

Impact of different physical activity levels on academic performance of PSAU medical female students

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Abstract

Physical activity plays a pivotal part in gaining cardio respiratory fitness hence improving academic performance in medical students especially females. Accordingly, it is important to evaluate the effect of physical activity on academic performance of the students using cardio respiratory fitness as a mediator. The study aimed to detect that cardio respiratory fitness goes between physical activity and academic performance in PSAU medical female students. Methods: Assessment of cardio respiratory fitness was done by 20m Shuttle Run Test [SRT], physical activity levels were determined by International Physical Activity Questionnaire [IPAQ] and Academic Performance [AP] was detected by Grade Point Average [GPA] over past three consecutive semesters and the relationship between them was tested. Results: The statistical analysis confirmed a high significant correlation between cardio respiratory capacity, academic performance and physical activity ($p < 0.05$) in moderate and high level physical activity without significant differences in low level physical activity in medical university female students ($p > 0.05$). The results of the bootstrapped mediation analysis indicated that physical activity had a direct effect on cardio respiratory fitness, which in turn influenced the academic performance among participants only in moderate to high physical activity. Conclusion: Consequently, the hypothesis that cardio respiratory fitness mediates the relationship between physical activity and academic performance in moderate to high activity was confirmed. Physical activity is a prerequisite for improved cardio respiratory capacity, leading to better academic performance for healthy academic life and future career in PSAU medical female students.

Keywords: physical activity; cardio respiratory fitness; academic performance; university students

INTRODUCTION

Health promotion and cardiopulmonary fitness are maintained by regular physical activity. This improves cardiovascular function [1]. Physical activity (PA) in the form of exercise program enhances body systems; including cardiovascular and respiratory systems. So, well-trained individuals have a decreasing sympathetic response and an increasing parasympathetic response leading to a decrease in resting heart rate [2]. Regular physical activity improves cognitive and physical function in adolescent and later in their life so decreasing the health complication that results from increased fatness and increased risk factors of cardiovascular diseases [3]. Cardio respiratory fitness (CRF) mirrors the capacity of the cardiovascular and respiratory systems. Students with high CRF have positive cardiovascular profile when compared to unfit colleagues as CRF is an indicator of students' physiological state [4, 5].

Brain function and structure are affected by physical activity in the children and adolescent. Many studies found a strong relationship between exercises-induced improvement in physical fitness (PF) and cognition function & academic performance (AP). So, executive function is improved [6, 7].

Previous studies found a bidirectional relation between AP and PF, some of them proved that PF goes between PA and AP; while, other studies found that PA indirectly affects AP through enhancing PF [8]. Encouragement of physical activity in university-motivated students is very important as those students are excited to be superior in learning and activity. So, they are always engaged in routine physical activity to be physically fit [9-11].

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In medical female students, decreasing the physical activity produces a negative effect on physical fitness due to weight gain. Overweight in those students results in high incidence of many health hazards as cardiovascular disease and musculoskeletal disorder which affect their performance. Sufficient knowledge about benefits of physical activity and hazards of decreasing activity level should be continuously informed [11-14].

Sedentary lifestyle is more common in academic life of university students especially females, so changes in cardio respiratory capacity and anthropometric measurements will be consequently resulted. A prior study by Gáldi [15] stated that participation in sports activities is decreased with aging. Only 50% of those aged over 15 years are regularly participated in routine activity; therefore, adiposity and associated complications are increased. Educational level in academic life is affected by the level of fitness; so, increased physical activity is required.

Physical activity (PA) stimulates brain activity and encourages cognitive function leading to better academic performance [15-17]. Gaining health by regular physical activity relieves depression, yields higher self-confidence, helps to make better relations, prevents cardiovascular diseases and reduces mortality rate [18]. We hypothesize that physical activity positively affects academic performance. So, the aim of this study is to evaluate the relationship between physical activity, physical fitness and academic performance in female students in PSAU.

MATERIAL AND METHOD

Study Design

This is a cross-sectional study aimed to evaluate the effect of physical activity on cardio respiratory fitness and academic performance from October to December 2019. The study sample comprised of 100 medical female university students, volunteered to participate in the study.

Subjects

All participants were university female student from medical colleges, born between 1996 and 2002 and, enrolled in last year of their academic life, and free of any chronic disease or medical condition. Their mean body height was 159.55 ± 5.33 cm and mean body mass was 60.7 ± 6.24 kg.

Materials

Body composition

The participants were instructed not to take any food or drink 10-12 hours before testing. A digital scale and a stadiometer with the accuracy of 0.1 kg and 1 mm were used to measure body weight and height. BMI is a calculation using body weight/ (height)² [19].

Cardio respiratory fitness (CRF)

CRF was evaluated by 20m shuttle run test by running between two lines 20m apart. Audio signal from CD was

kept at initial speed 8.5 km/h and increased by 0.5 km/h/min. The students were informed to run as long as possible in straight line while they listen to the signal. And they were asked to stop continuing the test either if they fail to reach the line two times with the audio signal or feel fatigue [20].

Academic performance

Measurement of academic performance for university medical students was done by taking their GPA over last three consecutive semesters for which the reliability was 0.966 using test-retest method [21].

Physical Activity

The International Physical Activity Questionnaire (IPAQ) [22] which is a self-reported physical activity level that includes seven questions with three levels of activity (light, moderate, and vigorous) was used for calculating the test-retest reliability. The coefficient for that was 0.882 [Appendix 1].

Statistical analysis

The data analysis was undertaken using the SPSS for windows version 22.0 (IBM Corp, Armonk, NY, USA). Frequencies and medians were used for basic descriptors whereas; the association between the variables was detailed and analyzed using t-test and analysis of variance (ANOVA). In addition, the regression analysis was developed in order to determine the relationship between the variables. The significance level was set at $p < 0.05$.

RESULTS

Table 1 summarizes the comparison of demographic data (age, weight, height, and BMI) between three groups. The three groups were homogenous related to these variables. While there was a significant difference in cardio respiratory fitness which evaluated by estimating VO₂max and academic performance (GPA) between the two groups.

Table 2 shows a high significant correlation between moderate & high physical activity and CRF as well as academic performance ($p < 0.001$). While, low physical activity exhibited a non-significant correlation ($p = 0.09$).

Table 3 exhibits indirect effects of CRF on AP, unstandardized coefficients (standard error). Bias corrected 95% CI based on bootstrap sample. The level of statistical significance was set at $p < 0.05$. The results of the bootstrapped mediation analysis showed that PA has a direct effect on CRF, which in turn affects the AP among students in moderate to high PA. After adjusting for CRF, the association between PA and AP does not appear prominently; while, the relation between CRF with AP is still the same. Neither PA nor CRF was related with the AP of low physical activity.

DISCUSSION

Health promotion is achieved by regular practicing of physical activity in academic life. Besides, physical activity promotes cardio respiratory fitness and enhances academic performance. Universities should provide suitable environment for activity for students so as to gain proper fitness and reduce health complication of inactivity [13].

The results of the current study confirmed the hypothesis that cardio respiratory fitness intervenes the relationship between PA and AP in medical female PSAU student. Every student individually accomplished her physical activity questionnaire by marking her own physical activity and academic performance. The results stated a significant correlation representing that student who more active would accomplish more results in academic achievements.

Data from previous studies revealed that the lack of physical activity in students has many health consequences in the society, as diabetes and obesity. The effect of physical activity on learning process has conflicting views but recently positive results on brain and mental health had been shown by students' physical activity [23]. Historically, a negative relation was found between nonacademic activity and academic performance [24]. Recently, Sallis *et al.* did not found a correlation between physical activity and academic performance [25]; while, Trudeau and Shephard compared between students involved in physical activity and students who did not involve on academic performance and found significant improvement in academic performance after conducting physical activity [26]. On the contrary, a study by Lindner [27] and Dwyer *et al.* [28], found a weak correlation between the results of the students and physical exercise. Other researchers studied the effect of physical activity and revealed better health without correlation with cognitive function [29].

Enhancement of academic performance by physical activity level of the students has many mechanisms as improvement in cognitive function that affects attention and arousal [30]. Also, stimulation of cerebral blood flow and arousal levels, release of specific neurotransmitters (noradrenaline, adrenaline, and serotonin); growing and plasticity of neurons result for brain development of derived neurotrophic factor (BDNF) related to angiogenesis and neurogenesis in the hippocampus that is a part of the brain responsible for memory; as well as vascularization and neural growth and synaptic transmission in the prefrontal cortices in those regions of the brain are tied to executive function [31-34].

More satisfaction in life for university students is achieved by reasonable level of physical activity, this is important issue for psychological well-being and markers of cardiovascular health and more satisfaction later on in future career [35]. In addition, conflicting data about the association between cognitive function and physical activity exists but it

is proved that exercise enhances long-term memory [36, 37]. This is by improved quantities of factors that has effect on increasing brain plasticity and cognition [38]. Physical activity in adult during academic life seems to save a person against memory loss in older age and minimize the risk of Alzheimer disease [39, 40]. Adolescence that usually are engaged in physical activity have improved nourishment of the brain, basal metabolic rate, self-confidence, and balanced behavior; all these factors help learning process and performance [41].

The strengths of this study are objective assessment of cardio respiratory fitness and academic performance. In contrast, physical activity was measured by self-reporting. In the future research, using direct measures of physical activity, such as accelerometry would strengthen assessment that reports the relation between physical activity and academic performance. The limitation of the study is that other factors should be considered when assessing academic performance as social, personal and motivation factors. Furthermore, only the association has been discovered in female. This is because females have high academic achievement than males. Comparing male and female students is needed to explain the differences. Also there is a need to explain which type of activity could be effective in addition to home and leisure time activities.

CONCLUSIONS

Moderate to high physical activities have strong relation with CRF and so AP; while, neither PA nor CRF was related with the AP of low physical activity. Physical activity is considered as an important factor that affects the university students, especially medical students because of high load of practical courses. Cardio respiratory fitness is affected by the level of students' physical activity and so the student academic performance could be affected. Hoping for successful career for those students in medical field is related to their level of physical activity.

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Table 1. Demographic data of the participants included in the study

Variable	LPA (n= 33)	MPA (n=34)	HPA (n= 33)	P value
Age, y	20. 3 ±0.35	21. 1 ±0.37	20.9 ±0.65	0.998
Weight, kg	60.3 ±3.6	59.7 ±3.5	61.02 ±2.1	0.242
Height, cm	162.4 ±1.8	162.5 ±1.6	163.1 ± 1.5	0.176
BMI (kg/m ²)	22.86 ±2.6	22.91 ±2.4	22.93 ±2.1	0.992
VO2max(mL.kg-1.min-1)	56.0± 13.6	61.0± 13.2	65.8 ±11.2	0.009
GPA	3.1±0.12	3.5±0.09	3.7±0.1	<0.001

BMI: Body Mass Index, CRF: Cardio Respiratory fitness evaluated by estimated VO2max, GPA: Grade Point Average. LPA: low level physical activity, MPA: Moderate level physical activity, HPA: High level physical activity.

Table 2. Relationship between cardiorespiratory fitness, academic performance physical activity

	LPA	MPA	HPA	P value
CRF	0.93	0.80	0.66	0.021
GPA	0.18	0.21	0.24	0.033
P value	0.09	<0.001	<0.001	

CRF: Cardio Respiratory Fitness, GPA: Grade Point Average. LPA: low level physical activity, MPA: Moderate level physical activity, HPA: High level physical activity.

Table 3. The mediation analyses of **cardio respiratory** fitness between physical activity and academic performance in three different physical activity

	Indirect effect	Bias Correction 95% CI	P _M (%)
LPA	0.003 (0.049)	0.097–0.100	18.6
MPA	0.132(0.044)	0.073–0.210	47.4
HPA	0.140 (0.041)	0.074–0.231	49.2

CI: confidence interval. P_M: percentage of mediation

Appendix 1

International Physical Activity Questionnaire Short form

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, running, fast bicycling, or fast swimming?
2. How much time did you usually spend doing vigorous physical activities on one of those days?
3. During the last 7 days, on how many days did you do moderate physical activities like bicycling at a regular pace; carrying light loads, and doubles tennis? Do not include walking.
4. How much time did you usually spend doing moderate physical activities on one of those days?
5. During the last 7 days, on how many days did you walk for at least 10 min at a time?
6. How much time did you usually spend walking on one of those days?
7. During the last 7 days, how much time did you usually spend sitting on a weekday?