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Case Study

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The Association of Physical Activity with Academic Performance Among Medical Students at King Abdulaziz University, a Cross-Sectional Study

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ABSTRACT

We sought to determine the associations between physical activity (PA) level and academic achievement and the correlation of PA with other variables. We also aimed to determine the exercise barriers among medical students at King Abdulaziz University (KAU). This cross-sectional study was conducted from March to May 2022, and 354 students participated. The students' PA was measured using the International physical activity questionnaire–short form (IPAQ-SF). The last semester's grade point average (GPA) was used to assess academic performance (AP) and the Exercise Barriers Scale (EBS) to assess exercise barriers. PA and AP relationship were insignificant. However, the overall correlation of PA to other variables was undetermined. PA levels among female medical students positively influence GPA whereas male students did not, and more than 50% of the participants had low PA levels. Our study indicates that the overall effects of academic achievement, gender, academic year, smoking, comorbidities, and BMI on PA level were insignificant. Our society requires awareness and support to promote PA, and the students require encouragement and support to exercise.

Key words: *Academic performance, EBBS, IPAQ-SF, Medical students, Physical activity*

INTRODUCTION

The body motions caused by skeletal muscle contractions that increase energy expenditure over the resting metabolic rate are defined as physical activity (PA) [1]. In addition, PA is a multidimensional behavior that can be represented in four ways: frequency, duration, intensity, and diverse types of exercise [2]. Regular PA is helpful for the primary and secondary prevention of various chronic diseases (e.g., cardiovascular disease, diabetes, cancer, hypertension, obesity, depression, and osteoporosis) and premature death [3]. Some researchers have discovered a link between PA and academic performance (AP), specifically, working memory capacity, reaction time, and understanding [4, 5]. In addition, PA increases blood flow to the cortex, increasing the volume of the hippocampus and promoting logical thinking [6]. The 2007 American Heart Association (AHA) and American College of Sports Medicine (ACSM) recommend that healthy adults should perform moderate-intensity aerobic PA for 30 minutes a day, five days a week, or perform vigorous-intensity aerobic PA for 20 minutes a day, three days a week [7-10]. However, reduced PA levels can harm normal human physiology, resulting in poor health and an increased risk of the early development of chronic diseases [11]. However, as exams, study periods, and the competitive nature of the field can be stressful, many medical students worldwide strive to achieve high grades and become talented physicians. AP in medical schools is of utmost importance and exploring other factors that affect AP is crucial, especially PA. Studies claim that exercising correlates with better student grades than not exercising. According to one study in Pakistan, 4th-year medical students at Rawalpindi Medical University scored low grades because of the lack of PA [12]. Further, two studies in Saudi Arabia support the idea that PA positively affects AP [13, 14]. However, no studies in Jeddah, Kingdom of Saudi Arabia (KSA) correlate PA with students' academic scores. Moreover, few studies have assessed barriers to PA with students in the medical field at KSA. Thus, we first aimed to determine the relationship between PA and medical students' AP to correlate PA with gender, BMI, smoking, and chronic disease. Our secondary goal was to determine the benefits and barriers of exercise among medical students at King Abdulaziz University (KAU) in KSA, Jeddah, Saudi Arabia (SA).

MATERIALS AND METHODS

Study design

The family medicine department at the College of Medicine, KAU, used randomized sample collection to conduct this cross-sectional study from March to May 2022. The College of Medicine's Research Ethical Committee (Reference No 122/22), KAU, Jeddah, Saudi Arabia, approved this study.

Data collection

The sample size included 323 students, at a 95% significance level and 5% allowable error. Regarding the inclusion criteria, only KAU medical students took part in the study. For the exclusion criteria, students outside of KAU, interns, handicapped (physically impaired) students, students outside the medical field, and incomplete data from the survey were excluded. We used Google forms to collect students' data.

First, our survey analyzed the following students' information: age, gender, university (KAU or others), academic year, faculty type (medicine or others), smoking/nonsmoker, associated comorbidities (asthma, diabetes, rheumatoid arthritis, hypertension, hypothyroidism, hyperthyroidism), any physical disability, grade point average (GPA) in the previous semester, and body mass index (BMI)—weight in kilograms divided by square height in meters [15].

Second, the International Physical Activity Questionnaire - short form (IPAQ-SF) was used to measure PA. Many countries have accepted this survey since its establishment in 1998 [16]. Despite the more extended version of the IPAQ having information, we used the short version because of its practicality and usability toward sample size [16]. A study by Craig showed that both the short and long versions of the IPAQ had similar outcomes [16]. The IPAQ-SF is used for participants between 15 and 69 years and comprises seven questions that aim to estimate sitting time as well as the frequency and duration of specific activities such as walking, moderate-intensity activities, and vigorous-intensity activities during the past seven days [17]. The IPAQ scoring protocol categorizes each participant into classes, such as low, moderate, and high PA, based on their responses to the survey [17].

Finally, we used only the exercise barrier categories from the Exercise Benefits/Barriers Scale (EBBS); the EBBS questionnaire is valid and reliable because it interprets a person's perception regarding the benefits and barriers of exercise [18, 19].

RESULTS AND DISCUSSION

We used Microsoft Excel v16.0 to arrange the data and IBM SPSS Statistics for Windows (Version 21.0) to analyze it statistically. The statistics were summarized for each categorical and ratio variable. Frequencies and percentages were calculated for each nominal variable. The mean and standard deviation were calculated for the ratio variables. The chi-square test was used to explore the link between the study variables and PA categories. The independent samples t-test was used to compare barriers to exercise. Cohen's d was used to present the effect sizes for the differences between groups. A one-way analysis of variance (ANOVA) test was used to compare the barriers to exercise scale items among physically active groups.

We collected data from 354 participants, and we excluded 27 participants based on our exclusion criteria. In total, our study included 327 students whose average age was 22.2 years, with a standard deviation of 1.7. The most frequently observed gender category was male (n=224, 68.5%). The average BMI was 25.5, with a standard deviation of 5.9. Approximately 50% of the medical students were overweight and obese, 16% were smokers (n = 52, 15.9%), and 8.9% reported comorbidities. **Table 1** describes the study participants' socio-demographic and general characteristics.

Table 1. Participants' Socio-Demographic and General Characteristics

	Overall (N=327)
Age	

Mean (SD)	22.2 (1.7)
Range	18.0 - 27.0
Gender	
Female	103 (31.5%)
Male	224 (68.5%)
Weight in kg	
Mean (SD)	73.1 (19.9)
Range	34.0 - 146.0
Height in cm	
Mean (SD)	168.6 (9.0)
Range	148.0 - 190.0
BMI	
Mean (SD)	25.5 (5.9)
Underweight	26 (8.0%)
Healthy	139 (42.5%)
Overweight	102 (31.2%)
Obese	60 (18.3%)
Academic year	
2nd	62 (19.0%)
3rd	45 (13.8%)
4th	51 (15.6%)
5th	72 (22.0%)
6th	97 (29.7%)
Smoking Status	
Yes	52 (15.9%)
No	275 (84.1%)
Comorbidities	
Yes	29 (8.9%)
No	298 (91.1%)

Pearson's chi-square test of independence examined the association between gender, academic year, academic achievement, BMI, smoking status, and comorbidities with PA categories. There was no significance in these variables statistically; **Table 2** presents the details.

Table 2. Association of Physical Activity (IPAQ) with various study factors

	IPAQ Physical Activity Category				
	Low (n=168)	**Moderate (n=98)**	**High (n=61)**	**Total (N=327)**	**p value[1]**
		Gender			0.7451
Female	53.0 (31.5%)	33.0 (33.7%)	17.0 (27.9%)	103.0 (31.5%)	
Male	115.0 (68.5%)	65.0 (66.3%)	44.0 (72.1%)	224.0 (68.5%)	
		Academic year			0.0611
2nd	37.0 (22.0%)	20.0 (20.4%)	5.0 (8.2%)	62.0 (19.0%)	
3rd	27.0 (16.1%)	11.0 (11.2%)	7.0 (11.5%)	45.0 (13.8%)	
4th	25.0 (14.9%)	13.0 (13.3%)	13.0 (21.3%)	51.0 (15.6%)	
5th	39.0 (23.2%)	16.0 (16.3%)	17.0 (27.9%)	72.0 (22.0%)	
6th	40.0 (23.8%)	38.0 (38.8%)	19.0 (31.1%)	97.0 (29.7%)	

		BMI			0.194
Underweight	13.0 (7.7%)	11.0 (11.2%)	2.0 (3.3%)	26.0 (8.0%)	
Healthy	69.0 (41.1%)	37.0 (37.8%)	33.0 (54.1%)	139.0 (42.5%)	
Overweight	51.0 (30.4%)	31.0 (31.6%)	20.0 (32.8%)	102.0 (31.2%)	
Obese	35.0 (20.8%)	19.0 (19.4%)	6.0 (9.8%)	60.0 (18.3%)	
		Smoking			0.4791
Yes	30.0 (17.9%)	12.0 (12.2%)	10.0 (16.4%)	52.0 (15.9%)	
No	138.0 (82.1%)	86.0 (87.8%)	51.0 (83.6%)	275.0 (84.1%)	
		Comorbidities			0.6151
Yes	13.0 (7.7%)	11.0 (11.2%)	5.0 (8.2%)	29.0 (8.9%)	
No	155.0 (92.3%)	87.0 (88.8%)	56.0 (91.8%)	298.0 (91.1%)	

[1] Pearson's chi-squared test.

Figure 1 shows the PA's impact on academic achievement (GPA). AP among physically active females significantly differed (p = 0.001). However, among physically active males, this relationship was insignificant (p = 0.840).

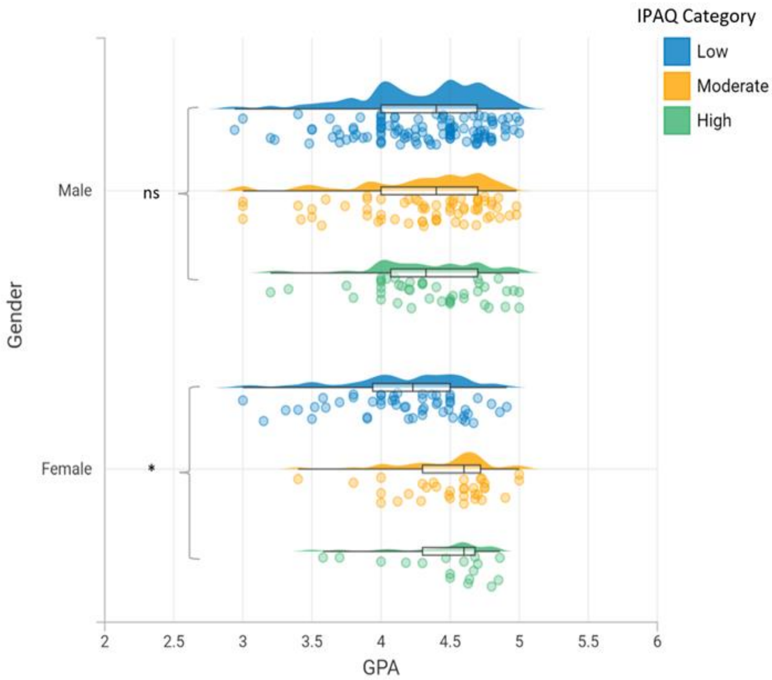

Figure 1. Comparison of Grade Point Average across Physical Activities categories by Gender

The female group scored higher for "*My family members do not encourage me to exercise*" (M = 1.19, SD = 1.09) than the male group did (M = 1.04, SD = 1.05). An independent samples t-test showed that this difference was not significant (t (190.96) =-1.23, p =.219, Cohen's d = 0.12). Similarly, no barriers to exercise showed any significant differences by gender. **Table 3** presents a summary of the details.

Table 3. Comparison of Barriers to Exercise Items by Gender

		Descriptive statistics			**Test statistics**			**Effect size**
Barriers to Exercise Scale / **Exercise Millie Subscale**	**Gender**	**n**	**Mean**	**Std. Dev.**	**df**	***t***	***p***	**Cohen's *d***
Places for me to exercise are too few.	Male	224	1.616	1.207	217.41	-0.617	0.538	0.06
	Female	103	1.699	1.092				
	Male	224	0.585	0.848	214.59	0.839	0.403	0.08

I think people in exercise clothes look funny.	Female	103	0.505	0.778				
Exercise facilities do not have convenient schedules for me.	Male	224	1.674	1.082	219.38	-0.532	0.595	0.05
	Female	103	1.738	0.970				
It costs too much to exercise.	Male	224	1.714	1.144	207.93	-0.918	0.360	0.09
	Female	103	1.835	1.086				
I am too embarrassed to exercise.	Male	224	0.911	1.084	208.42	0.765	0.445	0.07
	Female	103	0.816	1.027				
Places for me to exercise are too far away.	Male	224	1.509	1.140	204.09	-1.943	0.053	0.18
	Female	103	1.767	1.104				
Time Expenditure Subscale								
Exercise takes too much time from my family responsibilities.	Male	224	1.487	1.132	208.52	1.130	0.260	0.11
	Female	103	1.340	1.071				
Exercise takes too much time from family relationships.	Male	224	1.371	1.055	205.49	1.045	0.297	0.10
	Female	103	1.243	1.014				
Exercising takes too much of my time.	Male	224	2.000	0.980	193.16	-0.490	0.625	0.05
	Female	103	2.058	1.008				
Physical Exertion Subscale								
Exercise is hard work for me	Male	224	1.688	1.113	215.55	-0.793	0.429	0.07
	Female	103	1.786	1.016				
I am fatigued by exercise	Male	224	1.741	1.048	199.72	-0.757	0.450	0.07
	Female	103	1.835	1.039				
Exercise tires me	Male	224	1.893	1.045	198.71	0.779	0.437	0.07
	Female	103	1.796	1.042				
Family Discouragement Subscale								
My family members do not encourage me to exercise.	Male	224	1.036	1.050	190.96	-1.232	0.219	0.12
	Female	103	1.194	1.094				

The mean value for "*My family members do not encourage me to exercise*" was highest in the low PA group (M = 1.24, SD = 1.13), indicating that physically inactive participants considered discouragement from family members a barrier to exercise. One-way ANOVA utilizing the Welch F-ratio showed that this difference was statistically significant at F(2, 160.80) = 3.80, p = .024.
Moreover, the mean value for "*Exercising takes too much of my time*" from *the Time Expenditure Subscale* was highest in the *low PA* group (*M* = 2.18, *SD* = 0.93), followed by the *moderate* (*M* = 1.95, *SD* = 0.93) and *high* (*M* = 1.67, *SD* = 1.12) groups (*p* = 0.004), implying that physically inactive participants considered time consumption as a barrier to exercise.
Similarly, the low PA group had the highest mean values for "Exercise is hard work," "Fatigued by Exercise," and "Exercise tires" and these differences were significantly higher compared to those in the moderate and high physically active groups (p < .001, 0.009, and 0.025, respectively). However, items related to "Exercise takes too much time from family relationships" and "Exercise takes too much time from my family responsibilities" were insignificantly different among the PA groups. Furthermore, exercise places, clothing, facilities schedules, costs, as well as embarrassment factors were insignificant. However, the distance factor was highest in the moderate PA group (M = 1.68, SD = 1.06), followed by the low (M = 1.68, SD = 1.17), and high (M = 1.20, SD = 1.08) groups. One-way ANOVA utilizing the Welch F-ratio showed that this difference was statistically significant at F(2, 157.27) = 4.90, p = 0.009. **Table 4** presents a summary of the details.

Table 4. Comparison of Barriers to Exercise Items by IPAQ Categories

		Descriptive statistics			**Test statistics**	
Barriers to Exercise Scale	**PA Categories**	**n**	**Mean**	**Std. Dev.**	***F***	***p***

Exercise Millie Subscale						
Places for me to exercise are too few.	Low	168	1.732	1.161	1.744	0.178
	Moderate	98	1.643	1.142		
	High	61	1.393	1.229		
I think people in exercise clothes look funny.	Low	168	0.613	0.868	0.859	0.425
	Moderate	98	0.480	0.763		
	High	61	0.541	0.808		
Exercise facilities do not have convenient schedules for me.	Low	168	1.756	1.000	0.594	0.553
	Moderate	98	1.633	1.049		
	High	61	1.623	1.171		
It costs too much to exercise.	Low	168	1.762	1.139	0.249	0.780
	Moderate	98	1.694	1.097		
	High	61	1.820	1.148		
I am too embarrassed to exercise.	Low	168	0.940	1.065	1.191	0.307
	Moderate	98	0.888	1.102		
	High	61	0.705	1.006		
Places for me to exercise are too far away.	Low	168	1.679	1.170	4.902	0.009
	Moderate	98	1.684	1.061		
	High	61	1.197	1.077		
Time Expenditure Subscale						
Exercise takes too much time from my family responsibilities.	Low	168	1.506	1.148	1.890	0.154
	Moderate	98	1.480	1.067		
	High	61	1.197	1.077		
Exercise takes too much time from family relationships.	Low	168	1.315	1.033	1.817	0.166
	Moderate	98	1.469	1.057		
	High	61	1.148	1.030		
Exercising takes too much of my time.	Low	168	2.185	0.933	5.738	0.004
	Moderate	98	1.949	0.935		
	High	61	1.672	1.121		
Physical Exertion Subscale						
Exercise is hard work for me	Low	168	1.869	1.064	10.304	< .001
	Moderate	98	1.796	1.055		
	High	61	1.180	1.025		
I am fatigued by exercise	Low	168	1.905	1.016	4.911	0.009
	Moderate	98	1.776	1.000		
	High	61	1.393	1.115		
Exercise tires me	Low	168	1.976	0.979	3.788	0.025
	Moderate	98	1.878	1.058		
	High	61	1.525	1.134		
Family Discouragement Subscale						
My family members do not encourage me to exercise.	Low	168	1.238	1.128	3.801	0.024
	Moderate	98	0.888	0.973		

High	61	0.984	0.975

We conducted a cross-sectional study to measure the overall effect of PA level on the GPA of medical students from KAU. Our results found no significant relationship between PA levels and GPA. Moreover, gender, BMI, academic year, smoking, and comorbidities did not significantly influence PA. Conversely, physically active females have better GPAs compared with physically active males. Some previous studies found no significant correlations between PA levels and GPA [20-22]. Health graduate students in a university along the Texas-Mexico border were studied using the IPAQ-SF questionnaire and 76% of them reported an insignificant correlation between PA levels and GPA [22].

Additionally, utilizing the IPAQ-long form, the University of Vic-Central and Catalonia in Spain examined the effects of PA and context-specific sitting time on GPA and working memory capacity, finding an insignificant effect of undergraduate students' PA levels on their GPA [20]. In contrast, PA levels positively affected GPA among medical students at King Saud University in Saudi Arabia [14]. Likewise, a study of female health college students at King Khaled University in Saudi Arabia demonstrated that PA levels were positively associated with AP [13]. While our study showed a significant difference in GPA among physically active females, multiple methodological tools differentiate it from the two studies at King Saud and King Khaled Universities. First, we analyzed PA levels using the IPAQ-SF. King Saud University measured PA levels via a multiple-choice selection of frequency and duration, while King Khaled University measured PA levels by selecting one choice from previously categorized weekly periods of PA and PA levels. Second, we used IPAQ-SF, which measures PA during the last seven days. The personal level of PA could change from extremely inactive to extremely active, or vice versa, in less than a year; therefore, we attempted to correlate short-term PA measurements with AP by only considering the last semester's GPA. In contrast, other papers consider the total GPA from the first to the last semester. Nevertheless, our data showed that over half of the participants had low PA levels, similar to a study on Indian college students [23]. Although our study showed no association between PA and AP, previous studies have demonstrated many other PA benefits. A study of United States medical students showed a positive relationship between counseling patients about PA and personal PA habits; also, medical students were more active compared with their age-matched general population counterparts [24]. Moreover, a Vietnamese study found a substantial association between physical inactivity and depression in medical students [25]. Correspondingly, many studies have shown a correlation between poor sleep quality and physical inactivity among university students [23, 26]. These previous studies' findings and our results promote exercise habits and increase the awareness of exercise benefits in KAU. In addition, we found numerous adverse effects on PA, such as discouragement from family members, physical exhaustion from exertion, faraway places/gyms for exercise, and time spent exercising. To overcome these barriers to exercise, we suggest that universities should pay more attention to their sports facilities, sponsor more sports events, and increase academic sports hours. With these changes, we can raise the community's awareness of the adverse effects of a sedentary lifestyle and teach people all forms of exercise and they can select the appropriate method (depending on their fitness levels, time, and exercise location). Correspondingly, this will improve the population's PA level, resulting in a positive impact on medical students because they will gain further support from their family members and community.

Our study has some limitations. First, it is a cross-sectional study with selection bias in only one institution. Further, only those who used the online Google form participated in our study. Moreover, this research did not address all the factors that may influence PA or AP, such as coping strategies and mental illnesses. Additionally, we gathered GPA and BMI data based on self-reported responses, leading to the possibility of increased human error. Although we used a qualified measurement for PA level, the IPAQ-SF was self-reported, thus some results may have been overestimated. Despite these limitations, it is the first research in Jeddah, and one of the few in Saudi Arabia, to measure the overall effect of PA level on the GPA of medical students; therefore, future studies are required to confirm or deny our findings. Further, the question from the EBS, "My spouse (or significant other) does not encourage exercising," was not utilized within the discussion section because of many conflicts caused by cultural differences in our society. Therefore, we included another answer choice to that question: "This does not apply to me." Moreover, we believe that the top students in our institution neglect exercise because they prioritize studying and performing other university-related tasks. Furthermore, Jeddah has multiple barriers to exercise, such as limited access to exercise areas, reliance primarily on automobile transport, and little awareness of exercise. We suggest also using another accurate method to assess PA levels, such as utilizing smartwatches. The long-term PA effect on medical students' AP and follow-up on the students' PA level throughout the year as well as its reflection on GPA is an exciting topic. We also recommend that future studies about PA and AP relationship should exclude mental illnesses cases and poor coping strategies from the study, as these may affect PA or AP.

CONCLUSION

Our study indicates that the overall effects of academic achievement, gender, academic year, smoking, comorbidities, and BMI on PA level were insignificant. It also confirmed that the PA levels among female medical students positively influence GPA, and more than 50% of the medical students had low PA levels. Our society requires further awareness and support to promote PA. To conclude, the high ranks of inactivity combined with the harmful effects of some exercise barriers on PA indicate that students require more encouragement and support to exercise.

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CONFLICT OF INTEREST : None

FINANCIAL SUPPORT : None

ETHICS STATEMENT : Research Ethical Committee at the College of Medicine (Reference No 122/22), KAU, Jeddah, Saudi Arabia, approved this study. The methods applied were based on the guidelines and regulations of the ethical committee. Informed consent for study participation was obtained from all subjects (no subjects were under 16/illiterate/dead, from a parent and/or legal guardian/next of kin).

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