Factors affecting medical students' academic burnout: a moderation analysis

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ABSTRACT

Background. Burnout syndrome may threaten medical students' professional life through negative effects on their academic work and personal life. Therefore, it is very important to identify the risk and protective factors of burnout syndrome in this group of subjects. The present study aimed to determine the association of socio-demographic characteristics, current substance/medication abuse, and personality dimensions with academic burnout among medical students, and examine physical activity as a potential moderator of the personality dimensions-academic burnout relationship. Materials and Methods. In this cross-sectional study, a total of 400 medical students from the four courses of basic sciences, physiopathology, stagers, and internship (100 people at each course) in Zahedan, Iran, in 2018, were selected by stratified sampling method and evaluated using the socio-demographic information form, Baecke physical activity questionnaire, Temperament and character inventory, and Breso's academic burnout questionnaire. Finally, descriptive statistical methods, the Kruskal-Wallis test, Spearman's rank correlation coefficient, and hierarchical linear regression were implemented for data analysis. Results. The participants included 156 men and 244 women. The overall frequencies for current substance/medication abuse, exhaustion, cynicism, inefficacy, and academic burnout were reported to be 27.5, 10.3, 12.3, 6.5, and 25.8 percent, respectively. The study results showed that physical activity, persistence, and cooperativeness were negative, and the years in medical school, current substance/medication abuse, and novelty seeking were positively associated with academic burnout. Also, the regression analysis results revealed the moderating effect of physical activity in the novelty-seeking-academic burnout link. Conclusions. These findings are an important contribution to the current literature on academic burnout as they can provide a meaningful guide to integrating treatment protocols designed to reduce both frequency and severity of this syndrome among medical students. However, the etiology of academic burnout among this highly sensitive group should be further investigated in depth.

Introduction

Considering the various stressors exerted upon medical students during their academic years, compared to the students of other faculties, this group of students present a higher number of psychological and mental issues.[1] These stressors caused during the ac-

ademic years of the medical field, which are caused by the competitive environment of this field in 80 percent of the cases, can result in 'academic burnout' in medical students; if this burnout continues on into the residency or beyond, it can lead to significant outcomes such as reduced quality of life, losing motivation, academic failure, reduced job satisfaction, anxiety, depression, sleep disorders, fatigue, substance abuse, and suicidal thoughts.[2-5] The overall meta-analytical prevalence for academic burnout among medical students has ranged between 32.66 and 42.05% with the highest prevalence in the Middle East and Oceania;[6,7] this variation in frequency is caused by various internal and external factors affecting academic burnout.[2-10]

A combination of mental and physical fatigue can constitute burnout, which is often exacerbated due to occupational and professional requirements.[8,9] While Bradley introduced the term 'burnout' for the first time in 1969,[11] Freudenberger was the first person to identify the importance of 'personality' in the concept of burnout.[12] According to Freudenberger,[12] people suffering from burnout syndrome are sensitive, introverted, emphatic to others, and greatly dependent on the recognition and affection of others, and due to these characteristics, they make themselves too distinct from others. Continuing research on burnout, in a comprehensive interview, observation, and psychometric development process, Maslach and Jackson elaborated a method for assessing burnout as a multidimensional construct, which was beyond 'mere exhaustion'.[13] Along with emphasizing interpersonal dimensions such as intrinsic characteristics and social supports, they define burnout as a syndrome that is characterized by states such as physical exhaustion, helplessness, long-term fatigue, infelicity feelings towards incomplete works, life, and negative habits and behaviors of others.[13] While at first the term 'burnout' was limited to the field of human service, in the late 1980s, it shifted from a literal reference to the psychological domain.[14] Emphasizing the effects of negative temperament exerted on the academic burnout of university students and considering their different responses to similar stressful situations, Jacobs and Dodd realized that when predicting academic burnout, personality variables require more exploration and investigation than external environments.[15] Moreover, by dividing factors related to burnout into three categories, *i.e.*, personal characteristics, organizational characteristics, and job and role characteristics, Cordes *et al*.[16] emphasized the important role of personality dimensions in the burnout development.

According to Cloninger's multidimensional model,[17] personality, as one of the factors affecting academic burnout, consists of the two dimensions of character and temperament. Temperament includes various dimensions such as novelty seeking, harm avoidance, reward dependence, and persistence.[17] Novelty seeking is characterized by exploratory excitability towards a new stimulus and harm avoidance is characterized by behavioral inhibition when facing harmful or abhorrent stimuli. Also, reward dependence is characterized by a tendency for significant response to social reward signals and persistence is characterized by the tendency to sustain behavior in the context of intermittent reinforcement.[17] On the other hand, character included various aspects such as self-directedness, cooperativeness, and self-transcendence.[17] These dimensions are characterized by accepting oneself as an independent individual, perceiving oneself as an integral of humanity, and accepting oneself as an integral part of the world (as a whole), respectively.[17] Previous scarcity studies have mostly shown the important role of temperament and character in the development of academic burnout.[8,9,18,19] For instance, it has been reported that burnout and harm avoidance are positively related, and self-directedness and cooperativeness are negatively reported.[8,9] In addition, novelty-seeking predicts burnout in a positive way, while persistence predicts burnout in a negative way.[9,18,19] Only one study has shown that people with high persistence are more vulnerable to burnout.[20] While many pathways have been considered as a basis for the interaction between personality and health, it seems that by affecting social cognitions (*e.g.*, attitudes, perceptions, self-efficacy, and norms) and through the health-behavior model, personality dimensions impact health-oriented behaviors.[21] Since the evolution of character can be accompanied by reduced temperamental vulnerability to specific psychological disorders and psychological burdens, this issue may be highly important in preventing academic burnout and its related disorders.[5]

Despite the significant role of personality in developing burnout, this syndrome cannot be considered the result of only one factor.[8,9] Diverse studies have been conducted to determine the personal, organizational, and social factors influencing burnout, and their results have shown the importance of some other factors such as socio-demographic characteristics (including age, gender, relational status, and household income),[2,3,5,6,22] physical activity,[8-10] and substance/medication abuse.[4] Exploring the relationship between socio-demographic characteristics and burnout has resulted in conflicting results. A recent systematic review and meta-analysis indicated a significant association between female gender and burnout syndrome.[6] Contrary to this result, one study has shown that academic burnout is significantly higher among men than women.[3] After all, some studies reported no significant difference between gender and academic burnout.[23,24] Age has also shown varying levels of correlation with academic burnout in different

studies. For instance, Maslach *et al*.[25] found out that with increasing age, burnout syndrome significantly decreases. This is while recent evidence reported a positive correlation between age and academic burnout.[3,6] There are also conflicting results with regard to relational status. Some studies introduce being single as a risk factor for burnout,[25] while others report being married as a burnout-related factor.[26] These conflicting results highlight the importance of a more detailed examination of these covariates in the personality dimensions-academic burnout relationship among medical students.

Physical activity, as another burnout-related factor, is defined as any type of body movement caused by contractions and expansions of skeletal muscles, causing increased heart rate and sweating.[10] While the positive impact of physical activity has been mainly confirmed on mental health, its role in decreasing academic burnout among medical students deserves more research attention.[10] The few studies carried out in recent years on the effects of regular physical activity on decreasing academic burnout among medical students are in favor of its potential positive effect on improving quality of life and reducing the risk of developing burnout syndrome in this group of individuals.[10] It is possible that physical activity can prevent the development of burnout syndrome because it raises the ability to overcome negative thoughts and master learning, modifies emotional action tendencies, temporarily alleviates the stress of the individual, and provides the necessary chance for finding a solution, reducing the individual's physical vulnerability to stress, increasing the availability of central neurotransmitters (*e.g.*, serotonin and endogenous opioids), and improving sleep quality (because it has been shown that sleep disturbance may be associated with an increased likelihood of academic burnout).[10] Therefore, it seems that low levels of activity in students, particularly medical students, can make them vulnerable to academic burnout.

The current study

The present study improves upon the earlier reports by using a large, representative sample of medical students and by controlling for socio-demographic characteristics (*e.g.*, age, gender, relational status, residence, household income, and years in medical school) and current substance/medication abuse as potential covariates. Additionally, in the current study, physical activity is expected to act as a buffer against academic burnout in medical students for the reasons mentioned earlier. This study also extends prior research by investigating whether or not physical activity moderates the relationship between personality dimensions and academic burnout. While several studies have recently provided empirical support for the main effect of physical activity on burnout syndrome,[10,27] little is known about the potentially positive contribution of physical activity as a protective mechanism in the personality dimensions-academic burnout link. Our too little information about this topic makes it even more important to find an experimental solution to this question: is there a simple relationship between personality dimensions and academic burnout or are there additional factors such as physical activity affecting this relationship? Accordingly, this study is intended to explore the relationship of personality dimensions and medical students' academic burnout and assess the physical activity's moderation effect on this relationship.

Materials and Methods

Study design, participants, and procedures

This is a cross-sectional study carried out in 2018 and after obtaining ethical approval to examine the factors associated with academic burnout among medical students and the physical activity's moderation effect on the personality dimensions-academic burnout link. Considering the 45 percent burnout symptoms prevalence rate in medical students,[6] a confidence level of 95 percent, and an error level of 5 percent, the sample size was calculated to be 379. Power analysis using the G*Power software v3.1.9.7 for 95% power, α=0.05, d=0.15, and 14 potential predictors also calculated a minimum sample size of 194 subjects.[6,28] Accordingly, 400 medical students from the four stages of basic sciences, physiopathology, stagership, and internship (100 people at each stage) were entered into the study. In order to control Berkson's bias, the participants were selected among medical students in Zahedan, Iran based on probability and using stratified sampling. The exclusion criteria for the study included not obtaining consent for participation in the research and improperly filling out questionnaires. After obtaining the informed consent of the participants, they were given the socio-demographic information form, Baecke physical activity questionnaire, Temperament and character inventory, and Breso's academic burnout questionnaire to fill out in 30 minutes.

Measures

The socio-demographic information form

A form was developed by the researcher that includes various variables, such as age, gender, relational status, residence, household income, and years in medical school.

Baecke physical activity questionnaire

The physical activity questionnaire was developed by Baecke *et al*.,[29] which comprises 25 items to measure various aspects of physical activity, and its validity

has been proved in various studies. This questionnaire includes three sections; the first section deals with the individual's various body postures, the second section is for people who engage in the first and second types of exercises, and the third section covers physical activity in free time. The questions are scored based on a Likert spectrum from 1 to 5. In the end, the scores for all three sections are summed together and the result determines the level of the individual's physical activity. The highest possible score for the level of physical activity is 15. In Iran, Sanaei *et al.*[30] reported its reliability to be 0.78. In our study, Cronbach's alpha coefficient was found to be 0.85.

Temperament and character inventory

This inventory was designed to evaluate the dimensions of personality, which has two dimensions, *i.e.*, temperament and character, based on the biopsychosocial model proposed by Cloninger.[31] This questionnaire consists of 125 items and it is only suitable for individuals who are 15 or older. Each one of the subscales in this inventory includes a number of questions. Each question gets a score of one and the score for each of the dimensions is obtained by adding the scores for the subscales of that dimension. The components of temperament include novelty seeking, harm avoidance, reward dependence, and persistence. Character includes components such as self-directedness, cooperativeness, and self-transcendence. The score for the components of temperament ranges from 0 to 60, and the score for the components of character ranges from 0 to 65. The reliability and validity of this questionnaire were also reported as suitable in Iran.[32] In our study, the Cronbach's alpha coefficients for all subscales ranged from 0.63 to 0.88.

Breso's academic burnout questionnaire

Breso *et al*.[33] first developed this questionnaire in 1997, which measures three areas of academic burnout (*i.e.*, exhaustion, cynicism, and inefficacy). This questionnaire includes 15 items which are scored based on the five-option Likert spectrum from 'completely disagree' to 'completely agree', with the total score ranging from 15 to 75. Also, the cutoff scores for academic burnout, exhaustion, cynicism, and inefficacy are set as 50, 20, 15, and 25, respectively. The reliability of the questionnaire was evaluated by Breso *et al*. based on internal consistency (Cronbach's alpha) and they reported coefficients of 0.70 for the subscale of exhaustion, 0.82 for the subscale of cynicism, and 0.75 for the subscale of inefficacy. Moreover, its validity was evaluated using confirmatory factor analysis, which showed that the incremental fit index, the comparative fit index, and the root mean square error of the approximation index were acceptable. The validity and reliability of this questionnaire were also reported as suitable in Iran.[34] In our study, the Cronbach's alpha coefficient for this questionnaire was 0.87 for the total scores.

Statistical analysis

Descriptive statistical methods, including mean and standard deviation, were used to evaluate the obtained data. Due to the significance of the Kolmogorov-Smirnov test ($P<0.05$), non-parametric tests were performed. To compare the data among different groups, the Kruskal-Wallis test was used, and Spearman's rank correlation coefficient was used to assess the correlations among the variables. In order to evaluate physical activity's moderating effect on the personality dimensions-academic burnout relationship, hierarchical linear regression was applied. In order to perform this analysis, at the first stage, socio-demographic variables were included in the analysis. As the second stage, by controlling the effects of socio-demographic variables, independent variables including physical activity, current substance/medication abuse, and personality dimensions were contained within the study. In the third and final stage, two-way interactive terms were entered into the analysis. For the obtained data to be analyzed, SPSS v25 software was used and the significance level was assumed to be lower than 0.05.

Results

In this study, 400 Iranian medical students including 156 men and 244 women were evaluated. Table 1 shows the socio-demographic information of the participants, including age, gender, relational status, residence, household income, and years in medical school. The frequencies of burnout, exhaustion, cynicism, and inefficacy were also calculated based on socio-demographic characteristics to be compared using the Kruskal-Wallis test (see Table 1). This table shows that the frequency of burnout is higher among older medical students. In addition, the frequency of cynicism was higher among male medical students; the frequencies of exhaustion and burnout were larger among single medical students with a household income lower than or equal to 1000$ per month. The comparison and calculation of the frequencies of exhaustion and burnout varied based on the years in medical school. Continuing with the analysis, the total frequencies of current substance/medication abuse, exhaustion, cynicism, inefficacy, and academic burnout were 27.5, 10.3, 12.3, 6.5, and 25.8 percent, respectively. Moreover, comparing the mean (standard deviation) of physical activity and the frequency (percentage) of current substance/medication abuse according to socio-demographic characteristics using the Kruskal-Wallis test shows some variations (see Table 2).

Table 1. Deterring and comparing the frequencies of variables of exhaustion, cynicism, inefficacy, and academic burnout based on socio-demographic characteristics.

	Total, N (%)	Exhaustion n (%)				Cynicism n (%)				Inefficacy n (%)				Academic burnout n (%)			
Frequency (Total)	400 (100)	41 (10.3)				51 (12.3)				26 (6.5)				103 (25.8)			
Frequency (Split file)		**n (%)**	**Mean rank**	**χ^2 (df)**	**P**	**n (%)**	**Mean rank**	**χ^2 (df)**	**P**	**n (%)**	**Mean rank**	**χ^2 (df)**	**P**	**n (%)**	**Mean rank**	**χ^2 (df)**	**P**
Age																	
18-23	221 (55.2)	13 (5.9)	187.83	5.96 (1)	0.015	19 (8.6)	193.34	1.90 (1)	0.167	17 (7.7)	199.55	0.03 (1)	0.885	52 (23.5)	191.54	2.97 (1)	0.085
24-29	179 (44.8)	28 (15.6)	216.15			32 (17.9)	209.34			9 (5)	201.67			51 (28.5)	211.57		
Gender																	
Male	156 (39)	22 (14.1)	209.16	1.44 (1)	0.230	26 (16.7)	221.80	8.74 (1)	0.003	16 (10.3)	205.32	0.44 (1)	0.503	48 (30.8)	211.30	2.23 (1)	0.135
Female	244 (61)	19 (7.8)	194.96			25 (10.2)	186.88			10 (4.1)	197.42			55 (22.5)	193.59		
Relational status																	
Single	335 (83.8)	38 (11.3)	206.71	5.98 (1)	0.014	46 (13.7)	205.36	3.66 (1)	0.056	26 (7.8)	202.89	0.88 (1)	0.348	92 (27.5)	206.24	5.08 (1)	0.024
Married	65 (16.2)	3 (4.6)	168.48			5 (7.7)	175.47			0 (0)	188.21			11 (16.9)	170.92		
Residence																	
With parents	120 (30)	13 (10.8)	201.63	3.19 (2)	0.202	12 (10)	192.58	2.75 (2)	0.252	2 (1.7)	186.18	2.84 (2)	0.241	28 (23.3)	192.34	2.17 (2)	0.337
Dormitory	214 (53.5)	20 (9.3)	193.19			28 (13.1)	198.56			18 (8.4)	208.33			54 (25.2)	199.59		
Tenant	66 (16.5)	8 (12.1)	22.14			11 (16.7)	221.19			6 (9.1)	201.14			21 (31.8)	218.28		
Household income																	
≤1000$	301 (75.2)	35 (11.6)	210.97	0.03 (1)	0.002	44 (14.6)	206.65	3.46 (1)	0.063	20 (6.6)	204.36	1.36 (1)	0.243	86 (28.6)	209.41	7.23 (1)	0.007
>1000$	99 (24.8)	6 (6.1)	168.66			7 (7.1)	181.81			6 (6.1)	188.76			17 (17.2)	173.41		
Years in medical school																	
First	68 (17)	0 (0)	132.90	68.92 (4)	< 0.001	4 (5.9)	175.38	12.94 (4)	0.012	4 (5.9)	176.23	4.91 (4)	0.297	7 (10.3)	150.46	31.51 (4)	< 0.001
Second	58 (14.5)	1 (1.7)	145.17			5 (8.6)	182.91			5 (8.6)	219.10			10 (17.2)	175.43		
Third	80 (20)	1 (1.3)	186.47			5 (6.3)	183.71			7 (8.8)	198.90			20 (25)	184.76		
Fourth	77 (19.2)	11 (14.3)	243.20			13 (16.9)	226.27			0 (0)	199.73			26 (33.8)	235.16		
Other	117 (29.3)	28 (23.9)	248.71			24 (20.5)	218.34			10 (8.5)	206.98			40 (34.2)	229.97		

According to the results in this table, the mean score of physical activity was lower among older and single medical students with a household income lower than or equal to 1000$ and with a higher number of years in medical school. In addition, the frequency of current substance/medication abuse was higher among older male medical students with a higher number of years in medical school. In order to evaluate the intergroup difference in the subgroups of years in medical school, pairwise comparisons were used (see Figure 1). In the subscale of exhaustion, except for the first-second year, second-third year, and fourth-other year, all the groups had significant differences (Figure 1A). In the subscale of cynicism, the difference among none of the groups was significant (Figure 1B). With regards to burnout, the only significant differences were between the first-fourth year, the first-other year, the second-fourth year, and the second-other year (Figure 1C). With regard to physical activity, there was only a difference between the first-other year and the third-other year (Figure 1D). With regard to current substance/medication use, the only significant difference was observed between the first-fourth year and first-other year (Figure 1E).

The correlation matrix of the research variables showed a medium negative correlation between burnout and physical activity, between burnout and persistence, between burnout and cooperativeness, and between burnout and self-directedness; while there was a medium positive correlation between novelty seeking and burnout. Moreover, there was a weak positive correlation between burnout and harm avoidance. Furthermore, there was a medium and positive correlation between burnout and current substance/medication abuse (Table 3).

To evaluate the physical activity's moderating effect on the link between temperament and character characteristics and academic burnout, hierarchical linear regression was used. In the first stage, based on the Kruskal-Wallis test results, three socio-demographic variables of relational status, household income, and years in medical school were entered into the analysis. In Model 1, the coefficient of determination (R^2) was calculated as 0.104, showing that 10.4 percent of the variable of burnout can be explained by the variables of relational status, household income, and years in medical school. Considering the significance of the model (P<0.001) in the Fisher test, it can

Table 2. Determining and comparing the mean values (M) and standard deviation (SD) of physical activity and the frequency (%) of current substance/medication abuse based on socio-demographic characteristics.

Variables	Physical activity, M (SD)[a]	Current substance/medication abuse, n (%)[b]						χ^2 (df)[a], χ^2 (df)[b]	p[a], p[b]
		Total	Medication	Opium	Cannabis	Alcohol	Cigarette		
		110 (27.5)	83 (20.8)	8 (2)	19 (4.8)	37 (9.3)	64 (16)		
Age									
18-23	7.55 (1.78)	48 (21.7)						4.17 (1), 8.25 (1)	0.041, 0.004
24-29	7.26 (1.86)	62 (34.6)							
Gender									
Male	7.39 (1.94)	57 (36.5)						0.17 (1), 10.45 (1)	0.679, 0.001
Female	7.44 (1.75)	53 (21.7)							
Relational status									
Single	7.30 (1.79)	96 (28.7)						8.37 (1), 1.38 (1)	0.004, 0.240
Married	8.02 (1.89)	14 (21.5)							
Residence									
With parents	7.55 (1.82)	31 (28.5)						2.25 (2), 3.10 (2)	0.325, 0.211
Dormitory	7.42 (1.81)	55 (25.7)							
Tenant	7.20 (1.86)	24 (36.4)							
Household income									
≤1000$	7.30 (1.83)	89 (29.6)						6.40 (1), 2.60 (1)	0.011, 0.107
>1000$	7.79 (1.76)	21 (21.2)							
Years in medical school									
First	7.95 (1.93)	10 (14.7)						23.27 (4), 16.58 (4)	<0.001, 0.002
Second	7.54 (1.80)	12 (20.7)							
Third	7.83 (1.85)	17 (21.3)							
Fourth	7.23 (1.78)	29 (37.7)							
Other	6.90 (1.64)	42 (35.9)							

[a]Physical activity; [b]current substance/medication abuse.

Table 3. The correlation matrix for study variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
Physical activity	-												
Novelty seeking	-0.40**	-											
Harm avoidance	-0.29**	0.28**	-										
Reward dependence	0.06	0.09*	0.00	-									
Persistence	0.62**	-0.37**	-0.26**	-0.04	-								
Self-directedness	0.57**	-0.44**	-028**	0.01	0.61**	-							
Cooperativeness	0.58**	-0.45**	-0.34*	0.04	0.62**	0.87**	-						
Self-transcendence	-0.03	0.06	0.07	0.19**	-0.05	-0.13**	-0.09	-					
Exhaustion	-0.60**	0.37*	0.19**	-0.03	-0.53**	-0.43**	-0.48**	0.03	-				
Cynicism	-0.66**	0.45**	0.23**	-0.02	-0.61**	-0.57**	-0.58**	0.03	0.59**	-			
Inefficacy	-0.54**	0.28*	0.15**	-0.01	-0.48**	-0.41**	-0.39**	0.07	0.22**	0.38**	-		
Academic burnout	-0.80**	0.48**	0.28**	-0.04	-0.71**	-0.64**	-0.65**	0.05	0.76**	0.83**	0.68**	-	
Current substance/ medication abuse	-0.43**	0.31**	0.01	-0.01	-0.37**	-0.38**	-0.38**	-0.02	0.45**	0.51**	0.35**	0.57**	-

*P<0.05; **P<0.01.

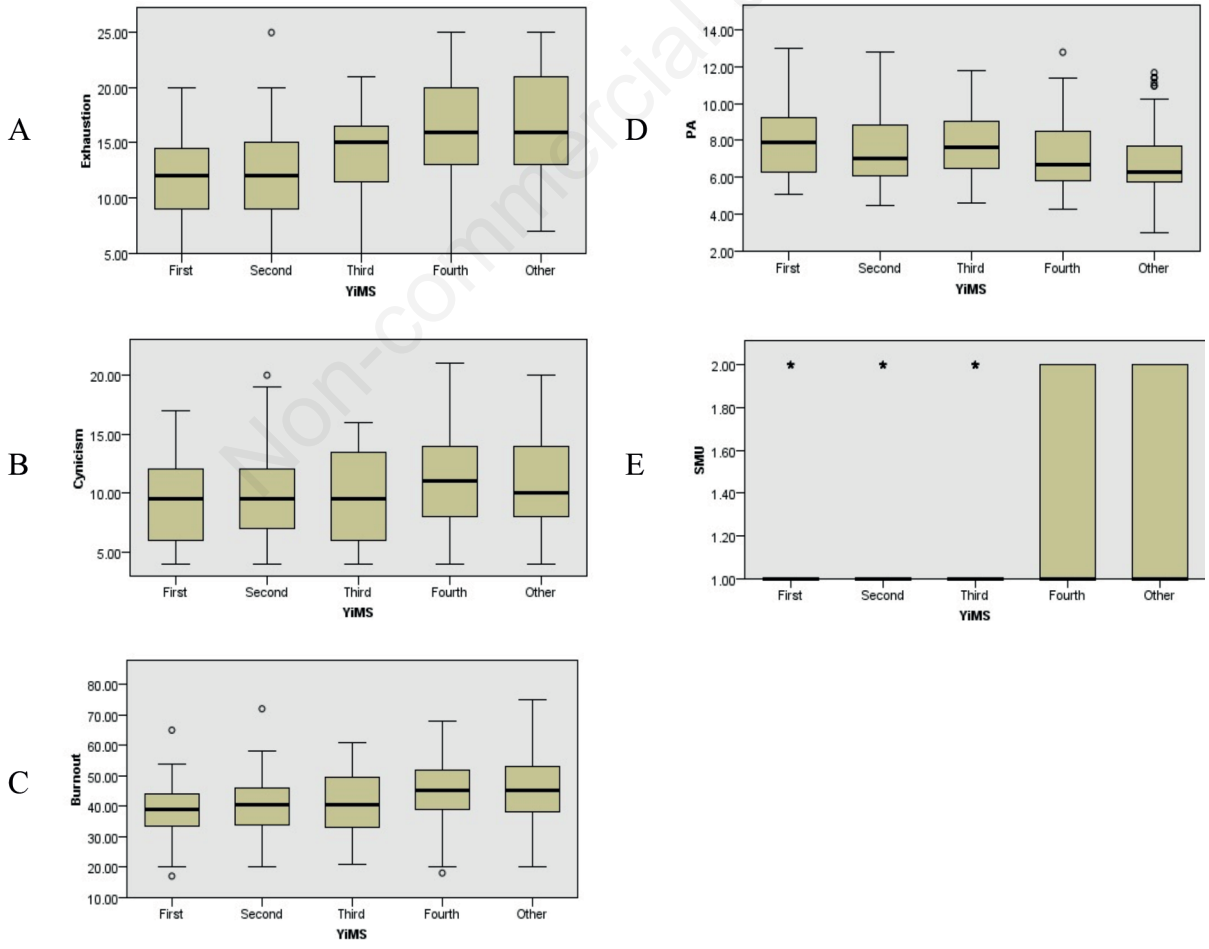

Figure 1. Pairwise differences of years in medical school. PA, physical activity; SMU, current substance/medication abuse; YIMS, years in medical school.

be inferred that the variables of relational status, household income, and years in medical school can related to burnout syndrome among medical students.

In the second stage, the variables of physical activity, current substance/medication abuse, novelty seeking, harm avoidance, persistence, self-directedness, and cooperativeness were incorporated into the analysis by controlling the effects of relational status, household income, and years in medical school. In Model 2, R^2 was calculated as 0.769, which shows that these variables explain 76.9 percent of the variable of burnout. Considering the significance of the model ($P<0.001$) in the Fisher test, it can be inferred that physical activity, current substance/medication abuse, novelty seeking, persistence, and cooperativeness can have an association with burnout syndrome among medical students ($\Delta R^2=0.66$, $P<0.001$).

In the third and final stage, two-way interactive terms were entered into the analysis. In Model 3, R^2 was calculated as 0.775, showing that 77.5 percent of the variable of burnout is explained by the role of the predicting variables. Considering the significance of the model ($P<0.001$) in the Fisher test, it can be inferred that the two-way interactive effect of physical activity × novelty seeking can affect burnout syndrome among medical students ($\Delta R^2=0.006$, $P<0.001$) (Table 4).

Discussion

The current study was designed and carried out on 400 Iranian medical students to explore the relationship of factors such as socio-demographic characteristics, personality dimensions, current substance/medication abuse, and physical activity with medical students' academic burnout and the physical activity's moderating effect on the link between personality dimensions and academic burnout. The results of the study showed that the total frequencies of exhaustion, cynicism, inefficacy, and academic burnout are 10.3, 12.3, 6.5, and 25.8 percent, respectively. In general, compared to similar studies carried out around the world, the levels of academic burnout and its subscales in the current study were lower,[6,7] and the cause for this result must be clinically investigated. Since academic burnout is a multifactorial disorder that is influenced by various internal and external factors such as personality dimensions,[8,9,18,19] socio-demographic characteristics (including age, gender, relational status, and household income),[2,3,5,6,22] physical activity,[8-10] and current substance/medication abuse (particularly alcohol),[4] this variable can show various levels based on the biopsychosocial differences among medical students in various communities. For instance, in the current study, alcohol consumption among Iranian medical students was lower than that of similar studies (9.5 percent *vs*. 15 percent).[35] Another point is the clear role of social support, particularly from friends, family, and significant others, in reducing academic burnout.[15,36] Compared to the United States and some European countries, because of the high level of social supports (particularly in the women's community) in Iran, the risk of burnout is lower. Another important factor is the difference in the curricula of various medical schools. In fact, there are

Table 4. Summary of the regression analysis for evaluating the moderation effect of physical activity on the link between personality dimensions and academic burnout of medical students.

Variables	Model 1		Model 2		Model 3	
	B (β)	SEB	B (β)	SEB	B (β)	SEB
Stage I: covariates						
Relational status	-3.93 (-0.13)**	1.38	-0.27 (-0.00)	0.72	-0.212 (-0.007)	0.72
Household income	-2.36 (-0.09)*	1.18	-0.51 (-0.02)	0.61	-0.33 (-0.01)	0.62
Years in medical school	2.03 (0.27)***	0.35	0.76 (0.10)***	0.19	0.80 (0.11)***	0.19
Stage II: predictors						
Physical activity (PA)			-2.39 (-0.40)***	0.19	-0.95 (-0.16)***	0.67
Current substance/medication abuse			5.75 (0.24)***	0.67	5.74 (0.24)***	0.67
Novelty seeking (NS)			0.42 (0.11)***	0.10	1.27 (0.35)**	0.42
Harm avoidance			0.01 (0.00)	0.10	0.01 (0.00)	0.10
Persistence (PS)			-1.84 (-0.20)***	0.31	-1.73 (-0.19)***	0.31
Self-directedness			-0.08 (-0.03)	0.12	-0.06 (-0.02)	0.12
Cooperativeness (CO)			-0.26 (-0.10)*	0.13	-0.32 (-0.12)*	0.13
Stage III: moderators						
PA × NS					-0.11 (-0.25)*	0.05
PA × PS					-0.57 (-0.05)	0.32
PA × CO					-0.39 (-0.03)	0.37
R^2	0.104	0.769	0.775			
F	F (3, 396)=15.27***		F (10, 389)=129.70***		F (13, 386)=102.04***	

*P<0.05; **P<0.01; ***P<0.001.

huge differences in the demography of medical students between Canada, the United States, and Australia and between Iran and some European countries, such as the United Kingdom, Sweden, and Spain in terms of age of matriculation, preliminary bachelor degree, and the curriculum.[24,37,38] In Iran, students can enter medical schools at the age of 18 or 19, without any need for a preliminary bachelor degree. On the other hand, the students are responsible for the selection of rotations and the organization of hospital shifts in Iran. Moreover, the level of direct engagement of Iranian medical students in the care of the patient is significantly lower than in other countries and the main clinical burdens will be put on residents and university professors. These conditions cause the burnout levels to be significantly lower among Iranian medical students compared to the medical students of other countries.

Moving on, the results of the study revealed that the frequency of burnout is higher among older medical students, and cynicism is higher among male medical students, which is in line with the results of Willcock *et al.*[39] and in conflict with the results of Santen *et al*.[38] who didn't observe a significant difference between the two genders. Furthermore, the frequencies of exhaustion and burnout were higher among single medical students with a household income of 1000$ or less, which is consistent with the results obtained by Irshad *et al*.[22] and in conflict with the results of Russel and colleagues.[26] On the other hand, the frequencies of exhaustion, cynicism, and burnout show some differences regarding the number of years in medical school. In addition, the frequency of current substance/medication abuse was higher among older male medical students with a higher number of years in medical school. These findings can be explained by mentioning that many medical students report that when entering the medical field, they have altruistic ideals, heroic images of themselves, and fantasies of healing the sick. Therefore, in order to realize these goals, medical students internalize compulsive type 'A' behavior patterns oriented toward approval and achievement. Within the final years of medical school, the ability to realize these ideals can be subjected to serious threats, which will be an underlying factor for psychological distress. Hence, the burnout process triggered by excessive attempts to meet some of these unrealistic expectations exerted upon the individual (whether by himself/herself or by the society) can lead to the development of mental and physical exhaustion, and ultimately reduced efficiency. In a similar study carried out by Macilwraith and Bennett in 2018 on 383 Irish medical students,[40] female medical students showed a significantly higher exhaustion, which is inconsistent with the findings of our study where no momentous difference existed between female and male students in terms of the level of exhaustion. It seems that this difference can be explained by considering insignificant differences among female and male students in terms of personality dimensions,[8,9,18,19] socio-demographic characteristics,[2,3,5,6,22] and physical activity.[8-10] However, in the current study, the frequency of current substance/medication abuse was significantly higher among male medical students, which can be a justification for the greater levels of cynicism among male medical students. Nevertheless, in our study, physical activity mean scores didn't show any significant difference in terms of gender, which is in conflict with the results of preceding studies. For instance, Macilwraith and Bennett showed that the total activity score was larger among male subjects.[40] Contrarily, the results of Webb *et al.*[41] and Hao *et al.*[42] demonstrated that the total activity score is higher among female medical students. Previous research showed a decrease in physical activity levels among medical students during their studies in medical school,[43-45] which is in line with our results. This finding can be justified by considering the increasing difficulty of courses, the exams, the working hours, and the occupational and professional demands and requirements during the educational years in medical schools.[40]

The correlation matrix for the research variables showed a medium negative correlation between burnout and persistence, between burnout and self-directedness, and between burnout and cooperativeness, while there was a medium positive correlation between burnout and novelty-seeking. Moreover, there was a weak positive correlation between burnout and harm avoidance. There is a suitable agreement between these results and the results of previous research only in a study carried out by Stoyanov and Cloninger in 2012,[8,9,18-20] persistence was considered as a positive predicting variable for burnout. However, the other results of their study had consistency with our findings.[20] Nevertheless, based on the results of our study and previous research, it seems that positive personality dimensions (*e.g.*, energy and optimism) can function as a buffer for stressors and hopelessness, thereby inhibiting dysfunction and inefficacy of medical students.[15] This interpretation in our study is significantly supported by the medium negative correlation observed between persistence and academic burnout. Furthermore, our study shows a medium positive correlation between burnout and physical activity as well as a medium positive correlation between current substance/medication abuse and exhaustion, cynicism, inefficacy, and burnout. These findings agree with the results obtained by Gerber *et al.*[46] and Cecil *et al*.[47] while they are in conflict with the results of the study by Macilwraith and Bennett where they show that there is an insignificant relationship between exhaustion and physical activity.[40]

Moreover, our study implies physical activity as a potential moderator in the novelty-academic burnout relationship. In order to explain these results, it can be said that physical activity can reduce academic burnout in medical students in different ways including: i) promoting mastery learning and the ability to cope with negative thoughts;[10] ii) modification of emotional action tendencies as a fundamental therapeutic strategy according to Barlow, Allen, and Choate;[48] iii) temporary freeing individuals from stress and giving them the chance for reviving personal resources necessary for re-encountering occupational requirements.[10] On the other hand, physical activity is able to inhibit the development of academic burnout by reducing the physical vulnerability of individuals to stress by increasing blood pressure and heart rate, as well as increasing access to central neurotransmitters (namely, serotonin and endogenous opioids), which are responsible for anti-depression effects in the body.[10]

Limitations and future directions

The current study faced a number of limitations as well. The small sample size and selection of participants from a single geographical location, once the results of this study are supposed to be generalized to other populations, account for the first limitation. Therefore, it is necessary to conduct similar studies in other locations around the world in order to accurately determine the risk factors for academic burnout. The second limitation was that in a cross-sectional study, we cannot be certain about the cause and the direction of a relationship. For instance, in our study, it is possible that burnout is the underlying cause of substance/medication abuse, and then the combination of these two increases the individual's burnout. Therefore, by designing longitudinal studies, this limitation can be mitigated. The third limitation is the increased chance of recall bias in this study using self-reported data. This limitation can be markedly resolved by interviewing individual participants in future research. The fourth limitation was that the results of regression analysis showed that only 0.6% of the burnout variable is explained by the two-way interactive effect of physical activity × novelty-seeking, which indicates a trivial and scientifically limited effect. Therefore, it is necessary for health policy-makers and planner to exercise caution when designing interventions based on the results of this study aimed at increasing medical students' health-promoting behaviors. The fifth and last point is that other factors affecting academic burnout among medical students such as social support,[49] social media use,[50] physical and mental workload,[4] and other variables that might play a role in developing academic burnout among medical students must be considered in future studies.

Conclusions

Despite the above limitations, our study improved psychopathological comprehension of academic burnout among medical students. To the best of our knowledge, the present work is one of the few studies that equally evaluated and compared the impact of sociodemographic characteristics, substance/medication abuse, personality dimensions, and physical activity on academic burnout. This systematic evaluation provided a better opportunity to observe physical activity as a protective factor in burnout syndrome and allowed us to find specific relationships between personality dimensions, physical activity, and academic burnout. Understanding such internalized representations can be essential for developing preventive approaches and therapeutic interventions in medical students' academic burnout.

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