

The Relationship between Maximum Oxygen Volume and Short Term Memory in Students of the Faculty of Sports Science, Medan State University

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ABSTRACT

Short term memory is a storage system for holding small amounts of information with a duration of 15-30 seconds for about 7 things. Regular exercise can increase a person's VO₂max value. A good VO₂max will cause an increase in the hormones BDNF, IGF-1 and FGF. The increase in these hormones can increase the stimulation of neurogenesis in the dentate gyrus of the hippocampus and in the subventricular zone of the lateral ventricles so as to produce good short-term memory function as well. This study aims to determine the relationship between VO₂max and short-term memory in students of the Faculty of Sports Science, Medan State University. This research is an observational analytic study with a cross sectional design. The population of this study were students of the Faculty of Sports Science, Medan State University. The sample in this study were 40 students selected by purposive sampling technique. VO₂max was measured using the 12 minute Cooper Test and short term memory was measured using the Digit Symbol Substitution Test. Data analysis in this study used Fisher's test and found that there was no relationship between VO₂max and short-term memory in students of the Faculty of Sports Science at Medan State University with $p = 0.723$. There is no relationship between VO₂max and short-term memory in students of the Faculty of Sports Science, Medan State University.

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1. INTRODUCTION

Memory (memory) is one of the most important noble functions because it is the basis for most other noble functions¹. Memory allows one to store and recall experiences to be recalled when needed.^{2,3,4} One type of memory is short term memory. Short term memory holds small amounts of information temporarily with a duration of 15-30 seconds for 7 items. Information in short-term memory is generated due to attention to sensory memory.^{4,5} Physiologists think that short-term memory is caused by continuous neural activity, which is the result of nerve signals traveling around a temporary memory trace in a circuit of reverberating neurons.⁶

Memory decline will give negative impact on the physical, psychological, economic and quality of life (unproductive at work, a burden on the family and society).⁷ Over time, memory loss will develop into dementia.⁸ Dementia is a symptom characterized by a decline in memory, the ability to think and the ability to carry out daily activities. According to the World Health Organization (WHO), around 47 million people in the world have dementia and there are 9.9 million new cases each year.⁷ Several previous studies have stated that memory loss is also present in depression⁹, not enough sleep¹⁰, and Alzheimer's disease.¹¹

Many things can reduce the risk of memory loss, one of which is regular physical activity, namely sports. Regular exercise done 3-5 times a week for 13 weeks can increase a person's VO₂max. VO₂max is maximal rate of oxygen use in aerobic metabolism.⁶

Recent research results have found that exercise can improve memory function and cognitive function. Christine et al conducted a study on young women and found that VO₂max affected short-term memory after rest (recovery).¹² According to research by Marc Roig et al in 2013 aerobic exercise has an effect on short-term memory.¹³ Another study conducted by Lin li et al in 2014 stated that acute

The Relationship between Maximum Oxygen Volume and Short Term Memory in Students of the Faculty of Sports Science, Medan State University. David Simangunsong

aerobic exercise can improve cognitive function assessed from a behavioral and neuroelectrical (MRI) perspective.¹⁴In 2015 Arcita Hanjani also conducted research which showed that the group that did regular aerobic exercise had better short-term memory scores than the group that did not do regular aerobic exercise.¹⁵Iswaran Ampalakan in 2016 also stated that there was a relationship between VO₂max (cardiopulmonary fitness) and short-term memory.¹⁶

Several other studies have obtained different results from the findings of the researchers mentioned above, where there is no significant relationship between exercise and memory. The results of research by Kathryn et al in California stated that exercise does not change short-term memory function. Research conducted by Kristen Hotting et al in 2016 stated that there was no change in memory in participants who did cardiovascular exercise with higher intensity and there was a decrease in memory in participants who did exercise with lower intensity.¹⁷Research by Jessica Hotter et al in 2013 stated that there was a significant decrease in short-term memory in the aerobic exercise group.¹⁸Based on some of the things above, researchers are interested in seeing how the relationship between VO₂max and students' short-term memory Faculty of Sports Science, Medan State University.

2. METHODS

This study uses the type of research observational analytic with a cross-sectional approach (cross-sectional study). This research was conducted from September to December 2018. The target population in this study was university students at Medan State University (UNIMED). The reachable population of this study were students of the UNIMED Faculty of Sports Science majoring in Sports Coaching Education (PKO). The sample size in this study was 40 people who met the inclusion and exclusion criteria. The sample size in this study was calculated based on the categorical analytic formula. Univariate analysis by assessing the value of VO₂max and short term memory function is presented in the form of a frequency distribution. Bivariate analysis assessing the relationship between VO₂max and short-term memory in students of the Faculty of Sports Science UNIMED majoring in PKO was carried out using Chi square test analysis. If it does not meet the requirements, Fisher's test is carried out.

3. RESULTS AND DISCUSSION

Description of the Maximum Oxygen Volume of FIK UNIMED Students in the PKO Department

VO₂ max measurement in this study was measured by doing a 12-minute Cooper Test. VO₂max value <44 is a bad category and ≥44 is a good category. In table 1 it can be seen that FIK UNIMED students majoring in PKO have more VO₂max which is not good (72.5%).

Table 1. Description of Maximum Oxygen Volume

Maximum Oxygen Volume	Frequency (n)	Percentage (%)
Good	11	27.5
Not good	29	72.5
Total	40	100

Description of Short Term Memory Functions of FIK UNIMED Students, PKO Department

Short-term memory function in this study was measured using the Digit Symbol Substitution Test (DSST). DSST value <49 is a bad category and ≥49 is a good category. In table 2 it can be seen that students of FIK UNIMED majoring in PKO have more good short term memory (55%).

Table 2. Short Term Memory Description

Short Term Memory	Frequency (n)	Percentage (%)
Good	22	55
Not good	18	45
Total	40	100

Relationship between VO₂max and Short Term Memory

This study aims to see the relationship between VO₂max and short-term memory using the Chi square test. In the Chi square test, more than 25% of the cells had an expected value of less than 5, so

The Relationship between Maximum Oxygen Volume and Short Term Memory in Students of the Faculty of Sports Science, Medan State University. David Simangunsong

the researchers used Fisher's test to determine the relationship between the variables in this study. Table 3 below shows 7 people (17.5%) FIK UNIMED students majoring in PKO who have good VO₂max have good short term memory and there are 14 people (35%) FIK UNIMED students who have bad VO₂max have bad short term memory . Based on Fisher's test, there is no relationship between VO₂max and short-term memory. (p=0.723)

Table 3 Relationship between VO₂max and Short Term Memory

		Short Term Memory				Total		<i>p.s</i>
		Good		Not good		N	%	
VO ₂ max	Good	n	%	n	%	11	27.5	0.723
	Not good	7	17.5	4	10	29	72.5	
	Total	15	37.5	14	35	40	100	

*Fisher's test

Discussion

VO₂ max in the study was divided into two categories, namely good and bad. Table 1 shows that students of FIK UNIMED majoring in PKO have more VO₂max which is not good, namely 29 people (72.5%). In the 12-minute Cooper Test treatment in this study, respondents were ordered to run as fast as possible. Respondents ran without knowing whether they had used their maximum abilities in running because there were no running speed requirements that had to be taken in the 12-minute Cooper Test. This causes respondents to tend to be slower when running so that the distance traveled is shorter which results in the resulting VO₂max value tends to be lower.

The results of research conducted by Syantica Putra showed that the 12-minute Cooper Test had the lowest average VO₂max value compared to other tests. According to Syantica, people who do this test must have high motivation in taking the test because the results of this test depend on the person's motivation. 19

Short-term memory in this study was divided into two categories, namely good and bad. Table 2 shows that students of FIK UNIMED majoring in PKO have more good short-term memory, namely 22 people (55%). Respondents in this study had a high frequency of sports which can be seen through the lecture schedules of FIK UNIMED students majoring in PKO. Regular exercise can affect cognitive function by increasing blood flow to the brain which causes an increase in oxygen saturation, and this increase occurs in brain neurotransmitters that facilitate information processing and regulation of neurotrophins such as Brain Derived Neurotrophic Factor (BDNF). 20 Excessive BDNF release will increase the process of neurogenesis in brain areas such as the dentate gyrus, subventricular zone and hippocampus. This has a good effect on memory function. 21,22 Respondents of this study also had minimal stress and minimal drug use which was known through a questionnaire given to respondents. Under stressful conditions, the hypothalamus will release the hormones Corticotrophin Releasing Hormone (CRH) and Releasing Hormone (RH). The release of this hormone will stimulate the pituitary gland to release cortisol through the adrenal glands. An increase in the hormone cortisol will suppress synapse plasticity which interferes with memory function, conversely a low cortisol hormone level causes memory function to tend to be better. 23,24 The use of certain drugs can also impair memory function. One of these drugs is the anticholinergic group. Anticholinergics inhibit acetylcholine and neurotransmitters which play a role in the process of learning and remembering. 25,26 In addition, respondents are in the age group that tends to have good vascularization of nerve cells and brain structure. Therefore, in this study most of the respondents had good short-term memory function which can be seen in good DSST values. 27

In this study, based on Fisher's test, there was no relationship between VO₂max and short-term memory (p=0.723). The results of Kathryn et al's research in California are in line with this study which states that exercise does not change short-term memory function. Factors such as the small number of respondents, non-homogeneous gender, and not measuring BDNF serum resulted in an unrelated VO₂max with short-term memory.¹⁸

The results of this study are not in line with research conducted by Iswaran Ampalakan at Padjadjaran University which states that VO₂max is related to short-term memory, where good VO₂max produces good short-term memory, and vice versa. In Iswaran's study, respondents were grouped by gender (male and female), then VO₂max was measured using the Harvard Step Test and the VO₂max value was determined based on *The Astrand Ryhming Nomogram*. After that, short-term memory function was measured using the Digit Span Test. Most of the VO₂max values in the male group were in the high category with an average of 50.4 and short-term memory values in the male group were mostly in the good category with an average of 7.9. 15 According to Jessica Hotter et al, the relationship between VO₂max with short-term memory can be identified by measuring serum BDNF. BDNF serum levels will increase in someone who regularly exercises (with a VO₂max which tends to be better).

4. CONCLUSION

From the results of the research on the relationship between VO₂max and short-term memory in FIK UNIMED students, it was concluded that FIK UNIMED students majoring in PKO had more bad VO₂max (72.5%), FIK UNIMED students majoring in PKO had more good short-term memory (55 %) and there is no relationship between VO₂max and short term memory. (p=0.723)

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The Relationship between Maximum Oxygen Volume and Short Term Memory in Students of the Faculty of Sports Science, Medan State University. David Simangunsong

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