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The Relationship Between Physical Activity Levels and Cardiorespiratory Fitness Among Cadet Medical Students in The Undergraduate Medical Program Cohort 4 at The Republic of Indonesia Defense University

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Abstract

Background: Physical activity plays a crucial role in maintaining cardiovascular and pulmonary health, especially for Cadet Medical Students who are required to achieve optimal physical fitness. However, it remains unclear whether the physical activity levels of Cadet Medical Students in the Undergraduate Medical Program Cohort 4 at the Republic of Indonesia Defense University meet the necessary fitness standards.
Objective: This study aims to analyze the relationship between physical activity levels and cardiorespiratory fitness among cadet students.
Methods: A quantitative cross-sectional design was employed, involving 72 respondents selected using a total sampling technique. Physical activity levels were assessed using the Bouchard Activity Diary, while cardiorespiratory fitness was evaluated through the 12-minute Cooper Test, which was converted into VO2max values.
Result and Analysis: The results showed that the majority of respondents had moderate (81.9%) and vigorous (18.1%) physical activity levels. The distribution of cardiorespiratory fitness indicated that 45.5% of male respondents had VO2max classified as excellent, whereas among female respondents, the majority (53.8%) fell into the good category. Spearman's correlation test revealed a significant positive relationship between physical activity levels and cardiorespiratory fitness ($r = 0.585$, $p < 0.001$). These findings indicate that higher physical activity levels are associated with better cardiorespiratory fitness. In conclusion, there is a significant correlation between physical activity levels and cardiorespiratory fitness among Cadet Medical Students in the Undergraduate Medical Program Cohort 4 at the Republic of Indonesia Defense University. These results highlight the importance of maintaining an optimal level of physical activity to improve cardiorespiratory.

Keywords: physical activity, cardiorespiratory fitness, VO2max, Cooper Test, cadet students.

Introductions

Cardiopulmonary fitness is one of the important indicators in assessing a person's physical health. It reflects the capacity of the cardiovascular and respiratory systems to support physical activity. Optimal cardiopulmonary fitness is associated with reduced risk of non-communicable diseases such as coronary heart disease, hypertension, and type 2 diabetes mellitus. In addition, good fitness also contributes to improving one's physical work capacity, endurance, and quality of life.[1,2]

Physical activity has a major role in improving cardiopulmonary fitness. The World Health Organization (WHO) recommends a minimum of 150 minutes per week of moderate-intensity or 75 minutes of high-intensity physical activity to maintain fitness.[3] However, various studies have shown that physical activity levels in the student population, especially in academically demanding environments such as medical students, tend to decrease (4). Lack of physical activity can reduce aerobic capacity, increase the risk of obesity, and contribute to a decline in cardiopulmonary health.[1] Student Cadets of the Bachelor of Medicine Study Program at the Defense University of the Republic of Indonesia (IDU) have unique challenges in maintaining

physical fitness. In addition to undergoing a solid academic curriculum, they are also involved in various military activities that demand high physical endurance. However, no study has specifically assessed the relationship between physical activity level and cardiopulmonary fitness in this group. Given the importance of physical fitness in supporting academic and military performance, understanding the relationship between physical activity and cardiopulmonary fitness in student cadets is highly relevant.

This study aims to analyze the relationship between physical activity level and cardiopulmonary fitness in cadet students of Bachelor of Medicine Cohort 4 of IDU. With this data, it is expected to provide an overview of the physical activity patterns of student cadets and the implications of their pulmonary heart health. In addition, the results of this study can also be used as a basis for developing policy recommendations or physical exercise programs that are more in line with the needs of student cadets.

Methods

This study used a cross-sectional design to evaluate the relationship between the level of physical activity and cardiopulmonary fitness in Student Cadets of the Bachelor of Medicine Study Program Cohort 4 of the Republic of Indonesia Defense University. The sample amounted to 75 people, selected by the total sampling method, with inclusion criteria including student cadets aged 18-22 years, healthy based on medical examination, and willing to participate in the study. Exclusion criteria included a history of cardiovascular or pulmonary disease, injuries that limit physical activity, and incomplete data. Physical activity level was measured using the Bouchard Activity Diary for 3 consecutive days, which was then categorized as low (<600 MET minutes/week), moderate (600-3000 MET minutes/week), and high (>3000 MET minutes/week). Cardiopulmonary fitness was assessed through the 12-Minute Run Test (Cooper Test), the results of which were converted into VO2max values (mL/kg/min) using the formula VO2max = (Distance traveled in meters - 504.9) / 44.73, with classification based on fitness categories. Data were analyzed using SPSS, including descriptive analysis for respondent characteristics and Spearman correlation test to assess the relationship between physical activity level and cardiopulmonary fitness (5). This study was approved by the Ethics Committee of the Faculty of Medicine and Health Sciences of the Indonesia Defense University, and all respondents gave written informed consent before participating in the study.

Results and Discussion

This study involved 75 student cadets, but there was 1 person who did not meet the inclusion criteria and 2 people dropped out because they did not take the 12 Minute Run Test (Cooper Test). Thus, the number of respondents analyzed was 72 people. The characteristics of the research subjects showed that the age range of respondents was 18-20 years, with an average age of 19 years.

The Metabolic Equivalent Task (MET) distribution shows that there is a difference between men and women in the level of energy expenditure during daily physical activity. Male respondents tended to have higher energy expenditure than females, which may contribute to their aerobic capacity.

Table 1. Distribution of MET Data by Gender

Metabolic Equivalent Task (MET minutes/week)			
Statistics	Male (n=33)	Female (n=39)	Total (n=72)
Mean	2565,7	2605,5	2629,0
Standar Deviasi	276,3	257,0	265,3
Median	2573	2538	2564,5
Minimum	2240	2147,5	2147,5
Maximum	3187,5	3187,5	3187,5

Physical activity levels categorized by the Bouchard Activity Diary showed that most student cadets met the criteria for moderate to vigorous physical activity, reflecting the physical demands of their academic and military activities.

The results of the 12-Minute Run Test (Cooper Test) showed that 45.5% of male respondents had VO2max in the excellent category, while 53.8% of female respondents were in the good category. The average VO2max was higher in the male group than the female, which was likely influenced by physiological differences such as muscle mass and greater oxygen transportation capacity in men.

The VO2max distribution results further showed that only a small proportion of respondents fell into the low fitness category. This finding indicates that the majority of student cadets have good to excellent cardiopulmonary fitness, which can be attributed to their fairly high physical activity patterns.

Table 2. Data Distribution of VO_2MAX Level Differentiated by Gender Gender Variables Number

Gender	Variables	Number (n)	Percentage (%)
Male	Very bad	-	-
	Bad	-	-
	Simply	3	9
	Good	15	45,5
	Very Good	15	45,5
	Total	33	100
Female	Very bad	-	-
	Bad	3	7,7
	Simply	10	25,7
	Good	21	53,8
	Very Good	5	12,8
	Total	39	100

Spearman correlation test was conducted to determine the relationship between physical activity level and cardiopulmonary fitness. The results showed a positive and significant relationship between the two variables ($r = 0.585$, $p < 0.001$), meaning that the higher a person's physical activity level, the better their cardiopulmonary fitness.

Table 3. Spearman Correlation Test Results

			Bouchard Classification	VO_2MAX Classification
Spearman's rho	Bouchard Classification	Correlation Coefficient	1.000	.585**
		Sig. (2-tailed)		.000
		N	72	72
	VO_2MAX Classification	Correlation Coefficient	.585*	1000
		Sig. (2-tailed)	.000	
		N	72	72

Relationship between Physical Activity and Pulmonary Heart FItness

The results of this study indicate that there is a significant positive relationship between physical activity level and cardiopulmonary fitness. The higher a person's physical activity level, the better their cardiopulmonary fitness, as indicated by higher VO2max values. This finding is in line with previous research which shows that physical activity plays a role in increasing aerobic capacity, improving the efficiency of the cardiovascular system, and increasing the body's resistance to strenuous activity.[6] Adequate physical activity can increase the heart's shock volume, improve oxygen circulation, and increase the efficiency of the lungs in gas exchange. In addition, regular physical activity can increase the contractility of the heart muscle, lower blood pressure, and accelerate recovery after strenuous.[7]

The better improvement of VO2max in individuals with high physical activity suggests that aerobic exercise performed regularly can improve the body's ability to supply oxygen to tissues during physical activity. The main factors that play a role in improving aerobic capacity include physiological adaptations in the cardiovascular and respiratory systems, including increased cardiac output, blood volume, and capillary density in skeletal muscle.[8]

Heart-Lung Fitness Differences Based on Gender

The findings of this study indicate that there are differences in cardiopulmonary fitness between men and women. The average VO2max of men was higher than that of women, with the majority of men in the very good category, while the majority of women were in the good category. This difference can be explained by physiological factors, where men have greater muscle mass, higher hemoglobin levels, and better oxygen transportation capacity than women. The greater muscle mass in males allows for more efficient utilization of oxygen during physical activity, thus improving aerobic performance.[9]

In addition to muscle and hemoglobin, hormonal factors also influence this difference. The higher testosterone hormone in men plays a role in increasing muscle protein synthesis, increasing red blood cell production, and increasing muscle oxidative capacity. In contrast, the estrogen hormone in women is more involved in body fat storage, which may affect metabolic efficiency during physical activity.[10]

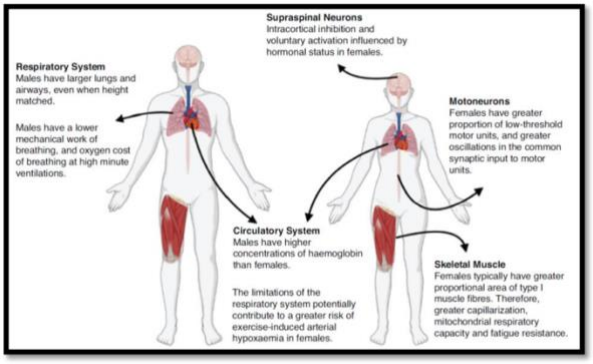

Image 1. Physiological Differences between Men and Women

This difference is in line with other studies showing that the difference in VO2max between men and women can reach 10-20%, even when exercise habits and lifestyle factors are controlled. Nonetheless, it is important to note that with proper and regular exercise, women can still achieve optimal cardiopulmonary fitness and have good physiological adaptation to physical activity.[11]

Interpretation of Correlation Test Results

The Spearman correlation test results showed that the relationship between physical activity level and cardiopulmonary fitness was moderate to strong ($r = 0.585$, $p < 0.001$). This correlation value indicates that although physical activity has an important role in cardiopulmonary fitness, there are other factors that also contribute to a person's VO2max value. These factors include genetics, diet, rest duration, and frequency and intensity of physical exercise. Although most student cadets have high physical activity, there

are individuals with moderately high physical activity but have VO2max that is lower than the optimal standard. This indicates that the effectiveness of physical activity can differ between individuals, depending on the intensity, duration and type of exercise performed. Aerobic exercise performed over a long duration with moderate to high intensity tends to be more effective in increasing VO2max than exercise with a less regular pattern.[12]

This study confirms the importance of consistency in physical training to achieve optimal cardiopulmonary fitness. Therefore, interventions in the form of more structured exercise programs are needed to improve the pulmonary heart fitness of student cadets, especially by considering individual variations in response to physical exercise. In addition, a holistic approach that includes adequate nutrition, good sleep patterns, and stress management should also be considered to support the improvement of overall cardiopulmonary fitness.

Conclusion

This study demonstrates a significant positive correlation between physical activity level and cardiorespiratory fitness among cadet medical students ($r = 0.585$, $p < 0.001$). Higher physical activity levels are associated with higher VO2max values. Male cadets showed better cardiorespiratory fitness than females, likely due to physiological differences. These findings emphasize the importance of maintaining adequate and consistent physical activity to optimize cardiorespiratory fitness.

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Author Contributions

All authors act as the guarantor of the manuscript. JIHM is the main investigator of this study. GJC, RSPF, MW, NP participated in the conception, data acquisition, data interpretation, and writing of the study. DC, HZFF and AR participated in data analysis and statistical analysis of the study.

Conflict of Interest

None.

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