



Correlation Between Energy Intake and Body Fat Percentage Aand The Cardiorespiratory Endurance of Wushu Athletes in "Klub Fighter" Banjarnegara

Dewani Saila Putri, Astrid Noviana*

Universitas Negeri Semarang, Indonesia

*Email: astridnoviana@mail.unnes.ac.id

ABSTRACT

Cardiorespiratory endurance is one of the physical fitness components needed by an athlete. Several factors, including nutritional factors, can influence cardiorespiratory endurance. This study aimed to investigate the relationship between energy intake, body fat percentage, and cardiorespiratory endurance in "Klub Fighter" wushu athletes in Banjarnegara. This study used an observational analytical design with a cross-sectional approach. A total of 25 people were sampled to find the respondents. Energy intake data were obtained using the 3x24-hour food recall method, body fat percentage was measured through Bioelectrical Impedance Analysis (BIA), and cardiorespiratory endurance was assessed using the Bleep test. Data analysis employed the Spearman Rank correlation test, and multivariate testing utilized the multiple linear regression method. This study revealed that 60% of athletes had an energy intake deficiency, 48% had a body fat percentage in the deficiency category, and 60% had cardiorespiratory endurance (VO₂Max) in the deficiency category. Energy intake was associated with cardiorespiratory endurance in "Klub Fighter" wushu athletes in Banjarnegara ($p < 0.05$). Body fat percentage is also related to the cardiorespiratory endurance of wushu athletes from "Klub Fighter" Banjarnegara ($p < 0.05$). A relationship was found between energy intake and body fat percentage, as well as cardiorespiratory endurance, in wushu athletes from "Klub Fighter" Banjarnegara.

Keywords: energy intake, body fat percentage, cardiorespiratory endurance, athletes

INTRODUCTION

An athlete needs good physical fitness to achieve optimal sports performance. One of the essential components of physical fitness is cardiorespiratory endurance. Cardiorespiratory endurance is the ability of the cardiovascular and respiratory systems to meet the oxygen needs of the muscles used during physical activity without feeling excessive fatigue. (Anggraeni & Wirjatmadi, 2019). Cardiorespiratory endurance can be measured by determining maximum aerobic capacity, also known as VO₂Max (Larasati & Yuliana, 2020). To maximize their performance, athletes need to enhance their cardiorespiratory endurance, as measured by VO₂ Max.

Cardiorespiratory endurance can be affected by age, gender, nutritional intake, physical activity, exercise, and body composition (Sahara *et al.*, 2019). Exercise combined with proper nutrition can improve an athlete's performance by approximately 72.5%. Adequate energy intake plays a role in the process of energy expenditure, which can increase and enhance endurance.

Research shows that energy intake has a strong and positively patterned relationship with cardiorespiratory endurance. This means that the higher a person's energy intake, the better their cardiorespiratory endurance (Penggali^h *et al.*, 2017; Muthmainnah *et al.*, 2019; Kuswari *et al.*, 2019).

Aside from energy intake, body fat percentage can also impact cardiorespiratory endurance by increasing VO₂ Max levels. An athlete must have a normal body fat percentage because if it is too excessive, it will lead to obesity, thickening of the walls of blood vessels, increased blood pressure, stroke, and heart disease (Kurnia *et al.*, 2020). Research indicates that body fat percentage is the variable most closely related to cardiorespiratory endurance, compared to diet quality and physical activity. Body fat percentage negatively affects VO₂Max, which means that cardiorespiratory endurance depends on adipose tissue (Sahara *et al.*, 2019; Komici *et al.*, 2023).

Most sports demand high cardiorespiratory endurance, one of which is wushu. In addition to cardiorespiratory endurance, wushu also requires strength, explosiveness, flexibility, agility, and balance (Pratama & Setyawati, 2021). Cardiorespiratory endurance is significant for wushu athletes because the match is carried out in 3 rounds, and each round has a duration of 2 minutes (Hanief, 2019). Wushu is also an interesting achievement sport that provides opportunities for its athletes to obtain numerous championship titles. This opportunity highlights the need for wushu athletes to focus more on their physical condition to compete optimally.

Banjarnegara is one of the regions in Central Java that shows its commitment to the development of wushu sports. One of the wushu gyms in Banjarnegara and a forum for coaching athletes is the "Klub Fighter." However, the results of preliminary studies indicate that the cardiorespiratory endurance of Banjarnegara wushu athletes remains suboptimal. Data from the Indonesian National Sports Committee (KONI) Banjarnegara regarding the results of the VO₂Max test of wushu athletes in 2021 shows that as many as one athlete is in the good category (14.3%), three athletes in the fair category (42.9%), and three athletes in the low category (42.9%).

Match preparation for wushu athletes, as seen in "Klub Fighter," focuses solely on physical and technical training. Nutritional factors, such as energy intake and body fat percentage, are still not the primary focus of attention in supporting athlete performance. Until this study was conducted, there had never been a measurement of energy intake and body fat percentage in wushu athletes at the Banjarnegara "Klub Fighter". Based on this description, the researcher is interested in further examining the relationship between energy intake, body fat percentage, and cardiorespiratory endurance in wushu athletes from "Klub Fighter" Banjarnegara.

METHOD

This study is an observational analysis with a *cross-sectional study design*. The research location is the Wushu gym "Klub Fighter" in Banjarnegara. The population in this study consists of all wushu athletes from the Banjarnegara "Klub Fighter," totaling 25 individuals. The sampling technique employed a total sampling approach, resulting in a research sample of 25 people.

The independent variables in this study consisted of energy intake and body fat percentage, while the dependent variables were cardiorespiratory endurance. The confounding variables were age, gender, physical activity, and smoking. Energy intake was obtained through interviews using the 3x24-hour food recall method. It was categorized into three groups: less (<80% of daily needs), enough (80-110% of daily needs), and more (>110% of daily needs)—as measured by body fat percentage using *Bioelectrical Impedance Analysis* (BIA). The cardiorespiratory endurance of athletes was measured using *the Bleep test* method. Data on gender, age, physical activity, and smoking were obtained through interviews using questionnaires.

The analysis technique uses univariate, bivariate, and multivariate analysis. Univariate analysis was performed to describe the characteristics of each variable under study. Bivariate analysis was performed to see the relationship between independent and dependent variables. The normality test used was the *Shapiro-Wilk test*, as the sample size was less than 50. The bivariate test uses *Spearman's Rank correlation* because the data is not normally distributed. It was used with $\alpha = 0.05$ and a 95% Confidence Interval (CI). The criterion in this test is that if $p < 0.05$, there is a relationship between the free and bound variables. If $p > 0.05$, then there is no relationship between the free and bound variables. The multivariate analysis model used is a multiple linear regression model because the dependent variable is numerical data.

RESULTS AND DISCUSSION

The results of the study are presented based on data collected through direct observation and interviews at the research location, namely the "Klub Fighter" in Banjarnegara. The data was collected from Wushu athletes at "Klub Fighter," which consisted of 25 people. The data collection consisted of age, gender, body fat percentage, smoking status, energy intake, and cardiorespiratory endurance (VO2Max), as well as information from Bleep test forms, physical activity logs, and 24-hour food recalls.

Characteristics of Wushu Athletes in "Klub Fighter" Banjarnegara

Univariate analysis was conducted to examine the characteristics of athletes, including age, gender, smoking status, body fat percentage, physical activity, energy intake, and VO2Max value. The attributes of wushu athletes in "Klub Fighter" Banjarnegara are presented in Table 1.

Table 1. Characteristics of Wushu Athletes in the Banjarnegara "Klub Fighter"

Variable	Category	Amount	
		N	Percentage (%)
Age	13-<18 years	14	56
	18-<23 years	5	20
	23-28 years	6	24

Variable	Category	Amount	
		N	Percentage (%)
Sex	Female	8	32
	Male	17	68
Smoking	Yes	3	12
	No	22	88
Fat body percentage	Less	12	48
	Normal	9	36
	Excessive	4	16
Physical activity	Light	18	72
	Medium	3	12
	Heavy	4	16
Energy intake	Less	15	60
	Adequate	10	40
	Over	0	0
VO ₂ Max	Good	2	8
	Adequate	8	32
	Less	15	60

Table 2 shows that the majority of respondents aged between 13 and less than 18 years old as 14 people (56%), male as many as 17 people (68%), non-smoking as many as 22 people (88%), have a body fat percentage in the low category of 12 people (48%), have light physical activity 18 people (72%), have energy intake in the category of less than 15 people (60%) and have a VO₂Max value in the category of less than 15 people (60%).

The Relationship between Energy Intake and Body Fat Percentage with Cardiorespiratory Endurance

Bivariate analysis was conducted in this study to examine the relationships between body fat percentage, energy intake, and VO₂Max. The relationship between energy intake, body fat percentage, and cardiorespiratory endurance in wushu athletes at the Banjarnegara "Klub Fighter" is presented in Table 2.

Table 2. The Relationship between Energy Intake and Body Fat Percentage with Cardiorespiratory Endurance

Variable	VO ₂ Max	
	R	Sig (p)
% fat body	-0,811	0,000*

Energy intake	0,693	0,000*
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*Statistical test: Spearman Rank (significant if $p < 0.05$)

Table 3 shows a significant relationship between energy intake and VO2Max, with a p-value of 0.000 ($p < 0.05$), a correlation coefficient (r) of 0.693, and a positive direction of the relationship. In this study, the energy intake of most athletes fell into the low category, resulting in a VO2Max value that was also still suboptimal. This research aligns with the findings of Kuswari et al. (2019) in taekwondo athletes, who demonstrated a strong relationship between energy intake and VO2Max, characterized by a positive pattern. This means that the more the athlete's energy needs are met, the better their VO2Max values will be, and vice versa. Another study on pencak silat athletes also revealed a relationship between energy intake and physical freshness levels (Putri *et al.*, 2024).

A good athlete's physical condition can be achieved by maintaining a balanced diet. The fulfillment of energy intake results from the metabolism of carbohydrates, proteins, and fats in food and drinks. These substances are broken down into smaller units, such as glucose, lactic acid, and fatty acids, and then used by the body's cells (Putri *et al.*, 2024). Energy intake that is appropriate to the needs can help athletes obtain the energy needed to carry out high-intensity exercises (El Ghina *et al.*, 2023). If the athlete needs a significant energy expenditure but the energy intake is inadequate, then his cardiorespiratory endurance becomes suboptimal (Wulansari *et al.*, 2021).

Table 3 shows that there is a relationship between body fat percentage and VO2Max, where the magnitude of the significance (p) is 0.000 ($p < 0.05$), with a correlation value (r) of 0.811, and the direction of the relationship is negative. This means that the lower the percentage of body fat of an athlete, the better the cardiorespiratory endurance. These results are in line with the research of Mahmud *et al.* (2024) In pencak silat athletes, there is an inverse relationship between body fat percentage and VO2Max. Studies conducted on wushu *sanda* athletes also revealed that a decrease in body fat percentage can improve athletes' performance (Chathuranga & Perera, 2022).

In weight-first sports such as wushu, athletes can gain an advantage over their opponents by increasing muscle mass and reducing body fat, so that their performance increases (Chathuranga & Perera, 2022). The intake of energy and protein into nutrients that affect the increase and decrease in muscle mass (El Ghina *et al.*, 2023). A low body fat percentage helps athletes sustain high-intensity workouts where carbohydrates are the primary source of energy. If the rate of body fat is high, it will reduce the distribution of oxygen to the muscles, and the body will have difficulty coping with the increased demand for oxygen during exertion (Mahmud *et al.*, 2024).

Confounding Effects on the Relationship between Energy Intake and Body Fat Percentage with Cardiorespiratory Endurance

In multivariate analysis, the linear regression model of *the Enter method* is used to determine which variables are most suitable for measuring the dependent variables. The confounding effect on the relationship between energy intake, body fat percentage, and cardiorespiratory endurance can

also be observed in the results of this analysis. The results of the multivariate analysis are presented in Tables 3 and 4.

Table 3. Confounding Test

Variable	p-value	Initial Coefficient B	of Changes in Coefficient B			
			I	II	III	IV
Fat body percentage	0,069	-0,460	0,000	7,123	14,530	33,058
Energy intake	0,006*	0,429	0,000	0,000	0,000	0,000
Sex	0,387	0,165	1,147	3,078	12,653	Out
Age	0,646	0,082	0,000	64,545	Out	45,455
Physical activity	0,995	0,001	Out	Out	Out	Out
Smoking	0,658	-0,069	0,081	Out	70,793	11,893

*Statistical test: Linear Regression (significant if $p < 0.05$)

Table 3 shows that physical activity was the first variable to be excluded from the model because it had the highest p-value. There was no change in the B coefficient of more than 10% after the physical activity variable was excluded, so that physical activity was not a confounding variable. Furthermore, the variables that were issued consecutively were smoking, age, and gender. There was a change in the B coefficient of more than 10% for each variable, indicating that smoking, sex, and age were the confounding variables.

Table 5. Final Results of Regression Model

Variable	B Coefficient	t-test	p-value	F count	Sig	R Square
Fat body percentage	-0,460	-2,000	0,060			
Energy intake	0,429	3,225	0,004*			
Sex	0,165	0,929	0,365	14,745	0,000*	0,795
Age	0,082	0,484	0,634			
Smoking	-0,069	-0,463	0,649			

*Statistical test: Linear Regression (significant if $p < 0.05$)

Based on Table 5, the final regression model yields an F-test value of 14.754 with a significance level of 0.000. Because the significance value is 0.000 ($0.000 < 0.05$), all the independent variables included in the final regression model, namely body fat percentage, energy intake, gender, age, and smoking, collectively influence the VO₂ Max variable. Meanwhile, partially, if the p-value is less than 0.05 and T is greater than the T value in the table, then the variable is associated with VO₂Max. Only the energy intake variable has a p-value of less than 0.05 ($0.004 < 0.05$) with a calculated t-value of 3.225, which is greater than the T-value of Table 2.262. Thus, the variables of energy intake were partially related to VO₂ Max, while the variables of body fat percentage, gender, age, and smoking were not associated with VO₂Max. The value of the determination coefficient (R^2) was 0.795, or 79.5%, indicating that the energy intake variable accounts for 79.5% of the variation in VO₂Max. In contrast, the remaining 20.5% was influenced by other variables that were not included in this research model.

In contrast to the results of bivariate analysis, body fat percentage did not have a significant relationship with VO₂Max after controlling for confounding variables through multivariate analysis, as indicated by the value of sig. (p) 0.060 ($p > 0.05$). The research conducted by Wulansari *et al.* (2021) in taekwondo athletes revealed no relationship between body fat percentage and cardiorespiratory endurance. The absence of this relationship can be attributed to several other factors, including age, gender, physical activity, dietary intake, genetics, exercise, smoking, caffeine consumption, and a person's hemoglobin levels (Larasati & Yuliana, 2020).

In this study, the weakening of the relationship between body fat percentage and VO₂Max after controlling for confounding variables could be caused by several factors. First, cardiorespiratory endurance tends to be lower in women because women have lower muscle mass and higher body fat than men. (Kurniawan *et al.*, 2024). In this study, eight respondents (32%) were women, suggesting that gender may be a confounding factor influencing the relationship between body fat percentage and cardiorespiratory endurance.

Second, changes in body composition, such as increased body fat and decreased muscle mass, also occur with age (Shabrina *et al.*, 2022). Research conducted by Bimantara *et al.*, (2023) showed no relationship between body fat percentage and VO₂Max because adolescent boys aged 13-18 years experience changes in cardiac physiology so that cardiac output increases and blood provides more oxygen. In this study, 12 people (48%) were aged 18 years or older, a time when an increase in body fat mass can occur. Therefore, age can affect the relationship between body fat percentage and cardiorespiratory endurance.

Third, smoking can reduce the VO₂Max value due to the high carbon monoxide content in the lungs, so that the oxygen level in the blood decreases by 15% (Herdina *et al.*, 2019). Research conducted by Latifah *et al.* (2019) revealed that smoking has a significant and negatively correlated relationship with VO₂Max. In this study, the number of athletes who smoked was minimal at three

people (12%), so it was not representative enough to describe the effects of smoking in general, and the results did not have a significant association with VO₂Max.

In theory, high physical activity can increase cardiorespiratory endurance because the heart and lungs will adapt during exercise (Salamah *et al.*, 2019). Physical activity is negatively related to body fat, and good body fat can increase VO₂Max (Larasati & Yuliana, 2020). In this study, physical activity did not affect the relationship between energy intake and body fat percentage, nor did it impact athletes' VO₂Max. This is because most respondents fall into the category of light physical activity. Additionally, when recording physical activity data, athletes often estimate the duration of physical activity by relying on their memory. This can lead to estimation bias when completing the physical activity form.

CONCLUSIONS AND SUGGESTIONS

There is a relationship between energy intake, body fat percentage, and cardiorespiratory endurance in wushu athletes from "Klub Fighter" Banjarnegara. For athletes, it is essential to take regular measurements of their nutritional intake to obtain personalized recommendations for dietary needs that support optimal performance. For coaches, the results of this research analysis can serve as a reference for developing training programs to maintain the athlete's body fat percentage. For further research, other body composition measurements can be conducted and analyzed, one of which involves comparing different types of exercise.

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