

Relationship between cardiovascular fitness and academic achievement among medical students of Udayana University in batch 2018



Dashinnie Narasimhanaidu,^{1*} I Nyoman Gede Wardana,²
I Nyoman Mangku Karmaya²

ABSTRACT

Background: Physical fitness especially cardiovascular fitness is one of the important factors in medical students' academic achievement which has been neglected by majority of the students. Through cardiovascular fitness the stress level could be reduced which will eventually help the students to achieve better academic results.

Aim: This study aims to determine the relationship between the cardiovascular fitness and academic achievements by medical students of Medical Faculty of Universitas Udayana from batch 2018.

Method: An experimental survey method has been used identify the relationship between cardiovascular fitness level and academic achievement. Respondents who attended this study were 79 students from the batch 2018. The cardiovascular fitness level will be measured

by Fartlek training which is conducted in medical faculty campus parking area. The students' academic achievement will be measured through their 1st biomedic exam results. Then, the pulse rate collected from the Fartlek training and the academic achievement from exam was compared to identify the relationship the cardiovascular fitness and academic achievement.

Results: The data was not normally distributed from the normality test. Spearman's rho test shows that the data is not significant with the ($p = -0.056$).

Conclusion: There was no significant relationship between the level of cardiovascular fitness and the academic achievement of the medical students.

Keywords: Cardiovascular fitness, academic achievement, pulse rate, Biomedic

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INTRODUCTION

Medicine is one of the longest and most stressful courses of undergraduate study program. It is a complex and demanding field of study and medical undergraduates not only require skill and competence in multiple disciplines, they also need to acquire knowledge on a wide-range of subjects over a limited time period.¹ Lately, weak academic performance and high failure rate was identity among several medical schools. Detention in any subject due to low attendance or failing before attaining final medical degree provides extra burden on the students as well as on the parents. Poor academic performance and poor attendance often indicates difficulties in adjusting to new environment.²

Medical students' academic performance plays a vital role in creating the finest quality alumnae. Therefore it is crucial for identifying the factors that influence academic performance among students can assist in reducing the failure rate in medical students. The academic performance of the students' has gained significant attention in past researches. Multiple factors are known to affect learning and academic performance, including personality, IQ

(Intelligence Quotient), family background, gender, age, learning styles, methods of study, parental and peer pressure and even psychological ailments.

The important factor which influences medical student's academic performance that much neglected is physical fitness. According most of the students they find physical fitness as a waste of time. The main reason to this is they fail to understand the important role physical fitness plays in a human's life including their academic achievements. Physical fitness is defined as any bodily movement produced by skeletal muscles that result in energy expenditure. It is the ability to perform moderate-to-vigorous levels of physical activity without undue fatigue and the capability of maintaining this capacity throughout life. The term "physical fitness" should not be mistaken with "exercise".⁵

Exercise, is a subcategory of physical activity that is planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective.⁶ Physical activity includes exercise as well as other activities which involve bodily movement and are done as part of playing, working, active

¹Undergraduate Medical Study Programme, Faculty of Medicine, Universitas Udayana

²Department of Anatomy, Faculty of Medicine, Universitas Udayana

*Correspondence to:
Dashinnie Narasimhanaidu,
Undergraduate Medical Study
Programme, Faculty of Medicine,
Universitas Udayana
mienargles@gmail.com

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transportation, house chores and recreational activities.⁷ Physical activity can be divided into two categories: health-related fitness and performance-related fitness. The general public focuses on health-related fitness, which is the amount of physical training required to reduce the risk of disease or injury. Military members focus on performance related fitness, which is the amount of physical training required to achieve a physical goal, such as climbing a mountain or manoeuvre chinks and chains on an aircraft carrier.⁸

Physical fitness training can be split into four major components allowing for the diversity of training necessary to accomplish mission tasks such as endurance, mobility, strength, and flexibility.⁸ Endurance is the body's ability to continually accomplish the same task in a repetitive fashion, such as loading supplies onto a ship. Mobility is the ability to move the body in space with the precision necessary to negotiate an obstacle. An example of this is climbing a wall. Strength is the ability to generate force attempting to overcome resistance such as lifting ammunition can. Finally, flexibility possesses the optimal joint range of motion such as required to reach overhead.⁹ All four aspects of physical fitness are important and essential in creating a physically well-balanced, injury-resistant, and mission-fit service member.¹⁰

Being physically fit enables you to move easily, meet the physical demands of everyday living and respond positively to increased physical demands under stressful conditions. The physical fitness you may associate with athletes and sports enthusiasts is referred to as "performance" related fitness.¹¹ This form of physical fitness may also be applied to train for jobs that require specific physical attributes and requires a different form of training to health-related physical fitness.¹² Evidence suggests that increasing physical activity and physical fitness may improve academic performance. Executive function and brain health underlie academic performance.¹³

Basic cognitive functions related to attention and memory facilitates learning, and these functions are enhanced by physical activity and higher aerobic fitness. Children respond faster and with greater accuracy to a variety of cognitive tasks after participating in a session of physical activity.¹⁴ Over the past three decades, several reviews and meta-analyses have described the relationship among physical fitness, physical activity, and cognition (broadly defined as all mental processes). The majority of these reviews have focused on the relationship between academic performance and physical fitness as a physiological trait commonly defined in terms of cardio respiratory capacity. A

rapidly growing body of work suggests that time spent engaged in physical activity is related not only to a healthier body but also to a healthier mind.

Recently, research into the association between physical activity and academic achievement has increased considerably. The latest studies have shown a link between physical activities integrated into classes, the amount of physical activity and aerobic fitness. The positive effects of physical activity on academic achievement have been detected.¹³ Participation in sports and exercise clubs has been linked to good performance at studies. Furthermore, it should be noted that studies that involved increasing the time spent in physical education classes and breaks and, correspondingly, decreasing the amount of time spent in academic classes did not show any deterioration in academic learning outcomes.¹⁶

The changes brought about by physical activity in brain structures and functions create additional possibilities for learning. Furthermore, motor and cognitive skills would appear to develop hand in hand, because the same mechanisms of the central nervous system are responsible for controlling both motor and cognitive skills in parallel. Physical activity also offers opportunities to meet and solve challenges in the living environment, which will further develop not only cognitive, but also social skills.⁹

METHODS

This study is an analytical study with cross-sectional approach where data's measurement only be done once on April 2019. The sampling method used in this study is simple random sampling. Students who are chosen for this research are medical students, Faculty of Medicine, Universitas Udayana batch 2018 as many as 84 volunteer participated. Students with chronic systemic disease such as heart failure, diabetes mellitus, hypertension; athletes; smoke; and them who are paralyzed physically were excluded in the study.

Cardiovascular fitness is defined as the fitness of the heart, blood and blood vessels. In this experiment the cardiovascular fitness of the participants is measured using Fartlek Training whereby, their pulse rate will be measured after the training. The result of the experiment will be measured as beats per minute (bpm) which will categorize them into very active (< 100 bpm), normal and less active. Academic achievement of the student will be correlated with the students' cardiovascular fitness level. If the result shows 645 and less, the achievement is fail, and vice versa.

Table 1 Cardiovascular fitness level based on Fartlek in 1st biomedical block

Fitness level	1 st Biomedical block		Total
	Fail	Pass	
Active	43	11	54
Not Active	19	6	25
Total	62	17	79

Table 2 Pearson chi square of pulse rate based on Fartlek training and 1st biomedic

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	46.630 ^a	46	0.446
Likelihood Ratio	50.908	46	0.287
N of Valid Cases	79		

Table 3 Spearman’s rho of pulse rate from Fartlek training and 1st biomedic block results

			Pulse Rate	Biomedic 1
Spearman’s rho	Pulse Rate	Correlation Coefficient	1.000	-0.056
		Sig. (2-tailed)	.	0.626
		N	79	79

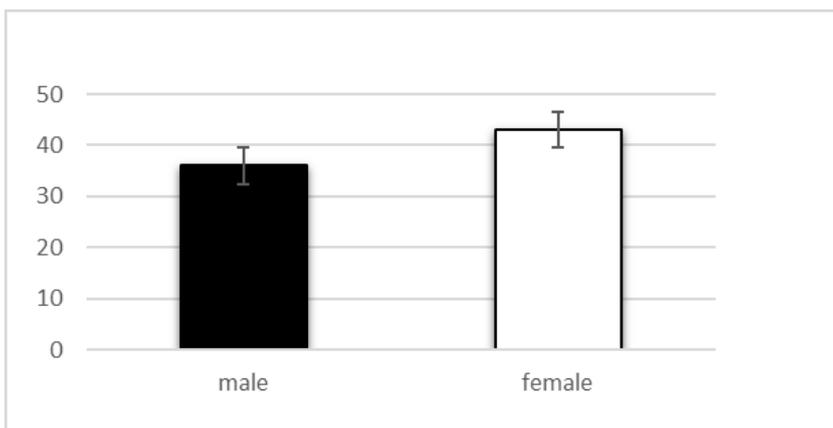


Figure 1 Sex distributions of the respondents

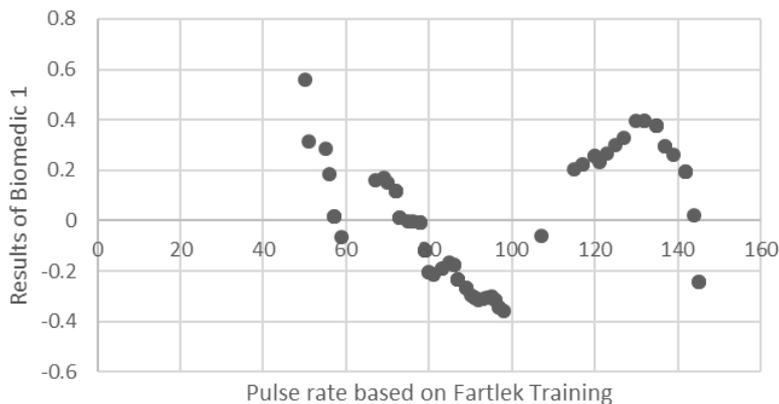


Figure 2 Block biomedic 1 results and pulse rate based on Fartlek training

RESULTS

Descriptive analysis in this study explains that the data been analyzed descriptively in term of measures of central tendency and measured of variability. It is mainly a measure of central tendency includes the mean, median and mode. Descriptive analysis of data helps to determine the normality of the distribution which is also known as normal distribution. Figure 1 showed the gender distribution of the respondents.

Based on the Figure 1, the respondents in this study are 36 male and 43 female with a total of 79 students. According to Table 1, the minimum statistic and maximum statistic of the body height is 154 and 174. The mean statistic and standard error of body height 160.48 ± 0.466 . The minimum statistic and maximum statistic of body weight is 48 and 80 whereby, the mean statistic and standard error is 61.51 ± 0.918 . The minimum statistic and maximum statistic of pulse rate of the students is 50 and 145. The mean statistic and standard error of the pulse rate is 95.39 ± 3.036 .

Based on Table 1, it states that 62 students have failed in the exam. Among them 43 students are active and 19 of them are not active. Then 17 students have passed the exam, whereby 11 of them are active and 6 of them are not active. In total there are 54 active students and 25 not active students which lead to a total of 79 students.

The normality test ($p < 0.05$) indicated that the data in this study was not normally distributed. Thus, the approach used to identify the relationship between the level of cardiovascular fitness and academic achievement in this research would be non-parametric tests which are Pearson’s Chi-Square and Spearman’s rho.

The scattered graph shown above is 1st biomedic block results against pulse rate based on the Fartlek Training. It is a monotonic graph because it has a monotonically decreasing and also a non-monotonic relationship. This indicates that index relationship between cardiovascular fitness level and academic achievement has the level of closeness in the relationship is moderate, significant, and in the opposite direction. Thus, Pearson Chi-Square test is used first.

According to the table 2, asymptotic significance of Pearson chi-square produces a value of 0.446. The value is not significant because it has to be less than 0.05 ($p < 0.05$). The likelihood ratio has a value of 0.287 which means it explicates the determined distribution. This shows the null hypothesis is rejected. Moreover, there is also a non-monotonic relationship obtained from the normal Q-Q plot data. Therefore, Spearman’s rho test will be used next.

Correlation test of Spearman's rho has been used for this thesis using SPSS Version 21 produce. The level of closeness and direction of the relationship between the two variables in this study is illustrated by the correlation coefficient. In this study value of correlation coefficient (Q) = - 0.056 is obtained. The two-tailed significance shows a value of 0.626 which means the index relationship between cardiovascular fitness level and academic achievement has the level of closeness in the relationship is moderate, significant, and in the opposite direction.

DISCUSSION

This experiment was carried out to proof that students whose cardiovascular fitness level is low achieve poorly in their academic compared to the ones whose cardiovascular fitness level is high. Comparison of these proportions illustrates that low level of cardiovascular fitness is a risk factor of students' academic achievements are poor. Students who are not active tend achieve poorly in their academic results compared to students who are active and athlete.

Though it has been reported that medical students tend to have relatively high rates of exercise, it has also been reported that exercise levels can wane as the academic year progresses. Though the exercise habits of medical students are important for their own physical and mental health, the consequences of poor exercise habits among medical students can extend to effect their academic performance.

Pearson Correlation test was initially carried out. The outcome of the test is a negative value was produced in this test (-0.050), which indicates that the data in this study is not normally distributed. Therefore, the approach used to identify the relationship between the level of cardiovascular fitness and academic achievement in this research is two which are Pearson Chi-Square test and Spearman's rho correlation test.

It also shows that there are respondents with lower level of cardiovascular fitness. This is shown by the category of not active with 25%. Factors that are affecting students' academic achievement are absence from class, lack of effort, parental pressure, health issues and finally cardiovascular fitness level. These factors play a major role in the students' academic achievement.¹⁸

The results collected from the tables, graphs and bar chart shows that this data is slightly lower when it is compared to the data from Basic Health Research which stated that cardiovascular fitness level is decreasing among medical students aged 19 years and over in Indonesia as much as 32.9%.

Medical students sometimes fail to make time investments in their own health, including exercise, in response to the rigors of medical school.

Similar studies have been done among medicals students of Southern Thailand Medical University, less than half of the participants (49.5%) were physically active. Male and preclinical students were more likely to be active. Recreational activity was a major type of physical activity among the medical students. Study-related activities and overtime shift work were the significant barriers to physical activity. The statistics showed preclinical students were more active than the clinical students. The mean statistic \pm standard error use of the Thai population was 789.30 ± 0.527 .²¹

Medical students in three Southern provinces of Thailand have a lower prevalence of the recommended levels of physical activity than the Thai population. Insufficient physical activity levels were identified in more than half of the medical students due to related barriers such as study-related activities and overtime shift work. As the less active populations, the clinical and female students should be a focused target to raise physical activity levels. An approach involving the medical school's policies should be an emphasis as a health promotion activity to balance study and health-related behaviours.²¹

This journal by Adilson²² is also similar to this thesis. The overall, the findings revealed that self-reported physical activity and cardiorespiratory fitness were consistently and positively associated with academic achievement. The measured physical activity was inconsistently related to academic achievement. Although the results varied, physical activity does not have a detrimental effect on academic achievement. The positive and significant association between cardiorespiratory fitness and academic achievement was shown in all reviewed studies although in two studies the relationship was only observed among girls, and in two others the significant effect disappeared when potential confounders were included in the analysis.²²

Previous study found the physical fitness status in medical students before their professional examinations and correlate their physical fitness score with the examination results. The study group comprised of young adults with a mean age of 20.04 years. Two third of the students in our study group had normal BMI. Of the remaining one-third of students, most students were overweight and obese, and only few were underweight. Students in our group had average physical fitness score and only a few had good scores. Rest of the students had poor scores. The statistical significant correlation between physical fitness score and university marks result is (P = 0.035).²³

The results of this study are not in accordance with the research in 2018. It has a positive effect of physical fitness on academic achievement was observed. Importantly, aside from consistently having high-fitness status, favourable change of physical fitness within the individual through the two-year study period certainly contributed to academic achievement, even after adjusting several potential confounding factors. Therefore, opportunities for increased physical fitness may be important to support academic achievement among junior high school students, regardless of academic gap. These findings support previous studies which suggest the benefit to academic achievement by enhancing physical fitness.²⁴

Another similar results was obtained by the author Elvar from year 2016, indicates that the use of different methods to express cardiorespiratory fitness, did not affect its relation to academic achievement for nine-year-old children. Body weight or body size must be considered when the association between cardiorespiratory fitness and academic achievement is explored. Body weight expressed to the sample's exponent when ratio scaling is applied may be the method of choice to adjust for different body sizes when exploring the relation between cardiorespiratory fitness and academic achievement.²⁵

The results obtained in this study are in opposite accordance with the theory states that cardiovascular fitness is one of the factors that influence a student's academic achievement. This has happened because the data or the number of participants in this study should have been 84 students, instead on 79 of them were able to make it. It did not reach the aimed number of students because; the students were actively participating in many other campus activities to gain their SKP points and also because of the exam schedules. Apart from that, during the data collecting process participants weren't able to follow the precautions stated. A few participants could not maintain their speed for the required time. They either slow down or speed up. There were participants who took time to identify their pulse rate and to count them.

Cardiovascular fitness can lead to an increased proliferation and survival of cells in the hippocampus. Earlier in this thesis, it was explained about the increased levels of brain-derived neurotrophic factor, endorphin and serotonin found in individuals after cardiovascular fitness. In addition to cognitive performance, increases in physical activity have also been implicated in improvements in mental health outcomes, such as depression and anxiety. In this context, physical activity has the potential to offset the stress and other mental health problems

that are frequently documented among medical students.

The cardiovascular system, composed of the heart, blood vessels, and blood, responds predictably to the increased demands of exercise. With few exceptions, the cardiovascular response to exercise is directly proportional to the skeletal muscle oxygen demands for any given rate of work, and oxygen uptake (VO_2) increases linearly with increasing rates of work.²⁶ The pattern of blood flow changes dramatically when a person go from resting to exercising. At rest, the skin and skeletal muscles receive about 20 percent of the cardiac output. During exercise, more blood is sent to the active skeletal muscles, and, as body temperature increases, more blood is sent to the skin. This process is accomplished both by the increase in cardiac output and by the redistribution of blood flow away from areas of low demand, such as the splanchnic organs. This process allows about 80 percent of the cardiac output to go to active skeletal muscles and skin at maximal rates of work. With exercise of longer duration, particularly in a hot and humid environment, progressively more of the cardiac output will be redistributed to the skin to counter the increasing body temperature, thus limiting both the amount going to skeletal muscle and the exercise endurance.²⁷

CONCLUSION

There was no significant relationship between the level of cardiovascular fitness and the academic achievement of the medical students who were the respondents of Medical Faculty, Udayana University, from the batch 2018. Cardiovascular fitness level and academic achievement have relationship of and negative or opposite direction. It is recommended to improve their academic achievement by keeping their cardiovascular fitness level active. They could use the Fartlek training as an example to start their cardiovascular fitness which helps them in keeping themselves active, and enhance their learning capability.

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