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## **PHYSICAL CONDITION CHARACTERISTICS OF JUNIOR RAFTING ATHLETE FAJI PURBALINGGA**

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## Abstract

**Background.** Physical fitness is a crucial component in supporting athlete performance in various sports, including whitewater rafting. This sport demands complex physical abilities, including aerobic endurance, upper-body strength, leg explosiveness, and core stability to navigate dynamic, challenging river currents.

**Aim.** This study aims to determine the physical condition characteristics of junior rafting athletes in Purbalingga and to analyze differences in physical condition test results by competition category.

**Material and Methods.** This study used an observational, quantitative approach. The subjects consisted of 68 junior rafting athletes aged 15–18 years from a rafting club in Purbalingga. Physical condition measurements included the Multi-Stage Fitness Test (MFT), push-up test, pull-up test, vertical jump test, and plank test. Data analysis was performed using descriptive statistics and the Mann–Whitney and Kruskal–Wallis tests, with a significance level of  $p < 0.05$ , in SPSS version 24.

**Results.** The study found that only height variables showed significant differences between male and female athletes ( $p < 0.05$ ), while age, weight, and BMI did not. In addition, there were no significant differences in all components of physical condition between rafting competition categories ( $p > 0.05$ ). In general, most athletes were in the Good (43%) and Fair (31%) categories.

**Conclusions.** The physical condition of junior whitewater rafting athletes in Purbalingga is generally good. The training program implemented has improved the athletes' basic physical condition, but more targeted training is still needed to optimize performance.

**Keywords:** Physical Condition, White Water Rafting, Junior Athletes.

## Introduction

To support optimal athlete performance, special attention is needed to various aspects that influence their physical and mental abilities (Liang et al., 2025; Ramadan & Samin, 2023). One important aspect that underpins optimal performance is physical condition (Ningsih et al., 2024; Rodrigues et al., 2025). Good physical condition allows athletes to train effectively, reduces the risk of injury, and increases endurance under competitive pressure (Kristiono et al., 2024; Xiao et al., 2021).

Physical condition is the foundation of sports performance development, as technique, tactics, and mentality will be well developed when an athlete has strong physical qualities (Andy Supriady, 2023; Farley et al., 2020). Physical condition is a requirement for athletes to improve and develop optimal sports performance, so all physical conditions must be developed and improved according to the characteristics, needs, and requirements of each sport (Y. Wang, 2025). Many factors determine a sport's performance. These include combining an athlete's physical condition, skills, abilities, techniques, determination, strategy, and mental preparation before the competition begins (Ying, 2024). Physical condition plays a crucial role in improving an athlete's technical and mental abilities (Nugroho et al., 2021; Sunarto et al., 2023). It is also an integral part of efforts to improve an athlete's performance. Physical condition is not only the foundation but also a vital supporting factor in an athlete's performance, enabling them to train optimally (Ding, 2025; Gandrapu & Rakesh, 2024).

Furthermore, optimal physical condition is a primary requirement for athletes to achieve maximum performance. This is a prerequisite that must be met by every athlete to improve and optimize their sporting performance (Islam, 2024; Liu & He, 2022). Therefore, an athlete's physical condition must be continuously developed and refined to meet the characteristics and needs of the sport they pursue. In whitewater rafting, physical fitness is crucial, given the demands of the activity, which require muscular strength, cardiovascular endurance, balance, agility, and good body coordination (Afrizal, 2022). Rafting athletes must navigate strong currents, maintain boat stability, and work harmoniously with their team in a dynamic, challenging environment. Therefore, a structured, measurable physical fitness assessment is essential.

Whitewater rafting is a water sport that demands high levels of physical ability, technique, and teamwork. Whitewater rafting is divided into several disciplines: sprint, head-to-head, slalom, and downriver racing. Optimal physical condition not only impacts performance during competition but also plays a crucial role in post-training or competition recovery. Each athlete has distinct physical characteristics that depend on age, gender, training intensity, and genetics (Hadiono et al., 2024).

In developing high-performance sports, particularly for junior athletes, understanding the characteristics of their physical condition is crucial. Information about an athlete's physical condition can be used as a basis for developing a more appropriate, effective, and tailored training program. However, studies specifically describing the physical condition characteristics of junior rafting athletes, particularly at the regional level, are still relatively limited. Therefore, this study aims to analyze and describe the physical condition of junior rafting athletes from FAJI Purbalingga.

## **Methods**

### **Procedure**

The method used in this study was an observational, quantitative approach aimed at identifying the characteristics of the variables under study. All study subjects were in good health, had no history of cardiovascular disease, did not suffer from asthma, and were non-smokers. Prior to the test, all subjects consumed a light snack one hour before the measurement and wore appropriate sports clothing and shoes. Prior to the study, the researchers obtained

permission from the rafting club coach and prepared the necessary research instruments, including stationery and questionnaires used to measure the study variables.

In addition, verbal and written explanations regarding the research objectives, implementation procedures, and potential risks were provided to all subjects prior to data collection. This research also received ethical approval from Semarang State University under research ethics letter number B/1913/UN37.1.6/KM.07/2025.

## Participants

The study subjects comprised 68 junior rafting athletes, in accordance with the Indonesian Rafting Federation's regulations. All subjects were aged 15–18 years and were from rafting clubs in Purbalingga. The athletes participated in a regular rafting training program, averaging 8–10 hours per week, and had approximately 2 years of rafting experience.

## Instrument

Height measurements were taken with a stadiometer, with the subject facing forward and standing upright, without shoes. Weight and body mass index (BMI) measurements were taken using an Omron Carada Scan Body Fat device (Singh et al., 2023). To measure the participants' body capacity and strength, a series of physical fitness tests was conducted. Maximal aerobic capacity ( $VO_2\text{max}$ ) was measured using the Multi-Stage Fitness Test (MFT), a 20-meter back-and-forth running test to a rhythmic sound that gradually increases until the participant is unable to follow the rhythm twice in a row (Triyulianti et al., 2023). Upper body muscle strength and endurance were measured using the Push-Up Test, in which participants performed as many push-ups as possible with correct technique for 60 seconds (Rozenek et al., 2022). Next, arm and upper back muscle strength was assessed using the Pull-Up Test, in which participants performed unassisted pull-ups to their limit for 60 seconds (Hufadz et al., 2025). Leg muscle explosiveness was measured using the Vertical Jump Test, which required participants to jump as high as possible from a standing position (Hermawan et al., 2023). Finally, core muscle strength and endurance were measured using the Plank Test, in which participants maintained a plank position for as long as possible without touching the floor (Zaidi et al., 2022).

## Data Analysis

This study employed quantitative descriptive analysis and nonparametric statistical tests, including the Mann Whitney and Kruskal Wallis tests. These analyses were used to determine differences in the average physical condition test scores of whitewater rafting athletes across competition categories. All statistical analyses were conducted using SPSS version 24 software with a significance level of  $p < 0.05$ .

## Results

This study aims to determine the physical condition of junior whitewater rafting athletes in Purbalingga. The data are presented as descriptive statistics to characterize the athletes' physical condition. Furthermore, the data analysis is complemented by statistical tests to determine differences in average physical condition test scores across competition categories.

Characteristics of the research sample

Table 1. Characteristics of the research sample

Characteristics	Men (n=34)	Women (n=34)
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	Min	Max	Mean $\pm$ SD	Min	Max	Mean $\pm$ SD	P-Value*
Age	12	18	16.74 $\pm$ 1.05	12	17	16.26 $\pm$ 1.08	0.073
Height (cm)	157	170	162.53 $\pm$ 6.2	149	165	157.5 $\pm$ 5.78	0.00*
Weigh (Kg)	50	66	61.88 $\pm$ 5.26	48	69	58.82 $\pm$ 5.84	0.23*
BMI	19,23	26,1	23.14 $\pm$ 2.65	19.11	25,12	23.67 $\pm$ 2.49	0.81

**Note:** \* Significant Mann-Whitney U Test

The analysis results in Table 1 show that, among the variables tested, only height differed significantly between men and women ( $p < 0.05$ ), with men having a higher average height than women. Meanwhile, the variables age ( $p = 0.073$ ), weight ( $p = 0.23$ ), and BMI ( $p = 0.81$ ) did not show significant differences ( $p > 0.05$ ). Thus, both groups have relatively similar characteristics in terms of age, weight, and BMI, while differences were observed only in height.

#### Characteristics of physical condition test results based on competition category

**Table 2.** Characteristics of physical condition test results based on competition category

Types of tests	Sprint			Head-to-head			Slalom			Downriver race			Sig
	Min	Max	M $\pm$ SD	Min	Max	M $\pm$ SD	Min	Max	M $\pm$ SD	Min	Max	M $\pm$ SD	
MFT	3	9	5.26 $\pm$ 1.5	2	8	4.63 $\pm$ 1.5	2	6	3.88 $\pm$ 0.97	2	7	4.22 $\pm$ 1.4	0.41*
Push-Up	15	52	30.2 $\pm$ 10.8	14	45	27.2 $\pm$ 9.1	16	50	30.4 $\pm$ 9.09	12	44	26.6 $\pm$ 10.4	0.78
Pull-Up	5	60	24.6 $\pm$ 16.3	2	45	14.3 $\pm$ 12.6	8	70	32.9 $\pm$ 17.7	3	60	21.1 $\pm$ 17.2	0.17*
Vertical Jump	18	52	33.18 $\pm$ 8.8	15	45	27.1 $\pm$ 8.5	22	55	37 $\pm$ 7.4	16	48	30.2 $\pm$ 9.3	0.12*
Plank Tes	1	7	3.5 $\pm$ 1.6	1	8	4.06 $\pm$ 1.7	1	6	3.2 $\pm$ 1.1	1	7	4.0 $\pm$ 1.5	0.54

**Note:** \* Singnifikan Kruskal-Wallis Tes

Based on Table 2, the results of the Kruskal–Wallis test based on the results of the physical test for the competition category show that all physical condition variables for each type of white water rafting competition category do not have significant differences, because all significance values are ( $p > 0.05$ ). In the MFT test, a p-value of 0.41 was obtained, indicating no significant difference in aerobic endurance capacity across competition categories; however, descriptively, the Sprint category had a higher average ( $5.26 \pm 1.5$ ) than the other categories. In the Push-Up ( $p = 0.78$ ) and Pull-Up ( $p = 0.17$ ) tests, no significant differences were found in arm muscle strength and endurance between competition categories. Although the Slalom category had the highest average Pull-Up score ( $32.9 \pm 17.7$ ), this difference was not statistically significant. Similarly, in the Vertical Jump test ( $p = 0.12$ ) and Plank Test ( $p = 0.54$ ), there were no significant differences in the explosive power components of leg muscles and core muscle endurance between the competition categories.

#### Overall test result characteristics

**Table 3.** Characteristics of overall test results

Category	Types of tests									
	MFT		Push-Up		Pull-Up		Vertical Jump		Plank Test	
	N	%	N	%	N	%	N	%	N	%
Very Good	7	10%	9	13%	6	9%	8	12%	10	15%
Good	31	46%	28	41%	22	32%	30	44%	27	40%
Fair	24	35%	20	29%	25	37%	21	31%	18	26%
Poor	9	16%	7	10%	10	15%	6	9%	8	12%

Very Poor	10	15%	4	7%	5	7%	3	4%	5	7%
Total	68	100%	68	100%	68	100%	68	100%	68	100%

Based on Table 3, the distribution of overall physical condition test results shows that the majority of athletes are in the Good and Fair categories across almost all tests. In the MFT test, the majority of athletes were in the Good category (46%), followed by Fair (35%), and only 10% were in the Very Good category. In the Push-Up test, dominance was also seen in the Good (41%) and Fair (29%) categories, with 13% in the Very Good category. In the Pull-Up test, the largest distribution was in the Fair (37%) and Good (32%) categories, indicating that the majority of arm muscle strength and endurance were moderate to good. Meanwhile, in the Vertical Jump test, the majority of athletes were in the Good (44%) and Fair (31%) categories, indicating relatively good leg muscle explosiveness. In the Plank test, the Good (40%) and Fair (26%) categories again dominated, with 15% of athletes in the Very good category.

Characteristics of the overall physical condition of white water rafting athletes

Table 4. Characteristics of the overall physical condition of white water rafting athletes

Category	N	%
Very Good	8	12%
Good	29	43%
Fair	21	31%
Poor	6	9%
Very Poor	4	6%
Total	68	100%

Based on the results in Table 4, the overall physical condition characteristics of junior rafting athletes in Purbalingga indicate that the majority are in the Good category, namely 29 athletes (43%). Furthermore, 21 athletes (31%) are in the Fair category, and 8 athletes (12%) are included in the Very Good category. Meanwhile, the number of athletes in the Poor and Very Poor categories is relatively smaller, namely 6 people (9%) and 4 people (6%), respectively.

## Discussion

The results of the study indicate that the anthropometric characteristics of junior whitewater rafting athletes in Purbalingga are generally uniform between male and female groups, except for height, which showed a significant difference. This finding aligns with Albaladejo-Saura et al. (2022). This study shows that differences in height during adolescence are largely influenced by variations in pubertal development between boys and girls. These differences are related to hormonal changes and differences in biological maturity between the sexes. Height is often an anthropometric characteristic that influences rowing efficiency because body segment length can affect lever length during the rowing stroke (Penichet-Tomas et al., 2021).

Research by Gäbler et al. (2023) on kayak and canoe athletes showed that anthropometric factors, such as height, muscle mass, and body composition, are related to performance in paddling sports because they affect the ability to generate thrust in the water and the efficiency of paddle movement. However, similarities in the variables of age, weight, and BMI in this study indicate that most athletes have relatively comparable basic physical conditions. This is important because uniformity in basic sample characteristics can provide a more objective picture in evaluating the physical condition of athletes.

The findings of this study also indicate that there are no significant differences in physical condition components between the rafting competition categories, namely sprint, head-to-head, slalom, and downriver race. Physiologically, whitewater rafting requires a combination of upper-body strength, aerobic endurance, and core stability. Paddling movements involve repeated muscle contractions in the arms, shoulders, back, and core, thus requiring a balance of strength and endurance (Hansen et al., 2022). Research by Manna et al. (2023) on kayak athletes shows that paddling requires a combination of strength, power, and endurance and involves both anaerobic and aerobic energy systems simultaneously. Therefore, the absence of significant differences across competition categories in this study can be explained by the similarity of physiological demands within each category. Furthermore, during the developmental stage of adolescent athletes, training programs are usually more focused on developing overall physical condition before specializing in specific abilities. The research findings indicate that several competition categories exhibited different average scores for each specific physical test. One notable finding was the sprint category, which had a higher average Multistage Fitness Test (MFT) score than the other categories. This can be explained by the fact that sprinting requires athletes to generate speed and endurance in a relatively short time with high work intensity.

This may be due to the sprint category's requirements, which call for athletes to perform fast, powerful, and repetitive rowing movements over a short race distance. These research findings are supported by Tomiak et al. (2016), which states that in the sprint competition category, athletes are required to perform rowing movements with high speed and power repeatedly. The study also showed that increased strength and stroke rate can be achieved through training with external loading and the use of visual feedback, which has been proven to increase the efficiency of athlete movements during the race. These conditions indicate that the sprint event requires a good combination of aerobic and anaerobic energy systems so that athletes can maintain optimal rowing speed and rhythm throughout the race. Athletes with greater aerobic endurance capacity tend to maintain high work intensity, delay the onset of fatigue, and sustain stable performance during competition (Pripstein et al., 1999).

The overall physical condition test results showed that the majority of athletes were in the Good and Fair categories in almost all physical test components. This indicates that the physical condition of the junior rafting athletes in this study was sufficient to support training and competition. In the aerobic endurance component measured by the MFT test, most athletes were in the good category. Aerobic endurance is an important component of whitewater rafting because paddling is sustained and requires a stable energy supply. Research by Wang & Zhao (2023) on kayaking found that cardiorespiratory capacity, such as  $VO_2\text{max}$  and the ventilatory threshold, is the main factor distinguishing high-level from club-level athletes. Athletes with greater aerobic capacity tend to maintain work intensity for longer and achieve better performance.

The results of these physical condition measurements indicate that cardiovascular endurance and arm muscle endurance are well developed among whitewater rafters. This finding aligns with research by Aristiyanto et al. (2020), which found that the most important physical condition components in whitewater rafting are cardiovascular endurance and arm muscle endurance. Cardiovascular endurance is closely related to the ability of the heart and lungs to support physical activity for a given duration (Hariyanti et al., 2022). Therefore, optimal physical condition and a high  $VO_2\text{Max}$  are important factors for whitewater rafters to maintain work intensity throughout the race. Furthermore, arm muscle endurance plays a crucial role in supporting the performance of rafting athletes. Muscle endurance is the ability of a group of muscles to contract continuously while holding submaximal loads for a given period of time

(Nubatonis et al., 2024). This ability allows the muscles to maintain consistent movement and generate the power required during rowing activities (Oronova et al., 2018). Without adequate arm muscle endurance, rowing movements cannot be performed optimally, which can affect movement efficiency and overall athlete performance (Ian Gee et al., 2016).

In addition, the plank test results showed that most athletes also had fairly good core muscle endurance. Core muscles play a role in transferring force from the lower to the upper body during rowing movements, thereby increasing movement efficiency and reducing the risk of injury (Willardson, 2007). High core muscle activation during rowing movements reaches approximately 85% of maximal contraction in several core muscle groups, indicating the importance of body stability in whitewater rafting (Kibler et al., 2006). Thus, the development of core muscle endurance should remain an important part of the training program for whitewater rafting athletes to support performance and body stability during rowing activities.

Overall, the results of this study indicate that the physical condition of junior rafting athletes in Purbalingga is in the Good category, with the majority in the Good and Fair categories. These findings indicate that the training program implemented for junior rafting athletes has developed the basic physical conditioning components required for whitewater rafting. Research on the performance profiles of kayak athletes also shows that athletes with good physical condition tend to perform more optimally across various fitness test components, such as muscle strength, endurance, and cardiorespiratory capacity. However, a small number of athletes are in the low category, so a more targeted evaluation of the training program is needed to improve specific physical condition components. Systematic, sustainable, and scientifically evidence-based training programs are crucial for developing young athletes to achieve optimal performance at higher levels of competition.

## **Conclusion**

The results of this study indicate that the physical condition of junior rafting athletes is generally in the Good category, with the majority in the Good and Fair categories across components such as aerobic endurance, arm muscle strength, leg muscle explosive power, and core muscle endurance. In addition, the results show that there is no significant difference in physical condition across rafting competition categories, indicating that the basic physical abilities of athletes at the junior development stage remain relatively even.

The findings of this study indicate that the implemented training program has improved athletes' basic physical condition, but further improvements and the development of a more targeted, specific training program are needed. Therefore, coaches need to implement a more balanced training program that focuses on developing aerobic endurance, upper body muscle strength, core muscle stability, and improving rowing technique to support optimal athlete performance in training and competition.

## **Generative AI Use Statement**

Artificial Intelligence (AI), specifically ChatGPT (OpenAI), was used in this study to analyze clinical reasoning narrative texts to identify linguistic patterns associated with specific logical fallacies and to assist in improving the academic English of the manuscript, including grammar, writing style, and clarity of presentation. The use of AI was assistive and under the authors'

supervision, and did not influence the scientific substance, data analysis, interpretation of results, or conclusions of the study.

### **Author Contributions**

Conceptualisation, K.M.S. and S.I.; methodology, S.I.; software, S.I.; validation, K.M.S. and S.I.; formal analysis, K.M.S.; investigation, S.I.; resources, K.M.S.; data curation, S.I.; writing—original draft preparation, K.M.S.; writing—review and editing, K.M.S.; visualization, S.I.; supervision, K.M.S.; project administration, S.I.; funding acquisition, S.I.

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### **Institutional Review Board Statement**

Code of Ethics Letter in Conducting Research Originating from Semarang State University, with letter number B/1913/UN37.1.6/KM.07/2025.

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### **Conflicts of Interest**

The authors declare no conflict of interest.

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