Pakistan Journal of Surgery & Medicine

The effect of physical activity on stress levels of medical students: A cross-sectional analysis

Original Article

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ABSTRACT

Background: Medical students are well known to work long hours, have financial difficulties, and face intense competition to succeed which may predispose them to significant psychological stress. Physical Activity may provide relief to stress in this population.

Objectives: To evaluate the effect of physical activity on the reduction of stress in medical students in a developing country.

Methods: Between April and May 2015, medical students at a private medical college within Karachi, Pakistan participated in a cross-sectional study to evaluate physical activity and stress levels. Questionnaires were distributed to all medical students by convenience sampling. A three-part questionnaire was developed based on the Perceived Stress Score to evaluate for the presence of stress. Patient demographics, Perceived Stress Score, participation, and the total duration of physical activity per week were obtained. Participants were also instructed to answer questions on other activities that they may be performing with the intention to relieve stress.

Results: A total of 235 participants were identified for further analysis. Based upon the Perceived Stress Scale (PSS), 30.3% of the medical students were found to have evidence of the stress with a mean PSS score of 16.95 ± 5.72. Participation in physical activity was found to cause a reduction in stress levels with medical students not reporting exercise is twice as likely to be stressed (OR 0.48, p = 0.015). In addition, the total duration of physical activity per week (>4 vs <2) was seen to be independently related to reduced PSS score (16.2 vs 18.2, p=0.028).

Conclusion: Both participation and longer duration of physical activity per week are associated with a significant reduction in stress levels within medical students.

Keywords: Stress, medical student, exercise, activity, burnout, college

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doi:
10.37978/pjsm.v1i2.167
Submission: Oct 30, 2019
Acceptance: Apr 27, 2020
Publication: May 11, 2020.

INTRODUCTION

Psychological stress is a term synonymous with a perception of increased pressure which occurs when an individual may not adequately cope with demands expected of them.[1] This pathology is widely recognized to be experienced by medical students, residents, and early physicians undergoing medical education and training resulting in a significant effect on their mental health.[2]

A well-established link exists between mental health and physical activity; a meta-analysis of experimental and observational studies revealed that exercise improves stress levels within both healthy individuals in addition to those with psychiatric and emotional disorders.[3] Current data suggest that participation in moderate-intensity physical exercise for a period of 15 to 30 minutes per day results in a reduction of stress, anxiety, depression, and mental health disorders within the general population.[4, 5] The improvement in mental health-related symptoms has been attributed to a reduction in distraction and cognitive dissonance while simultaneously improving self-efficacy.[6]

HYPOTHESIS

A biochemical hypothesis for these changes in anxiety, depression, and other mood disorder may be best explained by the monoamine and endorphin hypothesis.[6] The hippocampal 5HT1A receptor-mediated cAMP/PKA/CREB signaling pathway disturbance results in a depressed mind, it is thought that this signal pathology is improved by chronic exercise which subsequently produces improved mental health outcomes.[7]

Depression is typically managed with a combination of psychological and pharmaceutical therapy, however, there may be a significant benefit in symptom control by the addition of alternative approaches such as physical activity.[8] In the evaluation of stress, the gold-standard remains the perceived stress scale; this 14-item questionnaire contains 7 positive and 7 negative items, each of which is assigned a numerical value between 0-4 based on symptoms, subsequently, the sum of 7 negative stress questions are subtracted from the sum of the 7 positive questions to establish a final score.[9]

Although the use of physical exercise to improve symptoms of mental health in the general population, the specific effect of this physical activity on medical students in a developing country is less well known. We hypothesize that a reduction in stress levels may be seen with physical exercise. Subsequently, to evaluate this we evaluated the effect of physical activity and stress based on the perceived stress scale.

MATERIALS AND METHODS

A cross-sectional survey was distributed to medical students between April and May 2015 in a private medical college associated with a tertiary care hospital within Karachi, Pakistan. Before the initiation of the study, consent was obtained from all participating medical students with written informed consent which was supervised by the ethical review committee. Medical students from all years (1-5) were included for participation in the study regardless of whether they reported regular participation in physical activity or not.

Convenience sampling was utilized to select subjects for survey distribution however to reduce selection bias, attempts were made to distribute the survey evenly between all five groups. The initial section of the questionnaire queried the medical students' demographic information which consisted of the participants' age, residence (on-campus residence vs off-campus day scholar), and year of medical school enrollment. Also, the survey inquired about frequency, type, and total time spent on physical activity for 1 week.The second part of the survey evaluated stress levels within the participating medical students, the questionnaire utilized assessment based upon the Perceived Stress Scale.[9] A 5-point scale, from a minimum of 0 (rarely) to 4 (almost always) was used to evaluate responses. The questionnaire was not modified from its original form. Answers to negative questions were summed together followed by subtraction from the sum of positive questions. Participants with a Perceived Stress Scale score of < 20 were identified to not be stressed however participants with a score of ≥20 were acknowledged as being stressed.

The third part of the survey comprised of questions regarding alternative stress-relieving practices employed by medical students who were not related to physical activity. Medical students were not given limited choices to answer these questions and were free to report any activity which relieved stress for them such as hobbies or meditation.

The appropriate sample size for the study was calculated by a descriptive study open-source calculator with OpenEpi software version 3.0. Precision for the study was maintained at 5% with an anticipated stress percentage frequency of 50% which resulted in a total calculated sample size of 218. The sample size was inflated to 235 given anticipation for refusal of participation and non-responders.

EpiData version 3.1 was utilized for data entry and collection. The data was subsequently transferred to a Microsoft Excel Sheet following which analysis was completed by IBM SPSS version 19.0. A total of 4 response questionnaires had incomplete data and were subsequently removed from the final analysis. Tables related to baseline demographics and between physically active medical students was established. A bar chart illustrated the correlation between physical activity per week and Perceived Stress Scale scores. Subsequently, odds ratios were calculated for variables to locate significant factors.

RESULTS

A total of 235 participants met the inclusion criteria for the study. Table 1 describes the demographic characteristics, participation in physical activity, and stress levels of the medical student subjects. Although both males and females were represented in our study sample, the later were marginally more frequent (52.8%). Third-year medical students were the most represented class (30.2%) whilst a majority of the participants resided in university housing (59.1%). Participants were aged between 17 and 27 years with a mean age of 21.44 ± 1.663 years. A large portion of the study population (72.3%) were physically active and were involved in a minimum of 1 form of exercise.

Medical Students most frequently reported running (45.5%) as their preferred form of physical activity although jogging (29.8%), swimming (27.7%), football (23.0%) and floor exercises (23.0%) were also popular. Less frequent but other reported activities included dancing, horse riding, martial arts, and tae-kwon-do. Study participants who reported physical activity most

Baseline Characteristics	Frequency (%)
Gender (n=235)	
Male	111 (47.2)
Female	124 (52.8)
Year of Study (n=235)	
1	42 (17.9)
2	18 (7.7)
3	71 (30.2)
4	70 (29.8)
5	34 (14.5)
Residence Status (n=235)	
On-campus residence	139 (59.1)
Day Scholar	96 (40.9)
Physical Activity (n=235)	
Yes	170 (72.3)
No	65 (27.7)
Stress Level (n=231)	
Insignificant	161 (69.7)
Significant	70 (30.3)

Table 1: Demographics, participation in physical activity, and stress levels of the subjects.

	Stress n(%)	No Stress n(%)	P-value	Odds Ratio
Physical activity +	43 (25.7)	124 (74.3)	0.015	0.475
Physical activity -	27 (42.2)	37 (57.8)		
Consistency of physical activity +	24 (22.4)	83 (77.6)	0.125	0.578
Consistency of physical activity –	20 (33.3)	40 (66.7)		
Mental Imagery +	27 (25.0)	81 (75.0)	0.084	0.605
Mental Imagery -	43 (35.5)	78 (64.5)		
Breathing Exercises+	15 (25.9)	43 (74.1)	0.381	0.742
Breathing Exercises -	55 (32.0)	117 (68.0)		
Meditation +	17 (25.8)	49 (74.2)	0.342	0.733
Meditation –	53 (32.1)	112 (67.9)		
Personal Hobbies +	42 (26.3)	118 (73.8)	0.044	0.547
Personal Hobbies -	28 (39.4)	43 (60.6)		
Extracurricular activities +	32 (27.4)	85 (72.6)	0.319	0.743
Extracurricular activities -	38 (33.6)	75 (66.4)		

Table 2: Relation between stress with physical activity and other stress relieving factors

commonly stated that they were involved in the chosen activity for an average of 2-4 hours per week (22.6%). A minority of medical students reported involvement in physical activity for > 5 hours per week (15.0%).

A total of 70 participants (30.3%) were classified to be stressed based on the Perceived Stress Scale. The number of participants with each calculated Perceived Stress Scale score (PSS) is shown in the bar graph in Figure 1. Medical students had PSS scores which were between 2 and 30 points. The mean PSS score was 16.95 ± 5.72 whereas the median PSS score was 17. A large portion of the participants had a borderline PSS

score of 20 which was associated with a diagnosis of stress. Population distribution was negatively skewed.

A significant co-relation was witnessed between physical activity and stress levels within medical students (p=0.015). Evaluation of secondary factors and stress levels in medical students is compared in Table 2. Medical students who took part in their hobbies were found to be significantly less stressed (p=0.044), however other secondary factors including meditation, breathing exercises, mental imagery, and extracurricular activities were not associated with a reduction in stress. The participation of medical students in consistent physical activity was likely to result in stress reduction, however, statistical significance could not be attained.

Perceived Stress Scale scores and physical activity were compared utilizing one-way ANOVA with stratification based on several hours per week, (< 2 hours, 2-4 hours, > 4 hours). The duration of physical activity was associated with a reduction in stress level (F=2.475; p=0.008). Post-hoc statistical analysis was completed with Fisher's test. Medical students with >4 hours of exercise per week had a significantly lower PSS score (-2.94, p=0.028) when compared to participants with a total duration of the exercise of < 2 hours per week.

DISCUSSION

Females were slightly more populous within the study population (52.8%), this is in-line with prior reported literature on higher female prevalence within medical schools, and given this, it may be presumed that our reported findings may be generalized to other medical students.[10-13] A drawback of convenience sampling is an unequivocal number of participants from each medical school year with first (17.9%), second (7.7%), third (30.2%), fourth (29.8%), and fifth (14.5%) year students. Prior literature has suggested that disparities exist between prevalence and management techniques of stress within different years of medical school enrollment with a recent study, which utilized the Perceived Stress Scale reported that 59.7% of students suffered from stress.[12-13]

Our study reported that second and fifth medical students were most frequently stressed (71.6% and 71.1%), whereas fourth (53.3%), first (50.0%), and third (50.0%) year students were less likely to experience stress. This is in contrast to prior data which suggested that first- and third-year medical students had higher stress levels however without statistical significance. [14] The difference in stress levels between different

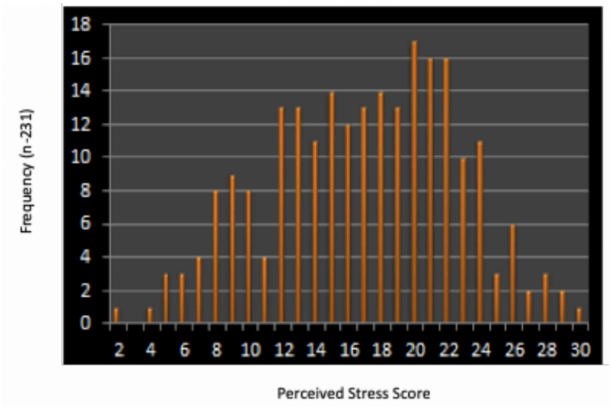

FIGURE 1: DISTRIBUTION OF PERCEIVED STRESS SCORES OF THE STUDY POPULATION (N=231)

academic years is likely multifactorial; given schedule differences, workload, and variations in types of education-related activity. Despite this, our reported prevalence of stress was much lower than prior studies which may be attributed to differences in medical school curriculum and emphasis on student well-being. [15] These confounding factors can result in lower participation in physical activity and lead to the discrepancies seen in the literature.Participants were characterized as stressed (≥ 20) or non-stressed (<20) based on the Perceived Stress Scale questionnaire.[9] A minority of medical students demonstrated significant stress (30.3%) which was found to be lower than both national (41.7%) and international (49.0%) data.[14, 16] Results may have been confounded with medical students participating in the study within 1 week of their exams. Despite this, other cross-sectional studies have shown similar results with a questionnaire-based study reporting stress was associated with predisposing psychosocial (OR 5.01, 95% CI 2.44-10.29) and academic-related (OR 3.17 95% CI 1.52-6.68) factors in medical students.[16] The reason for stress in medical students is broad, with common factors including high workload, parental expectations, exam frequency, extensive curriculum, financial pressure, isolation, and frequent self-reflection on plans which cumulatively result in a detrimental effect on academic performance ($r = -0.099$, $p > 0.05$).[17]

To help alleviate or reduce stress the involvement in sporting and social activities has had positive effects. [14] The use of exercise has particularly been helpful in students, with the population reporting improved capability to cope with stress and emotional trauma of medical school.[18] Our study validated these claims; of the 170 medical students who stated they took part in physical activity, 74.3% were found to have insignificant levels of stress in their life. In contrast in participants who denied physical activity, 42.2% were

categorized to have stress. There was a significant difference between those who did or did not exercise (p=0.015).

Confounding factors were evaluated within the 3rd portion of the questionnaire. Open-ended questions were inquired from medical students concerning activities utilized by them to de-stress. Medical students stated that they participated in personal hobbies, social interaction, meditation, mental imagery, breathing, and extracurricular activities to help alleviate stress. These activities were analyzed concerning the presence of stress with involvement in personal hobbies the only significant factor to reduce stress in participants (p 0.044, OR 0.547, 95% CI = 0.26-0.87).

Physical activity was found to significantly reduce stress levels in medical students in our study and the prevalence of stress was approximately two times more in participants who did not participate in physical activity. Besides, a positive correlation was found between the total duration of exercise per week (>4 hours vs <2 hours) and reduction in stress levels (mean difference of PSS score -2.94, p=0.028). Hence our study associates physical activity with a reduction in stress level.

CONCLUSION

Our results indicated that medical student involvement in physical activity results in a significant decrease in observed stress levels. Besides, a longer total duration of exercise per week can result in further improvement in stress levels. Medical students are likely to experience more stress than the general population and management are of this pathology is of utmost importance. We recommend that curriculum changes be considered to allow more exercise dedicated time for medical students. Besides, medical students should be screened for stress and be given appropriate help if deemed at risk.

As with other cross-sectional studies, our analysis was limited due to the inference between causality and temporality. Although physical activity likely relieves academic or psychosocial stressors, given our study design we cannot conclude this with certainty.

Prospective cohort studies may be performed in the future to help correlate physical activity with the incidence of psychological symptoms. We also believe recall bias may have occurred due to the distribution of a self-administered questionnaire. Given our study involved a single medical school, generalization of results to academic institutions across the globe may be difficult.

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AUTHOR CONTRIBUTIONS

NB, NB & MNK did Data Collections, Article Writing, statistical analysis & manuscript submission.
AA, AA, DS, MHB, AM, AM & ISK were involved in data collection.
SS did supervision of whole process.

ETHICAL CONSIDERATION

Institutional Review Board of the Aga Khan University granted ethical approval to authors on 29 June 2015.

HOW TO CITE

Butt N, Bader N, Khan MN, Allana A, Ashraf A, Siddiqui D, Baig MH, Mahmood A, Malik A, Khalek IS, Saleem S. The effect of physical activity on stress levels of medical students: a cross-sectional analysis. Pak J Surg Med. 2020;1(2):100-105. doi: 10.37978/pjsm.v1i2.167

CONFLICT OF INTERST

The author declared no conflict of interest

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MANUSCRIPT PROCESSING

Submission: PJSM-2019-000167-O-**30-Oct-2019**
Processing:
PJSM-2019-000167-P-19-Dec-2019
PJSM-2020-000167-E-22-Jan-2020
PJSM-2020-000167-C-11-Mar-2020
Acceptance: 27-Apr-2020
Publication: 11-May-2020

EDITORIAL TEAM

PUBLISHER NOTE