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ORIGINAL ARTICLE

Perceived stress and its effect on cardio-respiratory system in first year medical students.

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ABSTRACT… Objectives: To determine the correlation of perceived stress with blood pressure and pulmonary function tests in normal, healthy first-year medical students. **Study Design:** Cross Sectional study. **Setting:** Department of Physiology, Al-Tibri Medical College, Isra University Karachi Campus. **Period:** July 2021 to January 2022. **Material & Methods:** Data from 72 students enrolled during academic year 2021-22 were evaluated who met the inclusion criteria. The sphygmomanometer was used to measure the blood pressure parameters, and the Biopac ® data acquisition system was used to measure the pulmonary function test variables. A ten-item classic stress assessment questionnaire was used to evaluate the perceived stress scale, and the observed values were then correlated with the variables of blood pressure and pulmonary function tests. **Results:** The majority of the study cohort (69.44%) is in a moderate level of stress with female predominance (p=0.001), while diastolic blood pressure (p=0.008), mean arterial blood pressure (p=0.006), vital capacity (p=0.000), forced vital capacity (p=0.006), forced expiratory volume in the first second (p=0.003) all negatively correlated with perceived stress scale in the participants. **Conclusion:** The findings of the present study point toward possible delirious effects of stress on cardio-pulmonary health. The timely detection and address budding stress issues in the early years of medical schools by establishing counseling and preventive mental health services centers will prevent future morbidity and produce healthy doctors.

Key words: Blood Pressure, Psychological Stress, Pulmonary Function Test, Perceived Stress Scale, Students.

INTRODUCTION

Psychological stress in medical students is very common predominantly in early year students as professional college/university setting is quite different and perplexing from school.[1] With less parental involvement and the need to live away from home, s tudents have many added duties beside of their studies. These factors appear to be stress generating for students building various psychological issue like anxiety, depression, mood swings.[2] Symptoms of depression and even thoughts of suicide have been found to be quite common among medical students as seen in available literature.[3] The negative impact of these potential stresses on students is not limited to poor academic performance, but also adverse health effects. Chronic psychological stress has been shown to have detrimental effects on human health. There are many physiological pathways through which stress adversely affects health, but they are not fully understood.[4] The literature review shows a direct link between negative behaviour and inflammatory immune responses that lead to the development of various cardiovascular disease, including hypertension.[5] In addition, modifications in haemostatic processes play important roles in the initiation and progression of proinflammatory atherosclerosis and acute coronary disease.[6] The levels of inflammatory cytokines C reactive proteins, interleukin-6 (IL-6), interleukin-1 receptor antagonist (IL-1Ra), and interleukin-1 beta (IL-β) were found to be elevated in people with major depressive disorder compared to normal participants.[7]

Similar pro-inflammatory substances have been

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found to be responsible for various respiratory pathophysiologies, which involves inflammation of alveolar–capillary membrane lung matrix.[8] Pulmonary function test (PFT) is a vital tool not only for diagnosis and monitoring respiratory disease but for evaluation of risk of lung disease.[9] Psychological stress has been found to exacerbate respiratory symptoms and poor pulmonary function test in asthma patient.[10] To the best of our knowledge, there is no study comparing perceived stress and cardiovascular and respiratory parameters in young healthy adults particularly in medical students. The present study was conducted to assess the effect of perceived stress on blood pressure and pulmonary function tests of normal healthy first year medical students. The present study will help to raise awareness in stress management as an effective approach to preventing future respiratory and cardiovascular disorders.

MATERIAL & METHODS

This cross-sectional study was conducted between July 2021 to January 2022 and study participants were invited through advertisements to participate in this study. The Raosoft® software employed to calculate sample size, with margin of error 5% and 95% confidence level, population size of 100 first year medical students enrolled for academic year 2021-22 with response distribution of 50%. The recommended sample size was 80. We enrolled 90 students, out of them only 80 completely filled questionnaires. Furthermore 8 participants were excluded (due to smoking, asthma or have insufficient/data not suitable for analysis) finally the data of 72 students were evaluated in present study.

Permission and ethical approval for this study was obtained from ethical review committee (ATMC/IERC/06-2021/30), consent has been taken and data was collected according to declaration of Helsinki. The study participants met the following inclusion criteria: 18-22 years old healthy male/female students. Exclusion criteria were past or present history of any chronic medical or psychological condition, smoking and pregnancy.

Preparations for Experiment

Participants were briefed on the project during a familiarization session, and written consent was obtained. In order to avoid any confounding factor, the body mass index was measured (BMI: Weight in kilogram to the nearest 0.5 kg using digital scale and height in meters by vertical metal centimeter), as obesity is the known risk factor of stress.[11]

Procedure

Following BMI measurements, the baseline blood pressure were recorded with mercury Sphygmomanometer. The parameters of arterial blood pressures; systolic blood pressure (SBP), diastolic blood pressure (DBP), Mean Arterial Pressure (MAP) and Pulse Pressure (PP) were extracted. Oxygen saturation and heart rate was measured with finger pulse Oximeter® from index finger of non-dominant hand.

Respiratory Parameters (PFT)

For respiratory parameters Biopac® student lab was used. Participants were seated and used a nose clip. After series of practice blows, all the respiratory parameters were measured three times and the highest values were used in the analysis according to American Thoracic Society (ATS) guidelines.[12] Vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in first second (FEV_1) and ratio of forced expiratory volume in first second to forced vital capacity (FEV_1/FVC) were extracted from Biopac ® data acquisition system.

Perceived stress Scale

The Perceived Stress Scale (PSS) is a classic stress assessment instrument. This questionere has 10 questions that ask students about their emotions and thoughts over the past month. This questionnaire was observed to have good psychometric reliability.[13] The PSS scores can range from 0 to 40 with higher scores indicating higher perceived stress (0-13 low stress, 14-26 moderate stress, 27-40 high perceived stress). The participants were divided into two groups (group A with PSS score less than 20 and group B with PSS score of 20 and more) for the purpose of the calculation.[14]

Statistical Analysis

SPSS version 26 (SPSS software, Chicago, IL, USA) was used for statistical analysis. The normality of data was tested by the Shapiro-Wilk test and the Cronbach alpha for reliability of data was 0.709 for PSS. An independent sample t-test was used for comparison of two continuous variables. Pearson's correlation was applied to check relationship between variables. Values were expressed as mean (±SD), P < .05 were regarded as statistically significant.

RESULTS

Table-I shows demographics of study participants, the male participants are significantly more in height (p=0.000) and weight (p=0.001), they have lower oxygen saturation (p=0.004), higher diastolic (p=0.000) and MABP (p=0.000) but lower pulse pressure (p=0.000). Their VC (p=0.000), FVC (p=0.000), FEV1 (p=0.000) and FEV_1/VC ratio (p=0.000) is significantly higher as compared to female participants. While female showed significantly higher PSS score (p=0.001) compared to male participants. Figure-1, revealed that 69.44 % of the study participants were in moderate stress.

Table-II revealed level of PSS is significantly higher in participants with low height (p=0.009), weight (p=0.003) oxygen saturation (p=0.016), DBP (p=0.004) and MABP (p=0.004). Similar trend observed with higher PSS level with low VC (p=0.001), FVC (p=0.003), FEV1 (p=0.040).

Table-III Indicates Pearson's correlation of observed variables with PSS of study population, there is significantly negative correlation of stress level with height (r=-.352, p=0.001), weight (r=-.349, p=0.002), DBP (r= -0.308, P=0.008) and MABP (r= -0.320, P=0.006). While negative correlation also find between with VC(r= -0.462, P=0.000), FVC(r= -0.319, P=0.006) and FEV1 (r= -0.346, P=0.003) (only statistically significant data presented here).

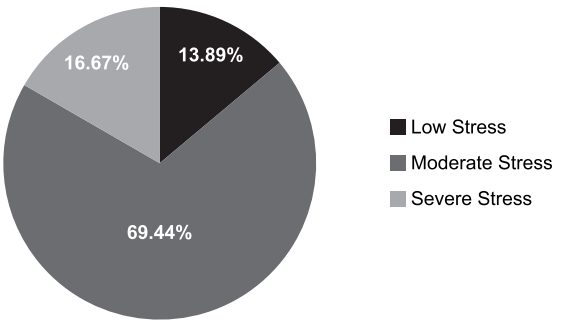

Figure-1. Prevalence of different levels of stress in study population (n=72)

Variable	Female (n=44) Mean (±SD)	Male (n=28) Mean (±SD)	P-Value
Age (years)	19.6 (0.78)	19.7 (1.2)	0.529
Height (cm)	159.2 (4.9)	174.0 (4.8)	0.000*
Weight (Kg)	57.8 (11.1)	66.9 (9.3)	0.001*
BMI (kg/m^2)	22.8 (4.4)	22.1(3.4))	0.506
Heart rate (beats/minutes)	90.4 (14.3)	90.7 (17.6)	0.919
Oxygen saturation %	98.7 (0.58)	97.5 (2.6)	0.004*
SBP (mmHg)	110.0(9.40)	108.2 (7.22)	0.395
DBP (mmHg)	68.6 (7.01)	81.0 (6.98)	0.000*
PP (mmHg)	41.3 (7.95)	27.1 (6.72)	0.000*
MABP (mmHg)	73.2 (6.88)	84.0 (6.67)	0.000*
VC (Litres)	2.7 (0.41)	3.8(0.43)	0.000*
FVC (Litres)	2.5 (0.60)	3.8(0.43)	0.000*
FEV_1 (Litres)	1.8 (0.65)	3.4(0.33)	0.000*
FEV1/FVC ratio	0.7 (0.21)	0.8(0.07)	0.000*
Total PSS	22.1 (5.69)	17.1(6.47)	0.001*

*P < 0.05
BMI= body mass index
SBP=systolic blood pressure
DBP=diastolic blood pressure
PP= pulse pressure
MABP= mean arterial blood pressure
VC= Vital capacity
FCV= forced vital capacity
FEV_1=forced expiratory volume in first second
FEV_1/FVC ratio= ratio of forced expiratory volume in first second to forced vital capacity
PSS= Perceived Stress Scale

Table-I. Demographics of study participants (n=72)

Variables	Group A (n=32)	Group B (n=40)	P-Value
Gender	1.5 (.50)	1.2 (.43)	0.006*
Height (cm)	167.9(8.48)	162.6 (8.29)	0.009*
Weight (Kg)	65.6 (11.9)	57.9 (9.58)	0.003*
BMI (kg/m^2)	23.3 (4.32)	21.9(3.73)	0.150
Heart rate (beats/minutes)	87.4(16.62)	93.0(14.45)	0.131
Oxygen saturation %	97.6 (2.48)	98.7(0.68)	0.016*
SBP (mmHg)	110.9(9.28)	108.0(7.90)	0.152
DBP (mmHg)	76.8 (8.30)	70.7 (9.16)	0.004*
PP (mmHg)	34.0(10.19)	37.2(10.12)	0.190
MABP (mmHg)	80.6(7.78)	74.8(8.45)	0.004*
VC (Litres)	3.4(.70)	2.9 (0.59)	0.001*
FVC (Litres)	3.3(0.85)	2.8(0.73)	0.003*
FEV1 (Litres)	2.7(1.01)	2.2(0.87)	0.040*
FEV1/FVC ratio	0.79 (.20)	0.7(0.18)	0.884

#Group A= PSS <20, Group B= PSS ≥ 20*P < 0.05
BMI= body mass index
SBP=systolic blood pressure
DBP=diastolic blood pressure
PP= pulse pressure
MABP= mean arterial blood pressure
VC= Vital capacity
FCV= forced vital capacity
FEV_1=forced expiratory volume in first second
FEV_1/FVC ratio= ratio of forced expiratory volume in first second to forced vital capacity
PSS= Perceived Stress Scale

Table-II. Comparison of Perceived Stress Scale (PSS)# levels in study participants

Variables	Pearson's correlation (r)	P
Age (years)	.038	0.751
Height (cm)	-.352	0.001*
Weight (Kg)	-.349	0.002*
BMI (kg/m^2)	.061	0.611
Heart rate (beats/minutes)	.213	0.073
Oxygen saturation %	.211	0.076
SBP (mmHg)	-.229	0.053
DBP (mmHg)	- 0.308	0.008*
PP (mmHg)	.087	0.470
MABP (mmHg)	-.462	0.000*
VC (Litres)	-0.462	0.000*
FVC (Litres)	-.319	0.006*
FEV_1 (Liters)	-.346	0.003*
FEV1/FVC ratio	-.101	0.398

*P < 0.05
BMI= body mass index
SBP=systolic blood pressure
DBP=diastolic blood pressure
PP= pulse pressure
MABP= mean arterial blood pressure
VC= Vital capacity
FCV= forced vital capacity
FEV_1=forced expiratory volume in first second
FEV_1/FVC ratio= ratio of forced expiratory volume in first second to forced vital capacity

Table-III. Correlation of variables with perceived stress scale of study population (n=72)

DISCUSSION

Our present study revealed that 70 % of study participants possess moderate stress. However comparing the demographics between male and female participants, it was observed that PSS level is higher in females, while the male participants are significantly more in height, weight, DBP, MABP but lower oxygen saturation and PP. Furthermore their VC, FVC, $FEV_1$and FEV_1/VC ratio is significantly higher as compared to female participants. It was further perceived that level of PSS is significantly higher in participants with low height, weight, and oxygen saturation, DBP, MABP, VC, FVC and FEV_1. While higher levels of PSS is found to be negative correlated with height, weight, DBP, MABP, VC, FVC and FEV_1.

Literature survey revealed that the stress level

among medical students higher than that of the general population ranged from 38% to 62%.[15] Similar to present study, according to one study carried out in one of the medical university in Pakistan, 80% of their student population is in moderate stress and 15.3% scored high, with female predominance, while similar trend had been observed from a Saudi study as well.[16,17] Despite the fact, some studies also show a predominance of male, the authors speculate that this may be due to the fact that male students had to get high grades and finish their classes quickly in order to start their careers.[18] But most of the studies like ours, found that women are more likely than men to perceive challenging and threatening events stressful.[19,20]

In our study male participants has higher height, weight, DBP, MABP values compared to female participants. Similar results have been observed by many studies, which suggested the role of androgens, in blood pressure regulation.[21,22] Similar to our study it was found that, the haemoglobin oxygen saturation during rest, is slightly higher in women than in men.[23] While in another research this difference is found to be present in adult females only, linking the female hormones with this phenomenon as pre-pubertal population in this research do not show gender-specific differences in oxygen saturation.[24] There is a difference in respiratory parameters in male and female participants in our study. In agreement to our results Heraganahally et al found that their male subjects showed significantly higher values of FVC, $FEV_1$with no significant difference in FEV_1/FVC ratio compared to female subjects. They suggested that women has smaller airway diameter, lung volumes, expiratory flow and diffusion surface responsible for lower values as compared to males.[25]

It was observed by our study that stress is negatively correlated with height and weight, although BMI was not found to be related with PSS. One of the reasons is that female participants possess higher PSS compared to their male counterpart and being shorter and lighter they might contribute in this negative correlation. Contradict to our results Mouchacca, J et all, find weight gain with perceived stress in their female participants.[26] There was no correlation between perceived stress and weight in a UK-based study that was comparable to ours.[27]

Another important observation of present study is negative correlation of PSS with DBP and MABP, one of the reasons is female contribution in this lower BP variables. Not surprisingly high BP variables were always related with stress as proven by many studies.[28,29] However literature survey has proven the link of low BP with chronic anxiety and depression. The researcher there suggested the altered sympathetic-parasympathetic balance and the tone of the hypothalamic-pituitary-adrenal axis responsible for this phenomena.[30]

No national or international data has been found to correlate respiratory function test with perceived stress in students, present study is the first one to identify the effect of perceived stress on respiratory function test in young apparently healthy freshly enrolled medical students. In one study checking respiratory function test followed by examination also found significantly lower values compared to fellow student without exam, pointing toward effect of acute stress on poor respiratory functions.[31] In a Chinese study, depression severity was independently correlated with a decline in college students' respiratory functions.[32] In another Korean study of 40–69 years of age population, depression was measured with Beck Depression Inventory (BDI) found significantly lower respiratory parameters in depressed subjects.[33] While in another study from India including females of 30 years and above found negatively correlation of PSS with all parameters of PFT.[14]

LIMITATION OF STUDY

This study involves self-reported perceived stress level that might be subjective and chance to bias is high. Detail study with self-inflicted stress on the participants is recommended. Pro inflammatory biomarkers were not assess due to financial strain, further studies to identify the biomarker and their blood level responsible for spawning lung injury is recommended. Limited number of students from a single class was included; an extensive

study recruiting all five years is suggested to find which academic year is most affected.

CONCLUSION

The present study revealed that the prevalence of PSS level is higher in first year medical students predominantly in female participants. That is postulated to responsible for altered BP and PFT parameters. It was observed that in apparently healthy individuals, sustained negative events of life are reversibly associated with inflammatory factors, while removal of those events also remove inflammatory factors pointing toward healthy and stress free life style modification.[34] The early detection and addressing possible perceived stress issue by establishing counselling and preventive mental health services centers in medical schools will prevents future morbidity and produce healthy doctors.

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3	Rehma BiBi	Manuscript writing.	
4	Syed Muhammad Masood Ali	Critical review.	
5	Tabinda Najeeb	Data collection.	
6	Alina Atif	Data collection and Analysis	