




Differences of physiological characteristics of taekwondo junior players vs pencak silat junior players

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Abstract

Introduction: Because of the fact that detailed data on the physiological characteristics of Pencak Silat are still limited. The primary purpose of this study to assess the physiological responses of Pencak Silat athletes and a secondary aim is to compare the physiological responses of Pencak Silat athletes with physiological responses of Taekwondo athletes. **Material and Methods:** This study has included 17 male junior martial art athletes (aged 15–16 years). This study requires all participants to completed one familiarization session and two experimental sessions. During the first session (laboratory condition), anthropometry was measured in the laboratory, and during the second session (on-court condition), the participants completed tests for anaerobic capacity (sprint test 60-m, vertical jump, push-ups, and sit-ups) and VO_{2max} test. **Results:** The statistical analysis revealed no significant differences in anthropometry, vertical-jump, sit-ups, push-ups, and 60-m sprint results among TKD and PKS groups. Furthermore, the TKD group had significantly higher VO_{2max} ($p=0.015$), when compared with the PKS group. **Conclusion:** The present investigation describes similar physiological characterizes, such as weight, height, BMI, BMR, body fat and also performances of vertical jump, sit-ups, push-ups, and 60-m sprint tests among Taekwondo and Pencak Silat athletes. However, in comparison with junior Pencak Silat athletes, the junior Taekwondo athletes have better VO_{2max} .

Keyword: Indonesian Athlete, Anthropometry, Assessments, Measurements, Martial Arts.

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INTRODUCTION

Taekwondo is an Olympic category-martial art sport practiced in over 180 countries worldwide, with approximately eighty million people adherents in this sport [1]. In fact, this art of self-defense is indigenous to the ethnic Korean, dating as far back as the 2333 B.C [2]. On the other hand, previous studies have been examined and observed of Taekwondo's physiological characteristics to determine a formula for aid in more appropriate planning and monitoring of specific training [3,4]. Previous literature pointed at the fact that Taekwondo demonstrates high peak anaerobic power characteristics of the lower limbs during competition and this attribute appears to be conducive to achieving success [4]. Because the fact of this characteristics, Monks et al. [5] suggested that High Intensity Interval Training (HIIT) with a rest-work ratio of 1:2 and 1:3 could be used as a training for improvement in anaerobic and anaerobic capacity as well as physical fitness in collegiate Taekwondo athletes.

Previous literature also examined the other physiological variables such as muscular endurance, power, VO_{2max} and speed of Taekwondo athletes [6-11]. Markovic et al. [6] examined the upper-extremity and trunk muscular endurance of international female taekwondo athletes using a 60-s push ups test, and suggesting that the endurance properties of the upper extremities may be important to support several technical and tactical actions in Taekwondo. Moreover, Casolino et al. [7] examined the lower limb muscular power using a squat/static jump tests (SJ), and found that mean SJ performances of Italian Taekwondo athletes are 40.7 cm. In this context, it is common for these researchers used a vertical jump (VJ), counter-movement jump (CMJ) and SJ tests as a parameter to assessed muscular power, because they believe the maximum jump height that achieved by an athletes, which is an indicator of lower limb (leg muscular) power, and can provide key information about their functional capacity and performance in many sports, specifically in martial art sport [12].

Previous research also reported VO_{2max} and speed of Taekwondo athletes. According to Bridge et al. [13], the VO_{2max} of senior male and female international athletes ranges between 44–63 ml kg^{-1} min^{-1} and 40–51 ml kg^{-1} min^{-1} , respectively. Furthermore, these results also reported that VO_{2max} scores is similar to that of males and females in other combat sports such as Karate, Judo, Wrestlers and Boxing that elicit marked demands on aerobic metabolism, but they are lower than those exhibited by athletes in endurance-based events such as Marathon athletes. Additionally, Sadowski et al. [9] reported the speed characteristics of Taekwondo athletes using 30-m conventional field-based testing methods, found that Taekwondo elite athlete faster than non-elite Taekwondo athletes (4.62 vs 4.81 s).

While many of the studies successes to examined and observed physiological characteristics of Taekwondo, that can be a formula for aid to planning training with greater precision, but detailed data on physiological characteristics of Pencak Silat are still limited. Pencak Silat is one of the martial art forms are becoming popular in the Western hemisphere [14]. Based on historical, Pencak Silat is indigenous to the ethnic Malays and has its origins in Southeast Asia, dating as far back as the 13th century [15]. Specifically, there are various internationally sanctioned competitions such as the European Championship inaugurated in 1985, South-east Asian Games (since 1987) and World Championships (since 1982) [16]. This evidence has shown that Pencak Silat is one of the martial art sports that popular in the World even though not become an Olympic-sport.

To our knowledge, there are only a limited number of human studies, which have focus on examined and observed physiological characteristics of Pencak Silat [17]. Therefore, the primary purpose of this study to assess the physiological responses of Pencak Silat athletes and a secondary aim is to compare physiological responses of Pencak Silat athletes with physiological responses of Taekwondo athletes.

MATERIAL AND METHODS

Subject

This study has included 17 male junior martial art athletes (aged 15–16 years). This study was performed in 01 July - 01 August 2019, which was the official competition break period and no official

game was played so. They were divided into two groups according to the type of martial art sport that they have mostly performed: group TKD engaged 8 Indonesian Taekwondo athletes and group PKS embraced 9 Indonesian Pencak Silat athletes. They were recruited based on the following criteria: they trained at least three sessions per week of 60 to 120 min duration per session, national or international level tournament participation, current and past non-smokers, none of the subjects had lower and upper-extremity injuries or musculoskeletal injuries within 6 months prior to the initial testing. Exclusion criteria include cardiovascular and respiratory disease. Alcohol and caffeine were not accepted about 24 hours prior to the experiments. All participants provided informed consent to participate in this study and all of the procedures were approved by the ethics committee of the Bandung Health Polytechnic.

Study design

This study requires all participants to completed one familiarization session and two experimental sessions. During the first session (laboratory condition), anthropometry was measured in laboratory, and during the second session (on-court condition), the participants completed tests for anaerobic capacity (sprint test 60-m, vertical jump, push ups and sit-ups) and VO_{2max} test. Both tests were separated by a week recovery periods. The participants had not undertaken any intense effort during the previous 24 hours or eaten any food in the 3 hours before the test were registered.

Protocol Procedures

Monday morning at 08:00 a.m., anthropometric was measured in Institut Teknologi Bandung, Sport Science laboratory. Anthropometry and cardiorespiratory tests were measured at constant ambient temperature (26 - 29 °C) and relative humidity (65 - 74 %). The body weight, body fat, body mass index (BMI), basal metabolic rate BMR was measured on Omron Digital Weight Scale HN 289, with participants wearing minimal clothes and being barefoot. The body height was measured with a stadiometer with 0.1cm readability (Seca 214 Portable Stadiometer, Cardinal Health, Ohio, USA). After the anthropometric measurements, the anaerobic capacity tests were performed in outdoor of laboratory building. Participants performed a warm-up (6 min jog at 6.8 km h⁻¹) prior to anaerobic capacity-testing. The pre-test began at 09:30 a.m. We measured the anaerobic capacity (sprint test 60-m, vertical jump, push ups and sit-ups). Five minutes were given between each test. A week after finished of anaerobic capacity measurements, the VO_{2max} test was measured. The selected test was a Cooper's 12-minute run test, providing us with each player's maximum VO_{2max} [16]. In this study, after all participants completed last task in each section, participants allowed to drink water ad libitum, but we encouraged to drink enough to maintain hydration.

Anaerobic Capacity tests

A 60-m "all-out" running sprint was performed in the outdoor of laboratory building. Instructions to begin running as fast as possible were given upon test initiation. Starting the test, the participant should ready themselves in a "standing start position" at one end of the 60-m sprint track (i.e. cone A). The first test administrator should count down to the start of the test (3 - 2 - 1 - GO). On the "GO" signal, the participant sprints at maximal effort to the end of the 60-m track (i.e. cone B). As soon as the participant crosses the 60-m line, the second test administrator (standing on the end line) must shout "CLEAR". The running time of the sprints were recorded using beam photocell system (Microgate, Bolzano, Italy).

The vertical jump test was administered according to the guidelines proposed by previous study [5]. Vertical jump test was were measured on Vertec polymers, houston, TX, USA. Vertec is a construction with horizontal vanes and each vane is 1-inch increments. The lowest vane was adjusted to be at the point of the longest finger with the arm fully extended and both feet on the ground, the jump height was simply the highest vane reached. The participants leapt vertically as high as possible using both arms and legs to assist in projecting the body upwards. a practice jump was performed to familiarize the participants before the recorded jumps. The mean of three attempts was recorded.

The protocol of push ups and sit-ups tests were based on previous test protocols [19,20]. For push ups test, we instructed hand of participants to width at 100% of predetermined biacromial breadth. The assessment of push ups test was adopted and based on previous assessment method [19].

(i) Palms must flat on the floor, (ii) fingers facing forward, (iii) knees locked, (iv) ankles must flexed. Additionally, participants were instructed to keep the torso tight so that the shoulders, hips, knees, and ankles maintained a straight line throughout the push-ups. We used metronome for controlled the push-ups test. A metronome-controlled push-ups tests rate was set at 50 beats during one minute. The trial was not counted if the participant not following the rules assessment.

The maximum number of sit ups performed in a 1-minute period was used for measures the strength or muscle endurance [20]. The rules assessment and equipment of sit ups-testing measures were identical to push ups-testing. Although, specific assessment rules of sit ups-testing are: (i) all participants require to laid on a flat, (ii) clean surface with knees flexed at 90 degrees and a partner assisted by anchoring the feet to the ground, (iii) the arms of participants should crossed over the chest, (iv) the participant elevated the trunk in a smooth motion in accordance with the beat of metronome, so that it creates an imaginary V-shape with participant's thighs, and (v) the trunk was lowered back to the floor so that the shoulder blades or upper back touched the floor.

Statistical analysis

The values are presented as mean \pm SD. Normal distribution of the sample was checked using the Shapiro-Wilk test. The repeated measures ANOVA was used to evaluate the body weight, body fat, BMI, BMR, and anaerobic capacity test. Statistical significance was accepted at the level of $p < 0.05$. Statistical analysis was performed with the use of the SPSS V.21.0 software.

RESULTS

Anthropometric data and anaerobic capacity data are shown in table 1 and table 2, respectively. The statistical analysis revealed no significant differences of anthropometric results among TKD and PKS groups. Furthermore, TKD group had significantly higher VO_{2max} ($p=0.015$), when compared with PKS group. Although ANOVA revealed significant difference of VO_{2max} among TKD and PKS groups, but there was no significant observed for vertical-jump, sit-ups, push-ups, and 60-m sprint on both of group.

Table 1. Anthropometric characteristics for TKD and PKS groups

Variable	Groups		
	TKD group (n=8)	PKS group (n=9)	p-value
Weight (kg)	62.08 (\pm 5.59)	57.40 (\pm 10.04)	0.263
Height (cm)	176.8 (\pm 6.63)	169.8 (\pm 10.5)	0.117
BMI (kg/m ²)	19.66 (\pm 1.62)	19.63 (\pm 1.81)	0.973
Body Fat (%)	10.23 (\pm 2.27)	11.07 (\pm 5.08)	0.673
BMR (Kcal)	1543.63 (\pm 81.48)	1449.22 (\pm 202.23)	0.237

TKD - group were Taekwondo athletes; PKS - group were Pencak Silat athletes. The values are presented as mean \pm SD; Superscript: Repeated measure anova.

Table 2. Anaerobic capacity parameters for both groups of athletes (Taekwondo and Pencak Silat athletes); description and estimated group differences

Variable	Groups		
	TKD group (n=8)	PKS group (n=9)	p-value
VO_{2max} (ml/kg/min ⁻¹)	55.70 (\pm 1.71)	53.23 (\pm 1.93)	0.015*
Vertical-jump (inch)	21.40 (\pm 3.25)	21.96 (\pm 7.73)	0.641
Sit-ups (rep)	30.63 (\pm 5.15)	33.67 (\pm 4.64)	0.219
Push-ups (rep)	36.00 (\pm 9.12)	40.56 (\pm 7.35)	0.272
60-m sprint (s)	8.35 (\pm 0.33)	8.48 (\pm 0.49)	0.538

TKD, group were Taekwondo athletes; PKS, group were Pencak Silat athletes. The values are presented as mean \pm SD, Superscript: Repeated measure anova. * Values are significantly different compared with pre-test ($p < 0.05$).

DISCUSSION

The aim of this study was to assess the physiological responses of Pencak Silat athletes and a secondary aim is to compare physiological responses of Pencak Silat athletes with physiological responses of Taekwondo athletes. To the authors' best knowledge, this is the first study that compare of physiological responses among Pencak Silat and Taekwondo athletes. This represents an important fact because physiological measurements are crucial to determine formula for aid in more appropriate planning and monitoring of specific training.

In our study, we measured and connected vertical jump and 60-m sprint, because vertical jump performance is related to sprint ability and change of direction [21]. This may be explained by our resulted vertical jump is associated with resulted of 60-m sprint in the TKD and PKS groups. Another study also explained this phenomenon, Comfort et al. [21] showed the stronger athletes in youth soccer players demonstrates superior sprint and jump performances. Specifically, these studies suggested that the importance of developing high levels of lower-body strength to enhance sprint and jump performance.

The presented findings show that anthropometry of TKD group were similar to PKS group. This can be seen from the statistical analysis that revealed no significant among TKD and PKS groups ($p=0.263$ for weight; $p=0.117$ for height; $p=0.973$ for BMI; $p=0.673$ for body fat; and $p=0.237$ for BMR). In Taekwondo category, these results support a previous study in which observed that the range of body fat Taekwondo junior athletes were range in 11–14.1 % [8]. Furthermore, Kim et al. [20] also explained that competitive junior taekwondo athletes do exhibit a lower range of body fat than their recreational counterparts, which is probably a function of disparate training volumes. On the other hand, we may speculate that, the similar characteristics in body composition between TKD group and PKS group might be causes of a similar level of competition and experience of participants in both of groups.

At the end of our protocol we find significant differences of VO_{2max} among the TKD and PKS groups, where's VO_{2max} of TKD group is greater than PKS group. These results support a previous study, according to Taaffe et al. [23] has been shown average VO_{2max} of Taekwondo male athletes are $55.8 \text{ ml/kg/min}^{-1}$. Additionally, in Pencak Silat category Aziz et al. [17] measured VO_{2max} of ten Pencak Silat athletes and was found the average VO_{2max} of Pencak Silat male athletes are $52.1 \text{ ml/kg/min}^{-1}$, and explained that the VO_{2max} of Pencak Silat is similar to the taekwondo and judo club level athletes. While these studies are similar with our findings, that explained the range VO_{2max} of Pencak Silat athletes were in $52\text{--}53 \text{ ml/kg/min}^{-1}$, but our study have shown that significant differences among VO_{2max} of Pencak Silat and VO_{2max} of Taekwondo (53.23 vs $55.70 \text{ ml/kg/min}^{-1}$). Although, finding comparisons with literature regarding difference of VO_{2max} among Taekwondo and Pencak Silat athletes was difficult, but we may speculate that the variation in body composition between different levels of competition and experience may be a cause of differences VO_{2max} among Taekwondo and Pencak Silat athletes [24].

In addition, we also measured the dynamic muscular endurance of Taekwondo and Pencak Silat athletes using push-up and sit-up tests. According to Toskovic et al. [25] muscular endurance one of the most important for successful performance in such combat-sports modalities. No significant differences in push-up and sit-ups tests performances also have been reported from previous studies [8,26]. Bridge et al. [8] reported, no differences in 60-s push-up test scores have been reported between international female taekwondo medallists and non-medallists. Furthermore, Baldi et al. [26] reported no significant differences in 60-s sit-up test performances have been reported between athletes who were active at various levels of competition. The results of this study might suggest that while the endurance properties of the upper extremities may be important to support several technical and tactical actions in Taekwondo or Pencak Silat athletes [8].

Our study has some potential limitations. Firstly, the small number of participants in this study. Secondly, we realize, the equipment e.g. portable metabolic devices are required to assess physiological profile of VO_{2max} on court. To address these limitations, long-term studies involving a large cohort and quality equipment are needed in order to confirm the physiological profile of Taekwondo and Pencak Silat athletes.

CONCLUSION

The present investigation describes a similar physiological characteristics, such as weight, height, BMI, BMR, body fat and also performances of vertical jump, sit-ups, push ups, and 60-m sprint tests among Taekwondo and Pencak Silat athletes. However, in comparison with junior Pencak Silat athletes, the junior Taekwondo athletes have better VO_{2max} . Furthermore, the findings of this study add to the scientific literature that supports the use of comparison among physiological characteristics of Taekwondo and Pencak Silat, to use the findings to plan training with greater precision or to detect talented individuals in this combat-sports.

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DECLARATION OF CONFLICTING INTERESTS

The authors state no conflict of interest with respect to the research, authorship, and/or publication of this article.

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