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Physiological Characteristics of Junior Taekwondo Athletes of Student Training Education Centres in Java

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Abstract

The measurement of physiological characteristics of junior athletes is important to do as the first step in determining and designing training designs that are appropriate for athletes. The purpose of this study was to measure the physiological characteristics of Indonesian Junior Taekwondo athletes, who were members of student training education centres (PPLP), in West Java, Central Java, and East Java provinces. This qualitative descriptive study conducted the process of collecting data of 8 male junior Taekwondo athletes and 9 female Taekwondo junior athletes. The results of the obtained data were compared with the data from previous research as a reference in determining the quality standards of Indonesia junior Taekwondo athletes compared with Taekwondo junior athletes from other countries. Related to anthropometric aspects, the results of this study showed that the body weight, height, and BMI of Taekwondo athletes were in the normal category according to WHO standard. Based on the results of anaerobic capacity measurement, Taekwondo athletes got unfavourable results on an average 30 meter sprint result. However, the results of vertical jumps and VO₂max indicated that Indonesian junior Taekwondo athletes were above the normal category determined previously. This research successfully described the physiological characteristics of Indonesian junior Taekwondo athletes in West Java, East Java, and Central Java student training education centres. The trainers are encouraged to provide a balance concept of aerobic and anaerobic trainings in order to create or to nurture Taekwondo athletes properly and appropriately.

INTRODUCTION

Since the beginning of the establishment as an official medal in Olympic 2000, Taekwondo has become a prioritized sport for some countries in achieving achievements in the event or other championships (Menescardi, Falco, Ros, Morales-Sánchez, & Hernández-Mendo, 2019). For example, South Korea, where the Taekwondo sport was born, always counts on Taekwondo as a prioritized sport in obtaining medals in every Olympic event. Besides South Korea, other countries, such as United States of America and Iran, put Taekwondo as one of prioritized sports for gaining a medal in the Olympic event (Lim & O'Sullivan, 2016).

Indonesia is also a country holding a fairly good record in achieving achievements in Taekwondo. It was proven in the Olympic 1992 in Barcelona, where Taekwondo became an exhibition sport. Indonesia successfully gained three silver medals and one bronze medal from male flyweight (50–54 kg), female finweight (–43 kg), female lightweight (55–60 kg) and male finweight (–50 kg). Unfortunately, after those attainments, Indonesia achievement in Olympic is not successful. It is shown by the absence of achievement in Taekwondo sport after the sport was officially published in 2000.

In this context, the training process becomes one of the problems identified in Indonesia that results in the numbers of barriers in bearing and creating quality athletes (Ma Et al., 2018; Monks, Seo, Kim, Jung, & Song, 2017). A lot of Taekwondo coaches in Indonesia experience difficulties to decide a suitable training design to train the junior athletes of Taekwondo in Indonesia. Generally, the coach cannot decide the training design as they are lack of information of the physiological characteristics of the junior athletes they are training (Park & Song, 2018).

Physiological characteristics measurement of the junior athletes is important to be taken as the initial stage in deciding and designing a suitable design for the athletes based on data (Bridge, Ferreira Da Silva Santos, Chaabène, Pieter, & Franchini, 2014; Faude Et al., 2007; Hausen Et al., 2017; Janowski, Zieliński, & Kusy, 2019). The study of literature review, related to the Taekwondo athletes of The United States of America, shows that they have a mesomorph body type due to

their average body weight is 45.4 ± 1.8 kg and have the body fat percentage of 13.8 ± 0.8 %. The result of another review related to the physiological characteristics of Taekwondo junior athletes states that the average of VO_{2max} owned by Spain Taekwondo junior athletes is 48.6 ± 2.5 ml kg⁻¹ min⁻¹ (Bridge Et al., 2014).

According to the fact of physiological measurement conducted in Taekwondo sport by the countries, it is important to conduct the measurement of physiological characteristics in Taekwondo sport, especially on the junior athletes in Indonesia. Knowing the physiological characteristics of the junior Taekwondo athletes could help the trainers or other sport practitioners to decide and to design suitable trainings for Indonesia junior Taekwondo athletes.

In addition, Indonesia has a centred training system for the student athletes known as Student Training Education Centre (PPLP). In the process, PPLP moves in the regional level (Province) to get and to train the potential athletes that eventually will be the athletes bringing a good name for their regions as well as their country in International sport events. PPLP is seen as the spearhead to create a hope of the emergence of athletes with excellent achievements. In concrete, there are some PPLPs that have good achievements in some national competition events (POPNAS, etc.) in Taekwondo. They are West Java PPLP, Central Java PPLP, East Java PPLP, and DKI Jakarta PPLP.

Therefore, it would be interesting if a research mapping the physiological characteristics of the Taekwondo athletes is conducted. The result can be a reference in building the Indonesia Taekwondo athlete achievements better than before. It is important as the literature related to this issue is limited in measuring and analysing the physiological characteristics of junior Taekwondo athletes, especially those who are involved in PPLP. For that reason, the purpose of this research was to measure the physiological characteristics of Indonesia junior Taekwondo athletes in the Student Training Education Centres in West Java, Central Java, and East Java. The research was expected to help the Taekwondo trainers in conducting a training process that could improve the achievements of Taekwondo athletes of Indonesia.

METHODS

Participants

This descriptive qualitative research conducted data collection on 8 male Taekwondo athletes aged 15.6 ± 0.5 years and 9 female Taekwondo junior athletes aged 15.3 ± 0.5 years. The samples were taken from the population that consisted of 13 male athletes and 14 female athletes from the total number of West Java, Central Java, and East Java PPLPs who were in the 15-16 year age range. In this research, the result gained was compared to some research results obtained from previous literatures related to the measurement of physiological characteristics of junior Taekwondo athletes as a reference in deciding the junior Taekwondo athlete quality standard in Indonesia and junior Taekwondo athletes coming from other countries. In the sample selection process, this research concerned on the inclusion and exclusion criteria decided prior to the research. The inclusion criteria is the criteria or characteristics that should be fulfilled by each member of population who will be the subject of the research. Meanwhile, exclusion criteria is the criteria or characteristics of those who cannot be selected to be the subject of the research (Manzano Nunez & García Perdomo, 2016).

The inclusion criteria of the study consisted of junior Taekwondo athletes from West Java, Central Java, and East Java PPLPs; aged 15-16 year old; did not smoke cigarettes; did not have respiration medical history; did not get injured for the last three months; and had a healthy statement letter from a doctor. The exclusion criteria included aged 17 years and above; got injured in the last three months; and did not follow the training conducted by the PPLP team in the last two weeks.

Procedure

All participants meeting the inclusion criteria in this research received explanation related to the research procedures, advantages, and the risk that would be faced in this research. All participants conducted a series of test in three sessions of test, including anthropometry test, aerobic capacity test, and anaerobic capacity test. In each session of test, one day of interval was given for recovery. In the anthropometry test, the height, weight, and BMI were measured. In the anthropometry test, the research utilized OMRON Karada

Body Scan HBF375. In the anaerobic capacity test, the 30m sprint and vertical jump were conducted. Meanwhile, in the aerobic capacity test, the VO₂max measurement by conducting 2.4km cooper-test was conducted. When the data were obtained, the results of the data were then compared to previous research results conducted by the World Health Organization (WHO) for the normal range of anthropometry (Johnson, Onuma, Owolabi, & Sachdev, 2017), Suzana M, et al (Suzana, Pieter, & Bharu, 2009) for the standard score of male vertical jump, (Monks Et al., 2017) for the standard score of female vertical jump, (Sadowski, Gierczuk, Miller, Cieśliński, & Buszta, 2012) for the standard score of 30-m sprint for male athletes, (Davis Et al., 2000) for the standard score of 30-m sprint for female athletes, (Erie Et al., 2008) (Bridge Et al., 2014) for the standard score of VO₂max for male and female athletes.

Data Analysis

This research used the descriptive quantitative data analysis technique by obtaining mean result of each characteristics, such as anthropometry, aerobic capacity, and anaerobic capacity. Furthermore, the mean of the gained data were compared to the results of the previous research.

RESULT

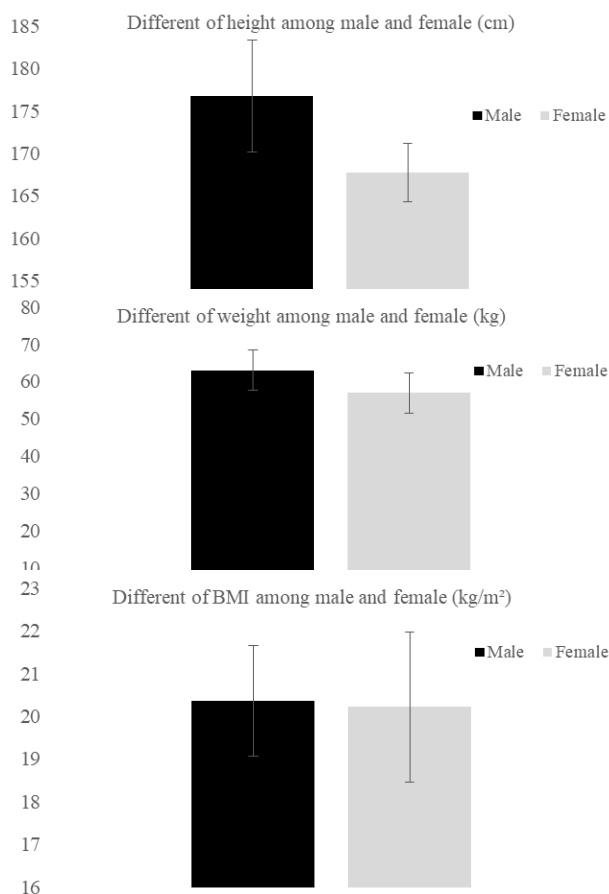
In this research, anthropometry data, anaerobic characteristics, and aerobic characteristics of the junior Taekwondo athletes of Java Island PPLP were gained.

Anthropometry

The result of anthropometry of this research shows that the weight, height, and the BMI of the Taekwondo athletes belonged to the normal category based on the WHO standard. In detail, the average result of the height of the male athletes was 176,75 cm and the female athlete was 167,78 cm. The average of the weight of male athletes was 63,07 kg, and 56,93 kg for female athletes. Meanwhile, the average of BMI was 20,36 kg/m² for male athletes and 20,22 kg/m² for female athletes. The comparison of the average gained in this research and previous research can be seen in Table 1. Meanwhile, Figure 1 explains the different result between male and female participants.

Table 1. Anthropometry Profiles of Taekwondo Athletes in West Java, Central Java, and East Java PPLPs

variable	Sex	Indonesia	Previous study
Height (cm)	Male	176.75±6.63	169 – 180
	Female	167.78±3.42	162 – 169
Weight (kg)	Male	63.07±5.41	55 – 73
	Female	56.93±5.31	52 – 70
BMI (kg/m ²)	Male	20.36±1.30	19 – 23
	Female	20.22±1.76	20 – 24

**Figure 1.** Result Differences of Male and Female Anthropometry Characteristics

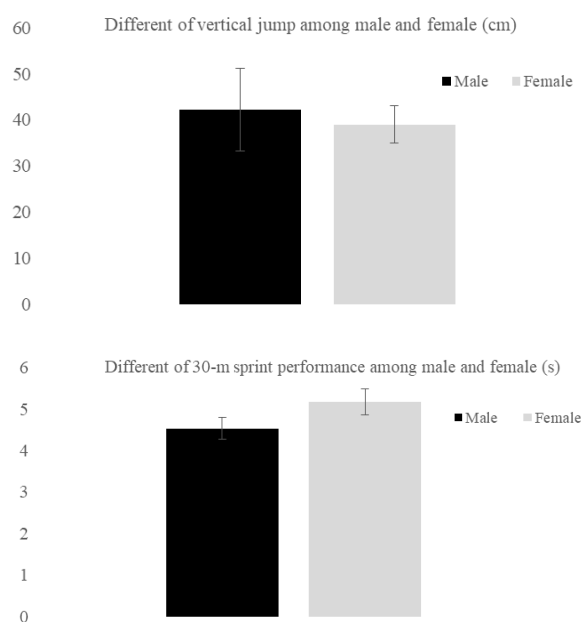
Aerobic Capacity

According to the measurement of the anaerobic capacity, the Taekwondo athletes gained a poor result on the average of 30-m sprint, where the male athletes recorded 4,53 second average sprint time and female athletes recorded 5,17 second average sprint time. Meanwhile, in the vertical jump average, only the female athletes who gained above the normal score compared to previous research. The female junior

Taekwondo athletes gained 39.01 cm, 4cm higher than the previous research. However, this result was not similar to the male athletes. Male Taekwondo athletes gained 42.13 cm height (8 cm lower than previous research). The comparison of the 30-m sprint and vertical jump of this research and previous research can be seen in Table 2. The result difference between male and female athletes' anaerobic capacity can be seen in Figure 2.

Table 2. Anaerobic Performance Characteristics Profile of Taekwondo Athletes of West Java, Central Java, and East Java PPLPs

Variable	Sex	Indonesia	Previous Study
Vertical jump (cm)	Putra	42.13±8.98	50 - 51
	Putri	39.01±4.09	34 - 35
Sprint 30 m (s)	Putra	4.53±0.26 ^	4.3 – 4.4
	Putri	5.17±0.32 ^	4.7 – 4.8

**Figure 2.** Anaerobic Performance Result Differences between Male and Female Athletes

Aerobic Capacity (VO₂max)

According to VO₂max data presented in Table 3 and Figure 3, the average of VO₂max male Taekwondo athletes was very good, 49,01 ml kg⁻¹ min⁻¹. The result shows that the male Taekwondo athletes had the average result above the normal standardized score (41.3 ml kg⁻¹ min⁻¹). Meanwhile, the female Taekwondo athletes also gained a higher average result of VO₂max than previous research. The average VO₂max of the

female Taekwondo athletes was 38,90 ml kg⁻¹ min⁻¹.

Table 3. Aerobic Performance Characteristics Profiles of Taekwondo Athletes of West Java, Central Java, and East Java PPLPs

Variable	Sex	Indonesia	Previous Study
VO _{2max} (ml kg ⁻¹ min ⁻¹)	Putra	49.01±19.86	41.3
	Putri	38.90±4.53	33.4

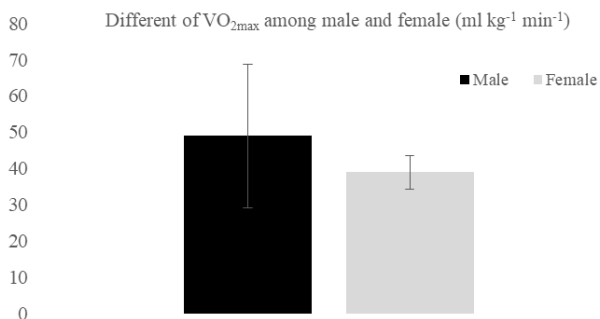


Figure 3. Result Differences of Male and Female VO_{2max} Characteristics

DISCUSSION

The purpose this research was to find out the anthropometry characteristics, the average of aerobic endurance characteristics (VO_{2max}), and the average of anaerobic characteristics (vertical jump and 30 meter sprint) of the Taekwondo athletes, especially in junior level. Besides, the research also compared the result to the normal range of standard scores set in the previous research. In line with the purpose of the study, this research had found out the average score of anthropometry, aerobic endurance, and anaerobic characteristics of Taekwondo athletes. It was proven by the gain of anthropometry data, including height, weight, and BMI. Other physiological characteristics were also obtained, including VO_{2max} and performance (vertical jump and 30-m sprint) that became the excellence and novelty of this research. Therefore, this research is expected to give addition to the existed literatures supporting the development of Taekwondo athletes training design based on the physiological characteristics on Indonesia junior Taekwondo athletes.

Specifically, this research has supported previous

literatures explaining the importance of athlete's physiological measurement as the initial data in developing and implementing the suitable framework or training design for Taekwondo athletes. The purpose of designing a suitable Taekwondo training is to prepare the athletes in managing their physical aspects and physiological demands of each competition. Therefore, in deciding the design of the suitable training, the detailed information related to physiological characteristics of each Taekwondo athlete is essential (Bridge, Jones, & Drust, 2009).

In this research, the average of Indonesia Taekwondo athlete belonged to the normal category in the WHO standard. It shows that the somatotype of Indonesia junior Taekwondo athletes, male and female, was mesomorph. This research supports the previous research that stated that the body type of the junior Taekwondo athletes are mostly mesomorph, even some athletes have ectomorph type (Pieter, 2012). The somatotype classification is based on the previous research conducted by (Yasuda, 2019), who says that the mesomorph body type usually have BMI in 18.5–24.9 kg/m² range. On the other hand, some previous literatures state that, generally, the body type of the Taekwondo athletes is influenced by the level or the class of competition, and the type of training conducted by every Taekwondo athlete (Marković, Mišigoj-Duraković, & Trninić, 2005).

In the measurement of the anaerobic performance of the Taekwondo athletes, all male and female athletes gained a good result in doing vertical jump performance. It supports the previous research arguing that Taekwondo athletes use the domination of their lower body (especially leg) and the 'stretch-shortening cycle' in creating power during a performance (Marković et al., 2005). However, the result of the vertical jump is different with the result of 30-meter sprint, where the result was not in the normal category in the standardized score in previous research. The literature is still limited to explain this phenomenon, but previous literature might assume that the training characteristics difference becomes the main factor that influences the speed gained by every Taekwondo athlete worldwide (Dotan, Mitchell, & Gabriel, 2013).

Another result shows that this research is a reflection of characteristics of some of the best junior

Taekwondo athletes in Indonesia trained by the PPLP of West Java, Central Java, and East Java as the result of the VO₂max of the Indonesia junior Taekwondo athletes was above the normal score set by the previous research. The finding indirectly supports the previous research stating that the aerobic process is needed by the Taekwondo athletes in the interval time between the rest and the attack or in doing the explosive power movement in a tournament (Melhim, 2001). On the other hand, the finding shows that the VO₂max of Indonesia junior Taekwondo athletes was above the normal, which indicates that the trainer or the coach of Taekwondo had succeed in training or developing the aerobic performance of the junior Taekwondo athletes in each PPLP they belonged to.

The researchers are aware that there are weaknesses of this research, for instance the aspects that could not be measured by the researchers such as emotional level or psychological factors during the measurement process that the different result might occur. Besides, we expect that further research would concern the weakness and use better sports equipment in the measurement process. We expect that the finding of this study would reinforce the trainers to consider each physiological characteristics (anthropometry, aerobic, and anaerobic performance characteristics) in designing the training for Taekwondo athletes. According to the findings of the study, we suggest that trainers should conduct trainings to improve endurance in order to increase the aerobic capacity and balance the training with the high intensity interval training, thus the anaerobic capacity of the athletes could also increase. The data of this research are expected to be the initial data for further research in deciding or creating training design that is suitable for the Indonesia junior Taekwondo athletes. Besides, the data of this research could also be used as the reference in identifying the potential of Indonesia Taekwondo athletes.

CONCLUSION

This research shows that the average of the anthropometry of the athletes were mostly mesomorph. It is indicated from the BMI of the athletes. Besides that, the aerobic capacity score of the Indonesia junior Taekwondo athletes was higher than the normal score

found in previous research. The result of the vertical jump of Indonesia Taekwondo athlete was also above the normal score of the previous research. Only the 30-meter sprint that did not belong to the normal category set in previous research, both for male and female athletes. We suggest that the trainers and coaches could design the endurance training to improve the aerobic capacity and balance the training with the power training, such as high intensity interval training, to improve the anaerobic capacity of the athletes. The suggestion is that further research should be complemented by other factors such as agility, flexibility, power, etc.

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