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## **A study of physical fitness characteristics of junior wushu players depend on sex difference**

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**Abstract:** Physical fitness was an activity or exercise that can accelerate regeneration when performing several exercises or training. This study aimed to examine the physical fitness characteristics of male and female junior wushu players, followed by determining physical performance differences between both groups. The analytical observational study method was implemented to conduct this study using a cross-sectional approach. Fifty junior wushu players (male: n= 25, height= 147.78 ± 12.96 cm; female: n= 25, height= 147.78 ± 12.60 cm) participated in this study by conducting some physical fitness tests. The results showed significant differences in the indicators of 20-meters running with a P-value of 0.049, backbend with a P-value of 0.000, and vertical jump P-value of 0.021. Meanwhile, there was no significant difference between male and female wushu players in the T-test, push up, sit up, dan sit & reach (P>0,05). From the results, it can be said that male players have higher scores in terms of weight, height, speed, and power, while female players have higher scores in terms of flexibility. This study concluded that it can be taken into consideration to optimize training and testing procedures for junior wushu players.

**Keywords:** wushu, physical fitness, sex, junior players

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### **INTRODUCTION**

Physical fitness was something that a person very much needs, even though only for daily activities. Humans must maintain physical fitness because a fit physique will impact the body's work system and human health itself (Zhai et al., 2020). On the other hand, physical fitness was an important thing that an athlete must improve. In addition, physical fitness can support the work pattern of athletes so that during the training period or the competition, the body system was well maintained and can reach peak performance. Naser et al., (2017); Saunders et al., (2016) state that physical fitness was vital to maintain their physical quality. Generally, physical fitness in a male was slightly higher than that of a female. The physical fitness of a wushu player certainly needs to be considered (Huang et al., 2018), in addition to maintaining the fitness of the player himself, as well as supporting technical and tactical abilities (Mancha-Triguero et al., 2019).

Physical fitness was an activity or exercise that can accelerate regeneration between exercises performed, reduce fatigue, increase overcompensation, ease athletes to handle weights exercise, and help athletes recognize and find the number and frequency of injuries due to excessive fatigue (Castillo-Lozano & Casuso-Holgado, 2017). Physical fitness affects the results obtained (Vrbik et al., 2017). Physical fitness was the body's ability to carry out a physical activity routinely and for an extended time without experiencing fatigue and still has energy reserves to carry out the following physical activity (Nala, 2011). On the one hand, physical fitness can show how to fit a child or teenager is. Low fitness levels have a high risk of cardiovascular disease, obesity, mental disorders, and bone problems (Cadenas-Sanchez et al., 2019). As with this idea, (Ortega et al., 2012) conducted a study with more



than one million samples of Swedish adolescents with low muscle strength who may have a high risk of death one day.

Wushu was a sport that requires a physical bio-motor component, both fighting and art (Liu, 2021; Mao & Cai, 2020; Tan et al., 2017). The bio-motor components needed in wushu sports include strength, flexibility, power, agility, speed, and vo2max (Huang et al., 2018) are very important supporting factors in improving athlete performance. Therefore, it was necessary to pay attention to these bio-motor elements to improve physical fitness in wushu players.

In general, a person's physical fitness characteristics are different, and many factors influence them, such as sex differences (Bompa, 2012; Pradas et al., 2021). As men do more activities than women, generally, they have higher physical fitness. When boys hit puberty, their physical fitness goes to the same level as women. However, after puberty, men will have higher physical fitness levels than women. The difference in this phase was usually related to muscle strength caused by different sizes and proportions, such as testosterone hormone in men is higher than in women. Isacco et al. (2012) said that estrogen makes girls have greater adipose tissue development than boys do when they are in the puberty phase.

In comparison, estrogen makes muscle mass development higher in boys than girls. Therefore, this study aimed to prove whether there was a significant difference in junior wushu players from the sex difference point of view. By comparing male players and female players, it can be a reference or evaluation material to improve an athlete's physical fitness further so that the proper training can be created to improve physical performance and improve an athlete's achievement (Courel-Ibáñez & Herrera-Gálvez, 2020), and material for evaluating appropriate exercise programs for male and female

Regarding fitness and anthropometric characteristics by sex, a study conducted by (Courel-Ibáñez & Herrera-Gálvez, 2020) showed that male players had good levels of cardiorespiratory fitness, upper body strength, grip strength, speed, and agility. However, the male player's dynamic balance test showed low posterior and anterior scores. Another study by (Courel-Ibáñez et al., 2018) shows that female athletes had higher levels of physical fitness due to their better body balance and explosive power, abdominal endurance, and cardiovascular capacity. Furthermore, they obtained lower waist and hip circumferences and thigh skinfold thickness than non-athlete subjects.

Based on interviews conducted by the author on several wushu trainers in Yogyakarta, it can be concluded that they have physical fitness data that was only used for grip without any clear follow-up for the process of developing the physical fitness data. The fitness data can be used to develop exercise quality, the performance of the players, and improve their players' performance (Bolotin & Bakayev, 2017; Buchheit et al., 2013; Nosek et al., 2021). Based on the background of the problems above, it was necessary to conduct a comparative study of the physical fitness of female wushu players with male wushu players. The aim was to determine how good the athlete's physical fitness was to be used as an evaluation material and improve other physical quality, which will later impact the quality of exercise to improve performance.

This research was fundamental because wushu players must monitor their level of physical fitness, considering measurement and evaluation as material to determine how good a wushu player's physical fitness was to monitor how far their progress is.

## **METHOD**

The methodology applied in this research was the analytical observational study method, which was managed using a cross-sectional approach. This study focuses on the time measurement, or data observation conducted once and on dependent and independent variables. This analysis was carried out on the data collected using anthropometric performance tests and several physical test items. The study procedure was initiated by determining the subjects or participants of the study. As a result, fifty junior wushu players in the Special Region of Yogyakarta, 25 male wushu players and 25 female wushu players aged 8-15 years participated in this study. The next step was determining the appropriate test instrument, which consists of:

The first instrument was the 20-meters Running, mean for testing the speed of the junior wushu players. The test was carried out on the athletic track of the Faculty of Sports Science stadium, Yogyakarta State University. The researchers used a digital stopwatch to measure the running time of the subjects. Subjects did warm up first for 20 minutes before doing the 20-meter running test three

times with ten minutes rest between the trials (Bračić et al., 2011). The timing was calculated in seconds. The second was the T-Test which aimed to determine a person’s agility by measuring how quickly he can change direction accurately (Dallas et al., 2019), such as forward sprints, left and right shuffling, and backpedalling. The more agile the subjects are, the faster they can complete the series of T-tests. Timing in this test was up to the nearest 0.01 seconds. The research subjects conducted two experiments with a three minutes recovery between the trials. The best score was used for further statistical analysis. The *push-ups* test intended to measure hand muscle strength (De La Motte et al., 2017). By contracting the arm area with the proper calculation and timing, it will strengthen the arm muscles better. The push-up test was carried out for 30 seconds and was carried out in a trial. Sit-ups are a test that aims to measure the strength of the abdominal muscles by lying on the back, bending knees, then lifting the body upwards (Ferreira Marinho et al., 2016). The body parts that focus on the sit-up movement are the hips and buttocks. The sit-up test was carried out for 30 seconds in a trial. Sit & Reach was aimed, according to Wells and Dillon in 1952, to generally measure shoulder, lower back, hip, and hamstring muscle flexibility (Gill et al., 2021). Sit and reach test was a valid and reliable test to measure flexibility (Huang et al., 2018). A wooden box, 30.5 cm x 30.5 cm x 30.5 cm (12 in) with a fixed ruler 53.34 cm (21 in) on top along with a top board that extends 22.86 cm (9 in) to the top. Foot direction was used in this study. Flexibility was measured in inches and centimetres. Backbend which was a floor exercise in which both hands and feet rest on the mat in an inverted position and then stretches, and the pelvis and abdomen are lifted (forming a bridge). Backbend aims to measure the flexibility of the subjects of this study. The subjects performed the backbend movement two trial times, and the best results were considered the final result. The unit in this test was centimetres. Lastly was the vertical jump, a fitness test that determines an athlete’s leg muscle strength or explosive power (Alp & Gorur, 2020). Professional athletes often use this test to determine an athlete’s progress during training. The higher the jump, the stronger the athlete’s leg muscles/explosive power. The result of the jump was recorded in cm. The subjects were given two chances to do it, and the best result will be used as the final result for further statistical analysis.

Before the research subjects did the seven physical test items, the research subjects did the anthropometric tests first. Anthropometric data were collected from all participants, including the height using a stadiometer and the weight using a digital scale. The following paragraphs deliberate the instruments and procedures used to determine the level of physical fitness and differences in physical fitness of the subjects in this study. After gathering all of the data, the next study data analysis consisted of quantitative data analysis with arithmetic average, standard deviation, maximum and minimum data for each variable, and the assessment of normality distribution using the Shapiro Wilk test. Then to determine the difference between groups, the researchers used the independent two-sample t-test with a significance level of  $p < 0.05$ . The procedure and statistical in this study werw using SPSS 25.

## RESULTS AND DISCUSSION

The primary purpose of this study was to examine the fitness characteristics of junior players in wushu and determine differences in physical performance based on the players’ sexes. This study evaluated the physical fitness of male and female wushu players. Such knowledge was crucial to identifying the determinants of player performance, competitive success, and injury prevention in wushu (Liu, 2021). The sample of this study amounted to 50 wushu players with the descriptive statistics results on the participant characteristics described in the table below:

**Table 1.** Height and weight statistics of participants (mean±SD)

	Male (n: 25)	Female (n: 25)
Height (cm)	147.78 ± 12.96	147.78 ± 12.60
Weight (kg)	41 ± 03	38.5 ± 13.19

We can see from table 1. that both male and female wushu players share the same height average, which was 147.78 cm. On the other hand, male and female wushu players had different weight averages, with 41 kg for male wushu players and 38.5 kg for female wushu players. Wushu players’ weight and height could affect the physical fitness test results and other components. Therefore, weight and height could be among many factors that cause physical differences.

**Table 2.** Descriptive Test Results and Difference Testing

		Mean	Stdev	Min	Max	P Value
20-Meter Running (s)	Male	3.9188	.40719	3.21	4.85	0.049
	Female	4.1548	.41898	3.34	5.13	
T-test (s)	Male	8.9676	1.34884	6.68	11.94	0.191
	Female	9.4892	1.43132	7.35	13.27	
Push-Up (n)	Male	18.0000	2.36102	8	21	0.320
	Female	15.0000	2.77791	6	17	
Sit-Up (n)	Male	45.6000	13.45672	28	74	0.086
	Female	39.6000	10.50000	24	66	
Sit & Reach (cm)	Male	36.1600	3.53471	31	44	0.727
	Female	36.6000	5.18411	30	50	
Backbend (cm)	Male	47.1600	11.19032	23	65	0.000
	Female	29.5600	12.85198	12	54	
Vertical Jump (cm)	Male	37.5600	8.87450	24	56	0.021
	Female	32.1200	7.14913	20	48	

Based on table 2 this study used a 20-meters running test to measure the wushu player speed. The results indicated that male wushu players performed running with the time average of 3.9188 seconds and the standard deviation value of 0.40719. The fastest male wushu player could run within 3.21 seconds, and the slowest took 4.85 seconds. On the other hand, female wushu players could perform the 20-meters running with a time average of 4.1548 seconds and a standard deviation value of 0.41898. The fastest female wushu players took 3.34 seconds to run, and the longest took 5.13 seconds.

The researchers also utilized a T-test aimed to measure the agility of the wushu players. The results showed that male wushu players could perform the T-test with a time average of 8.9676 seconds and a standard deviation value of 1.34884. The fastest male wushu players could perform the T-test within 6.68 seconds and the longest within 11.94 seconds. Meanwhile, female wushu players could perform the T-test with a time average of 9.4892 seconds and a standard deviation of 1.43132. The fastest female wushu players could perform the T-test within 7.35 seconds, and the longest took 13.27 seconds.

The wushu players also conducted push-ups for 30 seconds as the indicator to measure their strength. The final results showed that male wushu players could do push-ups 18 times on average, with a standard deviation value of 2.36102. The highest number of push-ups done by male wushu players was 21, and the lowest number was 8. Female wushu players could do push-ups 15 times on average, with a standard deviation of 2.77791. The fastest could reach 17 push-ups per 30 seconds, and the slowest could do six times.

The next was sit up indicator, which aimed to measure the wushu players' strength; results showed that male wushu players performed sit up 45.6000 times on average, with 13.45672 as the standard deviation value. The fastest player could perform 74 times, and the longest could perform 28 times. While female players could perform sit up for 39.6000 on average with a standard deviation of 10.50000. The fastest female player could sit up 66 times, and the slowest could do 24 times.

Sit & reach indicator meant to measure the player's flexibility showed results indicating that male wushu players could do sit & reach for 36.1600 cm on average, with the standard deviation value of 3.53471. The minimum value of male wushu players in the sit & reach test was 31 cm, and the maximum value was 44 cm. Meanwhile, female wushu players could do sit & reach with an average of 36.6000, with a standard deviation of 5.18411. Furthermore, female players can do a sit & reach test with a minimum of 30 cm and a maximum of 50 cm.

In the backbend indicator, which aimed to measure the players' flexibility, the results pointed out that male wushu players could perform backbend with an average of 47.1600 cm and the standard deviation value of 11.19032. The male players could perform the backbend test with a minimum of 23 cm and a maximum of 65 cm. Meanwhile, female wushu players could do backbends with an average

of 29.5600, with a standard deviation of 12.85198. Furthermore, female players could do the backbend test with a minimum value of 12 cm and a maximum of 54 cm.

Finally, to measure the power of the wushu players, a vertical jump test was performed. The results showed that male wushu players could perform the jump with an average of 37.5600 cm and a standard deviation value of 8.87450. Male wushu players could do the jump test with a minimum value of 24 cm and a maximum of 56 cm. Meanwhile, female wushu players could do the jump with an average of 32.1200, with a standard deviation of 7.14913. Furthermore, female players could take a jump test with a minimum of 20 cm and a maximum of 48 cm.

Based on table 2, it was found that there were significant differences in the 20-meter running indicator between the males and females because of the sig. 0.049, indicating males were significantly faster than females. The backbend indicator shows a significant difference between the sexes of males and females because of the value of sig. 0.000, females have higher flexibility compared to males. The sig. 0.021 shows the significant difference between males and females in the vertical jump indicator, and males have significantly higher power than females. On the other hand, there was no significant difference between male and female wushu players in the T-test (sig. 0.191), push-ups (sig. 0.320), sit-ups (sig. 0.086), and sit & reach (sig. 0.727) because of the sig value. > 0.05. However, from the average value of this study results on the T-test, push-ups, and sit-ups, male wushu players had better results than female wushu players. Meanwhile, in the sit & reach test, the average score for female wushu players was better than that of male wushu players.

Several studies have examined the physical characteristics of wushu players (Hanief, 2019; Huang et al., 2018; Noviani & Badri, 2019). The results of this study indicated that male players have higher scores in terms of weight, height, speed, and power (sig. < 0.05) than female players, the same results were obtained by (Huang et al., 2018; Öncen & Tanyeri, 2019) when evaluating differences in physical fitness by sex. Female players scored higher in terms of flexibility.

Wushu was a martial sport that demands good physical conditions (Tan et al., 2017). All the basic techniques in wushu need to be supported by good physical condition. Muscle strength plays a vital role in supporting all basic wushu techniques, especially leg muscle strength (Shilko & Novikova, 2018). Leg muscle strength was a physical condition factor used in kicking techniques. Exercises that can be applied to develop muscle strength are resistance exercises. As in a study found that resistance exercise can increase muscle strength significantly, (Nasrulloh & Wicaksono, 2020). Monteiro et al., (2020) stated that wushu sports athletes also need arm muscle strength to combine speed in making explosive power stimulation to produce a hard kick so that the opponent cannot dodge and hand strength to perform the component of the fall process. The abdominal strength indicator was evaluated using a 30-second push-up test. There was no significant difference between female and male sig values in this study. > 0.05. However, when observed from the average value, males have higher hand muscle strength than females.

Another factor was the strength of the abdominal muscles. In wushu sports, abdominal muscle strength was included as a variable in the study because it contributes to the defensive system from opponent attacks ((Huang et al., 2018). The stomach becomes the target area for the opponent's attack in wushu (Artioli et al., 2009). Besides that, abdominal muscle strength also contributes to the athlete's kicking power. In the indicator of abdominal muscle strength, which was evaluated using the 30-second sit-up test in this study, there was no significant difference between females and males. However, when seen from the average value, males have higher abdominal muscle strength than females.

The explosive power of leg muscles was needed in kicking and jumping (Noviani & Badri, 2019). The explosive power of the leg muscles was a combination of strength and speed or the maximum exertion of muscle force with a maximum speed (Ismoko & Sukoco, 2013; Mansur et al., 2018). With good leg muscle explosive power, athletes can produce hard and powerful kicks to beat opponents (Alp & Gorur, 2020). The leg muscle explosive power indicator of this study was evaluated using a vertical jump test. The results showed that males had significantly higher explosive power than females, as research conducted by (Pradas et al., 2021) stated higher explosive power values in male players than female players.

Speed was also a physical factor that affects the performance of wushu athletes (Monteiro et al., 2020). Speed was demanded in wushu because it functions to find points in terms of attacks that have an element of judgment and serves to assist in the process application of explosive power in getting a steady and robust attack as well as the application of the changing position process to avoid the



opponent's attack (Monteiro et al., 2020). The speed indicator of this study was evaluated using a 20-meter sprint with the results that males had significantly higher speeds than females.

Agility plays a role in unexpected movements, especially displacement movements (Garcia-Gil et al., 2018). Agility was defined as the athlete's ability to change positions quickly (Paul et al., 2016). An athlete will have many variations in attacking and avoiding the opponent's attack (Yudhistira & Tomoliyus, 2020). This agility skill was a reinforced statement, which states that wushu athletes must have good agility so that the opponent cannot predict the pattern of attack motion.

According to (Bompa, 2012), flexibility implies the motion area of one joint or several joints. Flexibility was a range controlled by the ability of the joint to be able to perform maximally within the available joint space without causing injury, (Nasrulloh et al., 2021). There are two kinds of flexibility, namely static and dynamic flexibilities. Static flexibility was determined by the size of the range of motion in one joint or several joints (Hamidur Rahman & Shahidul Islam, 2020). At the same time, dynamic flexibility was a person's ability to move at high speed. The flexibility test indicators used in this study were the sit and reach test and backbend. On the flexibility factor, different results were found. There was no significant difference in the sit & reach indicator between male and female players. Meanwhile, the backbend indicator showed a significant difference between the male and female players, stating that females have more flexibility than males.

Therefore, it can be concluded that male wushu players have better speed, strength, and power than female wushu players. This condition can be because men can produce greater strength and speed than women, have greater muscle mass, and have higher testosterone. The hormone testosterone itself has a very important role, namely making new blood cells, keeping bones and muscles strong, and encouraging muscle growth (Isacco et al., 2012).

Besides muscle mass and hormones, differences in lung capacity also determine why men have higher speed and power than women. Generally, women have smaller lung sizes than men (Carey et al., 2007). This difference makes women's body's ability to inhale maximum oxygen was lower than that of men. However, in terms of flexibility, female wushu players are better than men because the hormone relaxin affects pelvic movement and pelvic size in women, and female wushu players also have more fat accumulation than muscle. The structure of fat that is softer than muscle will increase women's flexibility level.

## **CONCLUSION**

The primary purpose of this study was to examine the fitness characteristics of junior players in wushu and determine differences in physical performance based on the players' sexes. This study evaluated the physical fitness of male and female wushu players. Such knowledge was crucial to identifying the determinants of player performance, competitive success, and injury prevention in wushu. Wushu was a sport that requires physical fitness. Based on the results of this study, it can be concluded that junior wushu players display differences in anthropometry and physical fitness components, especially in flexibility, power, and speed based on sex differences. Therefore, it was necessary to distinguish specific training programs for each male and female player. The results of this study can be used as consideration for optimizing training and testing procedures for junior wushu players.

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