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PHYSICAL ACTIVITY AND SMOKING HABITS ARE CLOSELY RELATED TO CARDIOVASCULAR ENDURANCE IN FARMERS

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ABSTRACT

In 2019, there were 523 million cases of cardiovascular disease which caused the deaths of 18.6 million people. In this manner, some major issue should be considered, high cardiovascular endurance, for example. Relatively, high cardiovascular endurance can reduce the incidence of cardiovascular disease by 40% to 70%. Objective to nalyzing the relationship between physical activity and smoking habits among farmers in Pandan Wangi Village. The method used is quantitative research with cross-sectional design involving 108 respondents. The respondents were selected by a simple random sampling technique. Data in this study were collected using GPAQ for physical activity variables, Brinkman index questionnaire for smoking variables, and Harvard step test for cardiovascular endurance variables. Meanwhile, Spearman rank test was used in the data analysis. The research shows that the characteristics of respondents were dominated by male (64.8%) within 36-45 years old age range group (52.8%). In addition, most of the respondents were non-smoker category (62.0%), had a high level of physical activity (52.8%), and a very good level of cardiovascular endurance (27.8%). Bivariate analysis shows that there is a significant relationship between physical activity (p-value = 0.005) and smoking behavior (p-value = 0.047) on cardiovascular endurance among farmers in Pandan Wangi Village. There is a significant relationship between physical activity and smoking habits on cardiovascular endurance among farmers in Pandan Wangi Village.

Keywords: cardiovascular endurance; physical activity; smoking habits

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INTRODUCTION

Cardiovascular disease is a non-communicable disease that causes the highest number of deaths in the world (Jumayanti et al., 2020). Global Burden of Cardiovascular Disease (2020) states that the incidence of cardiovascular disease in 2019 was 523 million cases which cause the death of 18.6 million people (Roth et al., 2020). High cardiovascular endurance can reduce the incidence of cardiovascular disease relatively by 40% to 70% (Tim Grove Kingdom United, 2019). Cardiovascular endurance is influenced by high physical activity since it can improve heart function and circulation, lung function, blood, the body's defense system, neuromuscular performance and stimulate bone development (Febriyanti et al., 2017). Moreover, cardiovascular endurance is also influenced by smoking habits which cause the decrease of cardiovascular endurance affected by carbon monoxide (CO) and nicotine in cigarette (Faza et al., 2019; Yusan et al., 2021).

Several studies show a significant relationship between physical activity and smoking habits on cardiovascular endurance. As stated by Saputra et al (2022) that there is a relationship between physical activity and cardiovascular endurance (Saputra et al., 2022). At the same time, a research conducted by Faza et al (2019) illustrates that there are differences between smokers who actively exercise and non-smokers who actively exercise (Faza et al., 2019). On the contrary, a number of studies show the opposite results including a research conducted by Pratiwi et al (2022) demonstrates that there is no relationship between physical activity and cardiovascular endurance (Pratiwi et al., 2022). Moreover, Indahsari (2017) in her research stated that there was no relationship between smoking habits and cardiovascular endurance (Indahsari, 2017).

Farming is a job that requires high physical activity since it involves intense muscle movement and requires work duration of six to seven hours a day. Thus, farmers' cardiovascular endurance to tend to be high (Handayani et al., 2021). Based on Riset Kesehatan Dasar (2018) data, in terms of physical activity proportion, farmers outranked any other occupation at 84.25% (Indonesian Ministry of Health, 2018). Albeit that advantages, farmers – generally – tend to have a smoking habit which may reduce cardiovascular endurance (Faza et al., 2019). Riset Kesehatan Dasar (2018) shows that, based on occupation, farmers placed first for smokers accounted for 61.32% (Ministry of Health, 2018). Therefore, this study aimed to a analyze the relationship between physical activity and smoking habits on cardiovascular endurance among farmers in Pandan Wangi Village.

METHOD

The research is observational analytical research with cross sectional research design conducted in December 2023 in Pandan Wangi Village, Jerowaru District, Kabupaten Lombok Timur (East Lombok Regency). The population of the study was 4.717 farmers selected by simple random sampling who met the inclusion criteria. Accordingly, the sample of this study were 108 people. The inclusion criteria in this study were residents of Pandan Wangi Village who work as agricultural laborers, aged ≤ 45 years, and willing to participate as research respondent by signing research informed consent form. Meanwhile, the exclusion criteria in the study were agricultural workers who had a history of asthma, chronic obstructive pulmonary disease (COPD), coronary heart disease (CHD), musculoskeletal disease, and were sick. Physical activity variable data was collected using the Global Physical Activity Questionnaire (GPAQ) from the World Health Organization (WHO). Brinkman index was used to collect data on smoking habit variables. Meanwhile as for cardiovascular endurance, Harvard step test was used. Furthermore, for the data analysis, this study employed Spearman rank statistical test. The research was approved by Ethics Commission of the Faculty of Medicine, Al-Azhar Islamic University of Mataram No.181/EC-01/FK-06/UNIZAR/XI/2023.

RESULTS

Table 1 shows that from the 108 respondents, the largest age group was between 36 – 45 years old for 52,8%, and the dominant gender was male with 70 respondents (64.8%). In terms of physical activity, 52.8 % of the respondents had high physical activity (57 respondents). Furthermore, most of the respondents BMI was in the normal category accounted for 34 respondents (31.5%). Additionally, the majority of the respondents in this study were categorized as non-smokers, 67 in total (62%). Lastly, the table above also shows that the cardiovascular endurance of the respondents was mostly in the very good category, amounted to 30 respondents (27.8%).

Table 1.
Respondent Characteristics

Characteristics	f	%
Age		
15-25 y.o	13	12,0
26-35 y.o	38	35,2
36-45 y.o	57	52,8
Gender		
Female	38	35,2
Male	70	64,8
Physical Activity		
Low	33	30,6
Moderate	18	16,7
High	57	52,8
Smoking Habit		
Heavy smokers	15	13,9
Moderate smokers	11	10,2
Light smokers	15	13,9
Non-smokers	67	62,0
Cardiovascular Endurance		
Very low	19	17,6
Low	17	15,7
Moderate	18	16,7
Good	24	22,2
Very good	30	27,8

Table 2.
Cross tabulation of the relationship between physical activity and cardiovascular endurance

Physical activity	Cardiovascular Endurance												p value	rs
	Very low		Low		Moderate		Good		Very good		Total			
	f	%	f	%	f	%	f	%	f	%	f	%		
Low	9	8,3	8	7,4	4	3,7	5	4,6	7	6,5	33	30,6		
Moderate	3	2,8	5	4,6	2	1,9	6	5,6	2	1,9	18	16,7	0,005	0,268
High	7	6,5	4	3,7	12	11,1	13	12,0	21	19,4	57	52,8		

The results of the analysis of the relationship between physical activity and cardiovascular endurance in table 2 show that most of the respondents who had high physical activity had very good cardiovascular endurance, accounted for 21 respondents. The results of the Spearman Rank statistical test obtained a p-value of 0.005 (p-value <0.05) which shows that there is a significant relationship between physical activity and cardiovascular endurance in farmers in Pandan Wangi Village. Relationship strength displayed by the correlation coefficient value of 0.268. In other words, physical activity and cardiovascular endurance have a moderate level of relationship with a positive correlation. Particularly, the higher the physical activity, the higher the cardiovascular endurance will be.

The analysis of the correlation between smoking habits and cardiovascular endurance in table 4 demonstrates that most of the non-smoking respondents had excellent cardiovascular endurance, amounted to 24 respondents. The Spearman Rank statistical test obtained a p-value of 0.047 (p-value <0.05) which shows that there is a significant relationship between smoking habits and cardiovascular endurance in farmers in Pandan Wangi Village. In terms of the strength of relationship, correlation coefficient value of -0.192 shows that smoking habits and cardiovascular endurance have insignificant correlation with a negative relationship. This implies that someone who has a smoking habit will have lower cardiovascular endurance.

Table 4
Cross tabulation of the correlation between smoking habits and cardiovascular endurance

Smoking habit	Cardiovascular Endurance												p value	rs
	Very low		Low		Moderate		Good		Very good		Total			
	n	%	n	%	n	%	n	%	n	%	n	%		
Heavy smokers	5	4,6	5	4,6	4	3,7	0	0,0	1	0,9	15	13,9	0,047	-0,192
Moderate smokers	1	0,9	1	0,9	5	4,6	2	1,9	2	1,9	11	10,2		
Light smokers	0	0,0	0	0,0	4	3,7	8	7,4	3	2,8	15	13,9		
Non-smokers	13	12,0	11	10,2	5	4,6	14	13,0	24	22,2	67	62,0		

The analysis of the correlation between smoking habits and cardiovascular endurance in table 4 demonstrates that most of the non-smoking respondents had excellent cardiovascular endurance, amounted to 24 respondents. The Spearman Rank statistical test obtained a p-value of 0.047 (p-value <0.05) which shows that there is a significant relationship between smoking habits and cardiovascular endurance in farmers in Pandan Wangi Village. In terms of the strength of relationship, correlation coefficient value of -0.192 shows that smoking habits and cardiovascular endurance have insignificant correlation with a negative relationship. This implies that someone who has a smoking habit will have lower cardiovascular endurance.

DISCUSSION

In this study, physical activity in Pandan Wangi Village farmers was measured using the Global Physical Activity Questionnaire (GPAQ) and obtained the most physical activity category which is high physical activity as many as 57 farmers. Farmers with high physical activity mostly have excellent cardiovascular endurance, accounted 21 respondents. The opposite is true for farmers with low physical activity as many as 33 respondents mostly have low cardiovascular endurance, accounted for 9 respondents. The study found that physical activity and cardiovascular endurance showed a significant correlation. Farmers' activity in Pandan Wangi Village play important role for such result. The farmers mostly carried out relatively high levels of physical activity when working, such as hoeing, shoveling, adding water, and carrying heavy loads on their backs. Apart from that, the farmers also prefer to walk to the field instead of using vehicle.

Farmers' high physical activity can increase stroke volume and cardiac output in each beat and reduce the frequency of beats. Therefore, the activity causes improved heart's work efficiency (Dewi et al., 2022). The efficiency of cardiac work increases due to increased contractility of the heart muscle, and increased interaction of contractile elements of heart muscle cells due to increased availability of extracellular calcium (Ca^{2+}) and ATPase enzyme activity. This increase in Ca^{2+} availability occurs through two mechanisms, the first is an increase in mitochondrial affinity for Ca^{2+} ions and an increase in Ca^{2+} inflow and the second mechanism is an increase in the amount of mitochondrial Ca^{2+} which affects the oxidation phosphorylation mechanism. The oxidation phosphorylation mechanism causes an increase in ATP so that as a result O_2 consumption will increase. In addition to increased metabolism, doing high physical activity regularly also causes thickening of the heart muscle caused by the physical activity. When performing high physical activity regularly, the body will experience a decrease in sympathetic tone and an increase in parasympathetic tone, which in turn will result in a decrease in heart rate frequency. The shock volume will also increase and lead to an increase in cardiac output. An increase in the volume of the bud will also lead to a larger end-diastolic volume which means that as the heart relaxes and replenishes blood, more blood is filled into the coronary blood vessels. This can increase cardiovascular endurance to pump blood and supply oxygen to the rest of the body (Nurhayati et al., 2019).

In addition to affecting the heart, high physical activity also causes the ability of lung inspiration to be maximized due to the ability of the lungs to expand more optimally accompanied by the ability of the

respiratory muscles to overcome maximum air resistance. High physical activity also causes an increase in the surface area of the alveolus where the O_2 diffusion process occurs to the pulmonary capillaries, as well as the amount of active microcirculation around the alveolus. This gas exchange from the alveolus to the pulmonary capillaries and the large surface area of the alveoli are also factors that contribute to improving cardiovascular endurance (Juniari et al., 2020). Muscle capillaries will also increase in quantity, so the amount of oxygen transported will be more and oxygen diffusion in the muscles is easier than someone who does not perform physical activity (Saputra et al., 2022).

Most of the farmers in this study were non-smokers, amounted to 67 respondents. Table 4 shows that non-smoking farmers mostly have excellent cardiovascular endurance, as many as 24 respondents. In contrast to farmers who are heavy smokers measured using the Brinkman Index instrument, most of them have cardiovascular endurance in the low and very low categories, accounted the same number of 5 respondents. Table 4 demonstrates that there is a significant relationship between smoking habits and cardiovascular endurance. Smoking habits can cause longer heart rate recovery which indicates a decrease of cardiovascular ability in supplying and transporting blood with sufficient oxygen during high physical activity. The problem caused by carbon monoxide in cigarettes. Carbon monoxide affinity level in cigarettes is 200-300 greater than oxygen in its ability to bind to receptors on hemoglobin (Hb) so that hemoglobin that binds to oxygen reduced. Therefore, chemoreceptors and baroreceptors will detect the reduced amount of oxygen in the blood vessels and then send impulses to the central nervous system and the body will respond to an increase of pulse rate. The high pulse response lasts longer resulting in the Heart Rate Recovery per minute will be longer to return to normal. This will certainly cause a decrease in cardiovascular endurance due to of overwork (Yusan et al., 2021).

In addition, carbon monoxide that binds to hemoglobin reduces the amount of oxygen delivered to muscles and other body tissues and promotes faster anaerobic metabolism during physical activity. Anaerobic metabolism produces lactic acid which can cause muscle fatigue. To compensate for the lack of oxygen, the heart will also work harder to pump blood in order to deliver oxygen to body tissues. Smoking also causes damage to the vascular endothelium and increases inflammation, which can lead to cardiovascular dysfunction and vascular thrombosis, thus reducing a person's cardiovascular endurance (Rabbani et al., 2022). Apart from CO, nicotine in cigarettes also cause the decrease of cardiovascular endurance. Nicotine can cause calcification in the respiratory tract. As a result of this, the ability of the alveoli to absorb oxygen is reduced so that less oxygen is absorbed and affects the work of the muscles. Nicotine also stimulates sympathetic nerve activity through the release of epinephrine in the adrenal glands and cardiac center in the central nervous system. Thus, epinephrine will increase the activity of cardiac pacemaker cells in the sinoatrial (SA) node, contractions and heart rate, causing the heart to work longer resulted in reducing cardiovascular endurance (Pramesti et al., 2023).

CONCLUSION

The result of the study concludes that there is a significant relationship between physical activity and cardiovascular endurance with a p-value of 0.005 (<0.05) and a correlation coefficient of 0.268. It shows a moderate and unidirectional relationship. Additionally, there is a significant relationship between smoking habits and cardiovascular endurance with a p-value of 0.047 (<0.05) and with a correlation coefficient of -0.192 which shows a very weak unidirectional relationship.

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