 6 maximal sprints covering a distance of 35 meters, with 10 seconds recovery time between each sprint. Time taken to complete each sprint were recorded. The peak power, mean power and fatigue index were calculated from the RAST's time results (Queroga et al., 2013). The reliability of RAST test are; peak power r = 0.831, mean power r = 0.714 and fatigue index r = 0.97.

20-meter multistage fitness test

Aerobic fitness performance was estimated using the 20-meter shuttle run test, which involved participants running back and forth over a 20-meter. The participants were required to run 20 meter in time with a "beep" sound from a CD recorder. The running sequence continued until the participants were unable to maintain the required pace set by the "beep." The estimation of VO2max was derived from the total number of completed laps during this test. The reliability of this test is $r = 0.90$.

Statistical Analysis

Statistical analysis was carried out using Statistical Packaging for Social Sciences (SPSS) Statistics version 25. Descriptive statistics (mean ± SD) was used to report the demographic data of the study and the frequency of the somatotype. The Pearson correlation test was used to measure the relationship between variables. Statistical significance level was accepted at $p<0.05$.

RESULTS AND DISCUSSION

Total of thirty-three (N=33) male Silat Olahraga athletes, age 20.06 ± 1.87 years old, mean weight 65.30 ± 13.09 kg and height 169.10 ± 1.06 cm, were participated in this study. The participants have normal Body Mass Index (BMI) of 22.87 ± 4.03 $kg.m^{-2}$ and good level of body fat percentage 11.23 ± 4.10 %.

The findings demonstrated that the body fat percentage was significantly correlated with aerobic VO2max performance (p=0.001, r=-0.568), peak anaerobic power (p=0.002, r=0.519) and average anaerobic power (p=0.003, r=0.504). However, no significant relationship was found with fatigue index (p>0.05). Table 1 presents the correlation analysis between body fat percentage and aerobic performance, meanwhile the association between body fat percentage and anaerobic performances are being reported in Table 2.

Table 1: Correlation between body fat percentage and aerobic performance

	VO_2max
Body Fat Percentage	-.568

Note. * $p < .05$

Table 2: Correlation between body fat percentage and anaerobic performances

	Peak Anaerobic Power	Average Anaerobic Power	Fatigue Index
Body Fat Percentage	.519*	.504*	.302

Note. * $p < .05$

Table 3: Somatotype

	Frequency (n)	Percent (%)	Characteristics
Endomorph	5	15.2	Larger frame
Mesomorph	22	66.7	Muscular
Ectomorph	6	18.2	Slim and lean
Total	33	100.0	

Findings of the present study showed that 15.2% of the Silat athletes were endomorph, 66.7% were mesomorph and 18.2% were ectomorph.

The findings of this study revealed a connection between body fat percentages and aerobic performance. This result is consistent with previous studies done by Nikolaidis (2013) and Amani et al. (2010), which found an inverse relationship between body fat percentages and aerobic performance. This phenomenon is attributed to the fact that increased body fat levels can reduce the delivery of sufficient oxygen to highly active muscles (Chatterjee et al., 2005). Usage of fat oxidation will limit oxidative capacity at high intensity phase (McArdle, Katch, & Katch, 2006). The 20-meter multistage fitness test employed in this study is an incremental test, triggering a transition in energy sources from fat to carbohydrate as intensity increases. Lower levels of body fat enabled participants to maintain incremental intensities effort until the high-

intensity stage, where the carbohydrate usage will dominate. Higher levels of body fat resulted in earlier attainment of VO2max as body cannot cope with the escalating oxygen demand during intensifying levels of exertion (Shete et al., 2014).

As for anaerobic performances, results indicated a moderate association between body fat percentages, peak anaerobic power, and average anaerobic power. However, no statistically significant relationship was identified with the fatigue index. This study's findings contrast with those of Nikolaidis (2013, 2012). Nikolaidis found a negative relationship between body fat percentages and peak anaerobic power in his research. This difference can be elucidated in terms of body composition. It is speculated that the subjects' phosphagen system and fat-free mas is optimal to facilitate the generation of explosive force necessary for peak anaerobic power. The phosphagen system, which predominantly relies on the rapid regeneration of adenosine triphosphate (ATP) through creatine phosphate, is important for short bursts of high-intensity activities (Guimarães-Ferreira, 2014). The adipokines hormones release from the adipose tissue explains the association between body fat percentages and average power. Adipokines hormones can influence metabolic responses and energy utilization. While excess fat may not be directly linked to power output, the interplay of these hormones might affect overall energy metabolism, potentially impacting sustained average power (Lee at al., 2019). According to Shapie (2011), Silat Olahraga athletes are more accustomed to anaerobic training compared to aerobic training. Moreover, a study by Aziz et al. (2002) demonstrated that Silat athletes possess elevated anaerobic power during their matches. Silat training regimen heavily emphasizes on speed, strength, and plyometric exercises, which collectively contribute to an increase anaerobic fitness component.

The findings of this study demonstrated that there is no correlation between body fat percentages and the fatigue index. Several factors can influence the fatigue index, and one of the important factors is body's buffering capacity. This capacity refers to the body's ability to regulate lactate buildup in the absence of sufficient oxygen (McArdle et al., 2006). When the buffering capacity is low, individuals may struggle to maintain and sustain their performance or force output over a specific time period. In a study conducted by Aschenbach et al. (2000), it was found that successful combat wrestlers demonstrated good blood buffering, which enhances their ability to withstand lactate accumulation and reduce the power drop which led to high fatigue index. The balance between the production of lactate through anaerobic glycolysis and its clearance via the buffering system significantly impacts the level of lactate accumulation (Edge et al., 2006). As exercise intensity increases, the production of lactic acid also rises, contributing to fatigue and performance drop (Khanna et al., 2006).

Majority of the Silat athletes involved in this study have mesomorph somatotype. This discovery aligns with the findings of a study conducted by Pieter et al. (2009), which observed that elite Silat athletes and those in the developmental stage predominantly exhibit the mesomorph somatotype. This trend toward mesomorphism can be attributed to the nature of Silat sport, characterized by anaerobic movements such as punches, kicks, dodges, and jumps, all of which engage fast-twitch muscle fibres (Shapie, 2014). Okilanda et al. (2021) found similar results that revealed the dominant body type possessed by fighting athletes is mesomorph. This finding was also reported by Samodra et al. (2023) that showed dominant mesomorph body type among Tarung Derajat Silat fighters. Mesomorphs' tendency to excel in activities requiring anaerobic energy systems further complements the demands of Silat as combat sport.

CONCLUSION

In conclusion, body composition as one of the fitness criterions has potential to influence other fitness components. This study reveals the interelation of body composition in shaping the aerobic and anaerobic capabilities of Silat Olahraga athletes. As a result, athletes aiming for higher sport performance level must strive to achieve an optimal balance between fat mass and fat-free mass. The demands of Silat Olahraga encompass both aerobic and anaerobic fitness, necessitating athletes to attain good fitness across both domains. The integration of somatotype considerations into athlete preparation contributes to optimizing performance outcomes in Silat. However, it is important to take note that while somatotype offers insights

potential, individual success in Silat is also influenced by dedication, skill acquisition, and mental resilience.

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CONFLICT OF INTEREST

AKM, MZMN, JDKN and SMSMPS declare that they have no conflict of interest.

AUTHOR'S CONTRIBUTIONS

AKM carried out this study and drafted the manuscript.

SMSMP participated in the design of the study and wrote the manuscript.

MZMN and JKKN reviewed the manuscript.

All authors read and approved the final manuscript.

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