



RESEARCH ARTICLE

## Physiological and Technical Analysis of Male Athletes from the Bumi Siliwangi Pencak Silat Club in Indonesia

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### Abstract

The Indonesian Pencak Silat Team made a brilliant achievement at the 2018 Asian Games by winning 14 gold medals and 1 bronze medal. Seeing the increasing popularity of Pencak Silat, identifying the physiological characteristics of these athletes is very interesting, but currently there are not many studies that examine this. Therefore, this study aims to examine the physiological profile of male Pencak Silat athletes at the Bumi Siliwangi club. This observational study involved two testing sessions, namely a laboratory session to measure anthropometry, VO<sub>2</sub>max, flexibility, agility, and anaerobic power, and a field session to analyze match performance, including technique, heart rate, and lactic acid levels. The results showed that athletes had an average height of 166.44 cm, a BMI of 20.1 kg/m<sup>2</sup>, a body fat percentage of 11.89%, and a muscle percentage of 37.53%. The average flexibility is 21.08 cm, agility is 5.63 seconds, peak power is 624.64 watts, and average power is 459.37 watts. This study concludes that Pencak Silat is an intermittent sport with moderate to high intensity, then the results of the study stated that pencak silat athletes from the Bumi Siliwangi club have physiological characteristics that are almost similar to athletes from other Asian countries. Thus, this study can be used to strengthen and become a reference for other research.

### Keywords

Pencak Silat, Physiological Characteristics, VO<sub>2</sub>max, Agility, Anaerobic Power, Martial Arts Performance

## INTRODUCTION

Pencak Silat is a typical Indonesian martial art (Mulyana & Lutan, 2021). This sport is one of the characteristics of Indonesia. With various situations and developments experienced by the Indonesian people, pencak silat is present as a culture and method of self-defense and has become local wisdom for its practitioners (Rachman et al., 2023). Pencak silat is a branch of sport that emphasizes dexterity, the numbers in this martial art are divided into two groups, namely art numbers and sparring numbers (Harahap & Mahfud, 2023).

Although other countries also have their own martial arts, Pencak Silat is an ancestral heritage of

Indonesia that has developed in various regions and has become a symbol of unity in Indonesian culture (Geertz, 1983; Suwaryo et al., 2008). On May 18, 1948, Pencak Silat warriors gathered and formed an organization called the Indonesian Pencak Silat Association (IPSSI) which later changed its name to the Indonesian Pencak Silat Association (IPSI). In 1980, the Inter-State Pencak Silat Association (PERSILAT) was formed, which established regulations in the field of Pencak Silat sports in 1985.

The development of Pencak Silat is very rapid both domestically and internationally. Since 1973, Pencak Silat has been part of the National Sports Week (PON) and continues to be competed until

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now. Pencak Silat has also developed into a competitive sport that is competed in the Asian Games, SEA Games, and European and World Championships. At the 2016 World Championships, it was reported that 37 countries participated (European Pencak Silat Federation, 2016).

The success of the Indonesian Pencak Silat team at the 2018 Asian Games by winning 14 gold medals and 1 bronze medal is an extraordinary achievement. One of the contributing athletes is Hanifan Yudani Kusumah who caught the public's attention with his victory.

Pencak Silat is a sport that requires physical development, especially in the sparring category. Important physical components include speed, agility, flexibility, strength, endurance, reaction, accuracy, and balance (Bompa & Buzzichelli, 2019). All of these components play an important role in improving basic sports technique skills (Saputro & Siswantoyo, 2018). Furthermore, studies also state that the observable indicator is the mastery of the basic techniques of the sport. Mastery of basic techniques with regular, systematic, repeated training and increasing loads will affect organs such as the heart, respiratory system, and blood circulation.

Therefore, to find out the effects caused by this sport, considering the increasing popularity of Pencak Silat martial arts, identifying the physiological characteristics of athletes is very interesting. However, in reality, research on the physiological characteristics of Pencak Silat is still minimal. For example, there is a study that examines the performance characteristics of Pencak Silat athletes, but only highlights the physiological characteristics of relevant elite exponents and identifies the characteristics of Pencak Silat fight results through videos only, both studies do not explain further about the physiological characteristics (Soo et al., 2018). Then there is also research that describes the physiological demands and physical profiles of elite-level athletes and martial artists (Aziz et al., 2002), and research that compares the physiological characteristics of Pencak Silat with other martial arts (Abidin et al., 2018; Apriantono et al., 2020). However, there has been no in-depth research on Pencak Silat in Indonesia or a comparison of the physiological characteristics of Pencak Silat athletes from various countries.

Based on previous references and interest in the challenge of researching the physiological

characteristics and performance of Pencak Silat athletes specifically (Aziz et al., 2002; Saputra & Muzaffar, 2022) then comparing the physiological characteristics of Indonesian Pencak Silat athletes with Pencak Silat athletes from several countries in Asia (Irianto & Lumintuarso, 2020). In this study, researchers will try to measure the physiological characteristics of Pencak Silat athletes in the men's category more intensively in the laboratory, as well as analyzing Pencak Silat match statistics in the sparring category.

Thus, this study aims to assess the physiological profile of Pencak Silat athletes in the men's category. This study is expected to provide new or additional findings that strengthen previous references on the physiological characteristics of Pencak Silat athletes in the sparring category.

## MATERIALS AND METHODS

This research was conducted in November 2021 and research ethics approval was obtained from the Ministry of Education, Culture, Research and Technology, Indonesian University of Education, project number 1322/UN40.A6/KP/2024.

This research is an Observational Study (Rezigalla, 2020). This study consists of two testing sessions, the first is a laboratory test session which aims to obtain Anthropometry,  $VO_{2max}$ , Flexibility, Agility, and Anaerobic Power data. While the second session is a field test which aims to get the results of match analysis seen based on techniques in Pencak Silat movements, heart rate, and blood lactate. There is a minimum interval of 48 hours between sessions. All experiments will be reported in manuscripts and conducted in accordance with the ethical standards of the Declaration of Helsinki (Smith, 1980). Figure 1 shows the Research Plan Framework for this study.

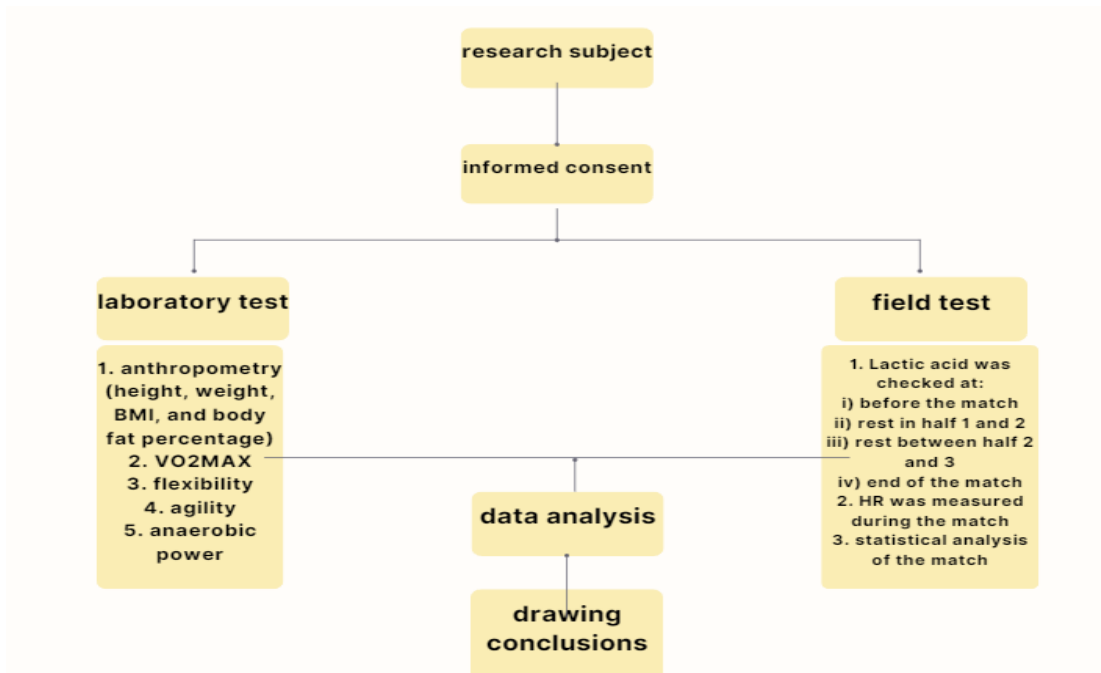
### Participants

The population in this study involved accomplished athletes who were members of the Bumi Siliwangi Pencak Silat Club. The sampling technique in this study was purposive sampling (Fraengkel, 2009). This technique includes people who are selected based on certain criteria determined by the researcher based on the research objectives, while people who do not fit the criteria are not sampled. The criteria for sampling are as follows:

**Inclusion and Exclusion Criteria**

Inclusion criteria are criteria for research subjects who can represent research samples that qualify as samples (Notoatmodjo, 2002). The sample criteria in this study are as follows:

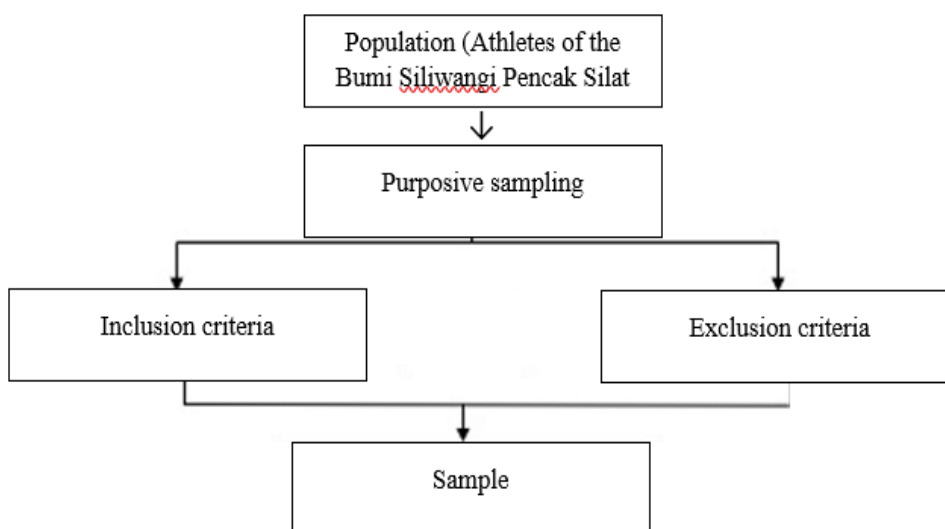
Male, 16-18 years old , Willing to participate in the research thoroughly. Subjects are skilled athletes who regularly participate in competitions in the previous two years and regularly practice at least 10 to 12 hours a week. The research subjects were sparring category Pencak Silat athletes who had participated in national and international tournaments.



**Figure 1.** Research plan framework

**Exclusion Criteria**

Exclusion criteria are criteria for research subjects who cannot represent research samples and do not qualify as samples (Notoatmodjo, 2002). Included in the exclusion criteria in this study are subjects who are experiencing / in the recovery period of an injury so that it has the potential to interfere with performance during the study.



**Figure 2.** Participants flowchart

### Data Collection

The dependent variables in this study are anthropometry,  $VO_{2max}$ , flexibility, agility, anaerobic power, heart rate, lactic acid levels.

Flexibility data collection using the takei flexibility measuring instrument, the method used is the Sit and Reach Test.

Agility data collection using the Smart Speed measuring instrument, the method used is 5-10-5.

Anaerobic Power data collection using Smart Speed measuring instruments, the method used is Running Based Anaerobic Test (RAST).

Retrieval of  $VO_{2max}$  data for Pencak Silat athletes which will be taken using the Bleep Test method.

Assessment of blood lactic acid, using a portable Accutrend Plus lactate meter (155x62x18.5 mm) battery (3x1.5 V, AAA type) weighing about 100 g. The range of measurement values is 0.8-22 mM. The device is suitable for use in athletes who produce high lactate concentrations mainly due to the contribution of anaerobic metabolism and also produces good accuracy. Blood was taken from all subjects by the blood sampling personnel. The volume of blood taken from the athlete's fingertip was 25-50  $\mu$  blood for each analysis.

Subjects were asked to wear a polar Heart Rate H10 from before the match to the end of the match. Heart rate measurements were taken to determine how much the athlete's heart rate was during each round of competition.

The statistical analysis of the match used the mechanism of recording the match using a camera, which was positioned at 5-meters from the north of the field, with a camera height of 3-meters. The techniques assessed for statistical analysis included kicks, punches, catches, and falls.

Data were analyzed by calculating the mean and standard deviation of each individual. Then conduct statistical tests by first knowing whether the data is normally distributed or not. By knowing the data is normally distributed, it can determine the test to be used whether parametric or non-parametric statistical tests using the help of the SPSS application.

### Procedures

Before the data collection process begins, the researcher first conducts sampling based on the inclusion and exclusion criteria that have been determined to the population, namely the Pencak Silat bumi siliwangi club which is under the auspices of the Bumi Siliwangi Pencak Silat Club It

has been determined that 12 sparring category Pencak Silat athletes are included in the inclusion criteria, while 2 more athletes are not allowed to be subjects because they fall into the exclusion criteria that have been previously determined.

After the subject is determined, the subject has been given an explanation and introduction to the tools that will be used 2 days before the research begins. Subjects are invited to read the informed consent sheet after getting an explanation related to the research. Subjects who are willing to take part in the study then sign the informed consent. Subjects who are not willing after receiving an explanation have the right to resign without any sanctions.

There are 2 sessions in the study, the first session is laboratory testing, and the second session: **First Session (Laboratory Test)**

Anthropometric data collection of subjects by collecting data on age, height, and body weight, muscle mass, fat mass. Figure 3 show Omron Karada Body Composition Monitor HBF-375.



**Figure 3.** Omron Karada Body Composition Monitor HBF-375

Flexibility data collection using the Digital Anteflexion Meter measuring instrument, and the method used is the Sit and Reach Test. Figure 4 show Digital Anteflexion Meter.



**Figure 4.** Digital anteflexion meter

Agility data collection using smart speed measuring instruments, the method used is the side step test. Figure 5 show smart speed fussion for agility 5-10-5.





**Figure 5.** Smart Speed Fussion for Agility 5-10-5

Anaerobic Power retrieval using Smart Speed Fussion measuring instrument, the method used is Running Based Anaerobic Test (RAST). Figure 6 show *Smart Sp.eed Fussion for RAST*



**Figure 6.** Smart speed fussion for RAST

VO<sub>2</sub>max data collection of Pencak Silat athletes who will be taken by the Beep test method.

The next process is the interval / pause before entering the second session, which is for 48 hours.  
**Second Session (Laboratory Test)**

In this field test session, the subject is given an explanation regarding the procedures for the field test and the risks that can occur.

The subject is wearing a heart rate sensor, namely the Polar H10 rate monitor H10 on the chest before wearing a body protector to get his heart rate. Figure 7 show *Heart Rate Monitor Chest Strap Polar H10*.



**Figure 7.** Heart rate monitor chest strap polar H10

After the sensor is successfully worn, the subject will then be asked to wear a body protector, pubic protective equipment, a plug, and other athlete needs. Figure 8 show *Body Protector Pencak Silat*.



**Figure. 8** *Body protector pencak silat*

The subject will be asked to perform Fighting as Fighting during a real match, and the subject is asked to compete in an all-out match. Figure 9 show simulation match



**Figure 9.** Pencak silat match simulation

Lactic acid levels will be checked by taking blood from the fingertips of the subjects using Accutrend Plus. Figure 10 show Accuratrend Plus ater Kit



**Figure 10.** Accutrend plus meter kit

Lactic acid levels were checked each round as described below:

- Before the Match
- Break between innings 1 and 2
- Break between innings 2 and 3
- End of Match

The entire match is recorded for match analysis purposes

## RESULTS

The main objective of this study is to examine the physiological characteristics of the Bumi Siliwangi Pencak Silat Club, especially the men's competition category. This study was conducted in November 2021 - December 2021. Based on the

results of the research that has been carried out, and after the data has been successfully analyzed, the results of anthropometric measurements are

obtained which are displayed in table 1 as follows:

**Table 1.** Statistical analysis anthropometry

Variables	Average $\bar{X}(SD)$
Age (Years)	16,75 ( $\pm 1,31$ )
Height (cm)	166,44 ( $\pm 5,77$ )
Body Weight (Kg)	55,73 ( $\pm 7,81$ )
BMI (kg/m <sup>2</sup> )	20,1 ( $\pm 1,68$ )
Body Fat (%)	11,89 ( $\pm 4,30$ )
Muscle Mass (%)	37,53 ( $\pm 1,91$ )
VO <sub>2max</sub> (ml/kg /min)	49,63 ( $\pm 4,95$ )

Table 1 explains that the average age of the current subject is 16.75 ( $\pm 1.31$ ) years, with a height of 166.44 ( $\pm 5.77$ ) cm, weight 55.73 ( $\pm 7.81$ ). Based on age and the results of measuring height and weight using Omron Karada, the average BMI of all participants was 20.1 ( $\pm 1.68$ ) kg/m<sup>2</sup>, the percentage of body fat was 11.89 ( $\pm 4.30$ ) percent, and the percentage of muscle owned by Pencak Silat athletes was 37.53 ( $\pm 1.91$ ) percent. In addition to anthropometry, other measurements of VO<sub>2max</sub> using the beep test method and obtained an average VO<sub>2max</sub> of 49.63 ( $\pm 4.95$ ) ml / kg / min.

**Measurement data of Flexibility, Agility, and Anaerobic Power**

After anthropometry is obtained, the next assessment is carried out in the same session, namely the laboratory test session where the subject will be examined for flexibility using takei flexibility, agility with the 5-10-5 method with the help of the smart speed fussion tool, and assessment of anaerobic ability using the Running Based Anaerobic Test (RAST) metote which is assisted by the smart speed fussion tool as well, so after the data is successfully obtained, it is immediately processed so that the data can be presented in table 2 as follows:

**Table 2.** Statistical analysis flexibility, agility, and anaerobic power measurement results

Variables	Average $\bar{X}(SD)$
Flexibility (cm)	21,08 ( $\pm 2,04$ )
Agility (Sec)	5,63 ( $\pm 0,28$ )
Peak Power (Watts)	624,64 ( $\pm 80,328$ )
Mean Power (Watts)	459,37 ( $\pm 74,694$ )

In table 2, the average flexibility of Pencak Silat athletes is 21.08 ( $\pm 2.04$ ) cm, and also the agility possessed by Pencak Silat athletes taken using Smart Speed Fussion with the 5-10-5 Agility method, the results obtained are 5.63 ( $\pm 0.28$ ).

To get Mean Power and peak power done with the Running Based Anaerobic Test (RAST) method with the help of smart speed fussion tools,

the average power result is 459.37 ( $\pm 74.694$ ) and the highest power is 624.64 ( $\pm 80.328$ ).

**Field Test Result Data (Match Simulation)**

In the field test results taken based on the results of the simulation of the match category Pencak Silat match with a total of five matches, the following Pencak Silat match statistics can be seen in table 3 below:

**Table 3.** Statistical Analysis Average techniques used from all athletes

Punch in	Kick In	Successful parry	Successful drop
12	24	14	4

Notes: The average is taken through video recordings of matches and statistical processing of the five matches played.

In Table 3, quantitative data is presented regarding the number of basic techniques performed by all subjects during the competition from the first round to the third round, the results show that on average the subject performs 12 punches that enter points, also on average the subject kicks to get

points as many as 24 kicks, in addition, the table also explains that on average the subject makes a successful catch 14 times, and among these catches the average subject can knock down the opponent four times in one match.

**Table 4.** Statistical analysis comparison of average techniques based on win/loss

Indicator	Win	Lose	p-value
Punch In	8 (±1,4)	5 (±2,6)	0.330
Kick In	14,6 (±3,7)	9,4 (±1,7)	0.685
Successful Parry	7,6 (±3,1)	6,4 (±3,4)	0.817
Successful drop	2,8 (±1,2)	1,4 (±1,0)	0.314

In the data table 4, it is known that the average incoming punch in each match is 8 (±1.4) punches by the winner, while the loser can only hit with an average of 5 (±2.6) times in each match. In addition, the average kick that entered the point in each match was 14.6 (±3.7) kicks by the winner, while the loser could only kick an average of 9.4 (±1.7) times in each match. In addition, the average successful catches made in each match were 7.6 (±3.1) catches by the winner, while the losers could only make successful catches with an average of 9.4 (±1.7) times in each match, then legal falls were 2.8 (±1.2) times by the winner and 1.4 (±1.0) times by the subjects who were declared losers. ANOVA has revealed that there were significant differences

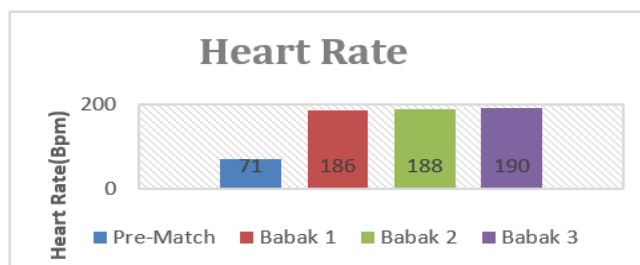
between the number of punches, kicks, catches and falls made by the winning subjects and the losing subjects (all different within the significant level of  $p < 0.05$ ).

**Heart Rate and Lactic Acid**

Heart rate and lactic acid are tested during laboratory test sessions, before the match simulation starts the athlete is wearing a heart rate sensor on the chest using Polar H10 and later the heart rate will be seen in each round, besides that lactic acid will also be assessed in four tests, the first before the match starts, the break between the first and second rounds, the second and third round breaks, and the end of the match. Therefore, the following data is obtained:

**Table 5.** Statistical analysis average heart rate of pencak silat athletes during match simulation

Variables	Heart Rate Assessment (bpm)			
	Before the Match	Round 1	Round 2	Round 3
Heart Rate	71.7 (±9.9)	186 (±8,93)	188,7 (±7,67)	190,6 (±9,61)



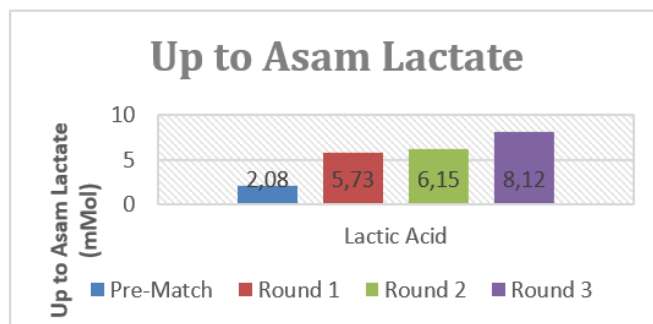
**Figure 10.** Heart rate diagram

From the data in table 5 above, the results showed that when the first round was completed and an average of 186 bpm was obtained, then the heart rate was taken after the second round ended and an average of 188.7 bpm was obtained, then the pulse

was taken after the third round ended and an average of 190.6 bpm was obtained. Apart from the heart rate, researchers also took blood samples to find out the lactic acid levels in the blood of male sparring category Pencak Silat athletes.

**Table 6.** Statistical Analysis Average lactic acid levels of Pencak Silat athletes during match simulations

Variable	Penilaian asam laktat			
	Rest	Round 1	Round 2	Round 3
Asam laktat	2,08 (±0,32)	5,73 (±1,03)	6,15 (±1,43)	8,12 (±3,21)



**Figure 11.** Diagram of lactic acid levels in the blood

From the data in table 6 above, the results show that at rest has an average of 2.08 (±0.32), then blood sampling to know the lactic acid level at the break of the first half to the second half and obtained an average of 5.73 (±1.03), then blood sampling to know the lactic acid level at the break of the second half to the third half and obtained an average of 6.15 (±1.43).

## DISCUSSION

The main objective in this study is to assess the physiological characteristics of male sparring category Pencak Silat athletes. Based on the references that researchers have so far followed, that research on the physiological characteristics of Pencak Silat athletes is still not much in demand, as evidenced by the existence of only three studies, namely those conducted by [Rashid Aziz et al., \(2002\)](#) which collected data on the physiological characteristics of elite Singapore Pencak Silat athletes and then compared their characteristics with taekwondo and judo. In other research conducted by [Abidin et al., \(2018\)](#) which compares the physiological profiles of Malaysian boxing, muay thai and Pencak Silat athletes, and the latest research is research conducted by [Apriantono et al., \(2020\)](#) which compares the physiological characteristics of

junior taekwondo athletes compared to Indonesian junior Pencak Silat athletes. Based on the references that researchers have reviewed more deeply, this research is the first study that does not compare the physiological characteristics of Pencak Silat athletes with other types of martial arts, but the findings of this study will be compared with previous research examining Pencak Silat based on its physiological characteristics. Then this research examines more deeply the physiological characteristics of Pencak Silat athletes strengthened by assessing flexibility, agility, hand grip, and aerobic and anaerobic abilities of Indonesian Pencak Silat athletes ([Subekti et al., 2019](#); [Zulfa et al., 2022](#)).

Based on some of our findings, male sparring category Pencak Silat athletes have an average body height of 166.44 (±5.77) cm, then the average BMI of all participants is 20.1 (±1.68) kg/m<sup>2</sup>, body fat percentage is 11.89 (±4.30) percent, and muscle percentage is 37.53 (±1.91) percent. In terms of height, Indonesian Pencak Silat athletes are not much different from athletes from Singapore with an average height of 1.72 (± 0.8) and Malaysia with an average height of 1.64 (± 0.08). Researchers assume that the role of nutrition and training characteristics has an important role in order to improve the anthropometric quality of athletes in Indonesia today ([Larson-Meyer et al., 2020](#))



Athletes who have  $VO_{2max}$  more than  $45.5 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  will have better match performance than athletes who only have  $VO_{2max}$  less than  $45.5 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  (Winata, 2020). Based on the research results contained in table. 1 where Indonesian Pencak Silat athletes have an average  $VO_{2max}$  of  $49.63 (\pm 4.95)$  and are assumed to have better match performance because they have an average  $VO_{2max}$  of more than  $45.5 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ . When compared to Pencak Silat athletes from Singapore and Malaysia, the Indonesian Pencak Silat athletes found by researchers tend to have a better  $VO_{2max}$  average than Malaysian Pencak Silat athletes. And recent research conducted by (Apriantono et al., 2020) found that Indonesian junior Pencak Silat athletes have an average  $VO_{2max}$  of  $53.23 (\pm 1.93) \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$  better than Malaysian (Abidin et al., 2018) and Singaporean Pencak Silat athletes (Aziz et al., 2002).

Men's sparring category Pencak Silat athletes must have good flexibility, agility, and anaerobic power to be able to perform their best techniques (Khotimah et al., 2023; Suwindia & Muliarta, 2023). In table 2, it is found that the average flexibility possessed by Pencak Silat athletes is  $21.08 (\pm 2.04) \text{ cm}$ , in addition, the average agility of Pencak Silat athletes is  $5.63 (\pm 0.28)$  seconds.

Data collection of average power and peak power of Singaporean and Malaysian Pencak Silat athletes using the Wingate Test method with a bicycle ergometer. The average power of Singaporean athletes is  $9.3 (0.7)$  (Aziz et al., 2002) and Malaysian athletes  $450.17 (\pm 66.72)$  (Abidin et al., 2018). Whereas in the research that researchers do to get Mean Power and peak power is done by the Running Based Anaerobic Test (RAST) method with the help of smart speed fussion testers. RAST testing has been validated as an evaluation protocol option for sports that use locomotion (Aziz & Chuan Teh, 2004), and it was found that post-effort physiological responses (lactate concentration and HR) were very similar (Queiroga et al., 2013). After the test was conducted, the average power result was  $459.37 (\pm 74.694)$  and the highest power obtained was  $624.64 (\pm 80.328)$ . Anaerobic Power of Singaporean Pencak Silat athletes looks better than athletes from Indonesia. This is related to in addition to the different levels of athletes between Indonesia and Singapore, the results of anaerobic power testing using the RAST method tend to have smaller values when compared to the Wingate Test method in testing (Ferna, 2009).

Then in the performance of the Pencak Silat match it was found that the dominant technique used by Pencak Silat athletes was kicks with an average of  $14.6 (\pm 3.7)$  kicks entered in each match carried out by the winner, as well as subjects who experienced defeat also used kicking techniques with an average of  $9.4 (\pm 1.7)$  times in each match. Then the results of this study are reinforced by the fact from the results of research conducted by Soo et al., (2018) that for attacking movements, the use of a single front kick is most widely used compared to punching techniques in Pencak Silat matches. Furthermore, Soo et al., (2018) explained specifically that Pencak Silat athletes use better active defense techniques as well, especially by using side kicks and front kicks. So it can be concluded that kicks in Pencak Silat are the dominant technique used. Then the average incoming punch in each match is  $8 (\pm 1.4)$  punches by the winner, while the loser can only hit with an average of  $5 (\pm 2.6)$  times in each match.

In the analysis of the pulse rate during the match, there was an increase in each round, this increase can be described in the form of a diagram in Figure 10. Then, the results of the analysis of lactic acid levels also experienced an average increase in each round, below we present it in the lactic acid level diagram in Figure 11.

We realize that this study still has some limitations. First, the small number of subjects in this study as well as the limited number of subjects who only utilize the men's sparring category, so we suggest for future research, to be able to conduct research in other categories so that it can answer phenomena that have not been revealed in this study. Second, we realize that there are still limitations to the measurement tools we use, namely portable metabolic devices which are very necessary to assess the physiological profile of  $VO_{2max}$  in order to obtain more optimal results during laboratory testing and in the field (match simulation). We suggest that future research should pay attention to the portable metabolism device, in order to find out the physiological characteristics of Pencak Silat athletes. However, from some of the results and facts that have been found in this study, it is hoped that it can help coaches, athletes or sports researchers to find and develop better training concepts for athlete development or formulate the right formula for screening potential talent in Pencak Silat athletes.

## Conclusion

Based on the results of the study on athletes who participated in the pencak silat match, it can be seen that the sparring category pencak silat is a sport that has alternating characteristics with medium - high intensity. The men's sparring category pencak silat athletes of the Bumi Siliwangi club have an average anthropometry that is almost the same as pencak silat athletes from other Asian countries. Pencak Silat athletes have average flexibility with a very good category, this will be able to help Pencak Silat athletes because the analysis of this study shows that kicks in Pencak Silat are used more often than punches or other techniques. Then during the Pencak Silat match there was an increase in heart rate and lactic acid levels in each round.

## ACKNOWLEDGMENT

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## Conflicts of Interest

The authors have no conflicts of interest to declare.

## Ethical Statement

Permission to conduct research was obtained from Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi Universitas Pendidikan Indonesia, numbered 1322/UN40.A6/KP/2024.

## Author Contributions

Study Design, K, YH, NAU, DIM; Data Collection, K, AR, YSP, NAU, AR, DIM; Statistical Analysis, K, YH, YSP, NAU; Data Interpretation, K, YH, YSP, NAU; Manuscript Preparation, K, AR, AR; Literature Search, K, AR, AR. All the authors agreed on the final draft of the manuscript before submitting it for publication.

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