National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Cardiovascular changes in medical students: Examination stress

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Received: August 09, 2018; **Accepted:** August 29, 2018

ABSTRACT

Background: Functioning capability of normal healthy individual can reduce due to stress which can be observed by the changes in their physiological parameters. Medical students do have huge burden of academic stress during the time of examination. This stress affects their normal physiology which subsequently might lead to pathological changes. **Aims and Objectives:** The objectives of the study were to assess the changes in the cardiovascular system in 2nd year medical students of Oman Medical College (OMC) during the state of examination stress. **Materials and Methods:** This was a randomized, observational-based study for 100 2nd-year students enrolled in 2013–14 batch for the medical program at OMC, Bawshar campus, Sultanate of Oman. Cardiovascular parameters such as pulse rate, arterial blood pressure were recorded at three stages. 1st, 3 months before the first formative assessment, second a day before the first formative examination, and third a day after examination. Data were collected and analyzed statistically using a paired *t*-test. **Result:** Significant difference (2-tailed <0.0001) was observed for the level of pulse rate heart rate (HR), systolic blood pressure, and diastolic blood pressure (DBP) before the exam and relaxed state as well as post exam state. Comparing the relaxed state values with the post-exam values for HR and DBP did not show any statistically significance. **Conclusion:** It is evident that the medical students undergo stress during their academic examinations. There is a need for intrusions such as social and psychological by the counselor or mentor to improve the quality of students' life. Mentoring and counseling specifically before the exam should have more weight so that students are trained to manage their stress by various regimes.

KEY WORDS: Examination Stress; Cardiovascular Vital Parameters; Medical Students

INTRODUCTION

The term "stress" was employed in 1930's by Selye, an endocrinologist.[1] Physiologically stress is the reaction of body to a change that requires a physical, mental, or emotional adjustment or response.[2] Mannapur *et al.*[3] observed that stress is a term in psychology and biology, which is the more recent decades, has become a commonplace of popular parlance.

Literature has reported an increase in the level of stress during medical training. It has been reported that they show depression.[4,5] and even suicide thoughts.[6,7] among medical undergraduates. Academic stresses in the form of assessment, formative as well as summative, are the most common cause for the occurrence of systemic pathologies such as autonomic, cardiovascular, and immune among the medical college students.[4,5] These all lead to mental and physical illness such as nervousness, mood changes, and menstrual disturbances in female students.[8] Competitive environments, ambition for higher achievements, family and peer pressure also do increase the extent of stress in the life of a medical student.[9]

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DOI: 10.5455/njppp.2018.8.0826429082018	

Stress to some extent is helpful to cope with problems, but too much of it can decrease the level of performance.[10]

The initial effect of stress on heart function is usually on the heart rate (HR).[11] Depending on the direction of the shift in the sympathovagal response, the heartbeat will either increase or decrease.[12] The next significant effect of stress on cardiovascular function is blood pressure.[13] Stress can stimulate the autonomic sympathetic nervous system to increase vasoconstriction, which can mediate an increase in blood pressure, an increase in blood lipids, disorders in blood clotting, vascular changes, and atherogenesis; all, of which, can cause cardiac arrhythmias and subsequent myocardial infarction.[11,14,15] Studies have shown that psychological stress can cause alpha-adrenergic stimulation and, consequently, increase HR and oxygen demand.[16,17] Thus, the effect of stress in student's life on long-term basis can cause pathological derangement.

Happiness index ranking on 10 point scale for Sultanate of Oman was 6.85 in 2012 being second in Gulf Cooperation Council and 22nd in the world.[18] Oman has been a well affluent society, and not much data is available related to the academic pressure in medical students. Thus, the aim of present study is to assess the changes in the cardiovascular system in 2nd year medical students during the state of examination stress so that we as educationist will try to find alternatives to overcome this state if it occurs in student's life. Oman Medical College (OMC) has advising and mentoring program for every student. The data generated from this study will guide advisors to modify their mentoring techniques for the better academic outcome of a student by decreasing the level of academic stress if identified.

Objectives

The objectives are as follows:

- To assess the level of HR and arterial blood pressure during relaxed state, before the exam and after an exam in 2nd year medical students.
- To compare the changes occurring in cardiovascular parameters during three phases in 2nd-year medical student.
- To compare the changes occurring in cardiovascular parameters during three phases based on their residential accommodation.

MATERIALS AND METHODS

The study was conducted in the Department of Natural Science, Oman Medical College, Bawsher Campus, Muscat, Sultanate of Oman, after having ethical approval from the institute. Study was conducted on 100 of 176 medical student of 2nd year for the batch 2013–14 who volunteered to participate in the study. Students who had faced any social or psychological stress at the time of recordings were excluded from the study. Other than this students having any known medical condition which could affect the cardiovascular parameters were not included in the study. International students were also not included in the study so that the data would reflect cardiovascular changes during exam stress for the local population.

The study is purposive, non-randomized, observational cross-sectional based having 88 female and 12 male medical students as participants. Ratio of female to male students' in OMC for the course of Integrated Human Structure and Function (BIOL-341) is 9:1. Personal information of participants was collected which included their accommodation during the course. All the participants were informed about the study and consent was taken.

Three recordings of arterial pulse and arterial blood pressure of voluntary students were assessed. First recording was during a relaxed state, i.e., 3 months before the exam was conducted. Second recording was done a day before the formative exam of their Integrated Human structure and function course (BIOL-341) and third recording was a day after the exam. Duration of study was 31/2 months.

Beurer digital automatic instrument type BM35, made in Germany was used to record systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse rate of the participants. Blood pressure and pulse rate of the right arm in sitting position were assessed and recorded for all the participants 3 times and mean values were considered for the data collection. Student's paired *t*-test was used for statistical analysis ($P < 0.05$).

RESULTS

Table 1 specifies that 88% of students who participated in the study were female while 12% were boys. Figure 1 shows 56 students lived in hostel a while 44 were residing at home.

Table 2 shows an increase in HR a day before the exam from relaxed state or a day after the exam by a 30.32% and 27.9%,

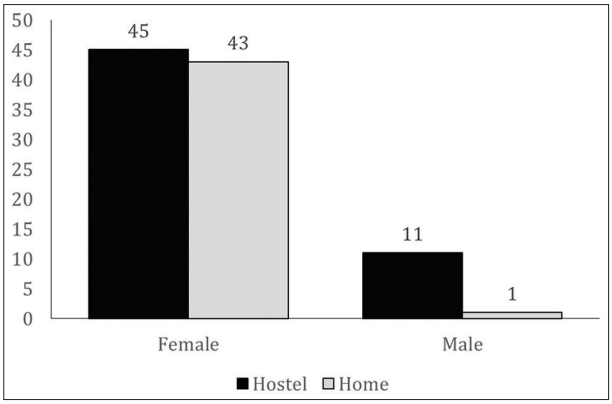

Figure 1: Frequency distribution as per students residential accommodation (hostel stay or at home)

respectively. It also shows an increase in SBP a day before the exam from relaxed state or a day after the exam by a 24.05% and 14.03%, respectively. Data also show increase in DBP a day before the exam from relaxed state or a day after the exam by 8.91% and 8.84%, respectively.

Table 3 shows significant paired sample *t*-test significant difference (2-tailed < 0.0001) for change in the level of HR when comparing its value before exam (pre-exam) state with post-exam state or relaxed state shows significant value. For SBP values were statistically significant at all the levels significance for DBP values with 2-tailed < 0.0001 has been observed for comparison between pre-exam state with relaxed or post-exam state not for relaxed state with post-exam state.

Table 4 shows not much change in the recording values of HR, systolic and DBP during three phases (relaxed, pre-examination, and post-examination).

Table 1: Gender variability

Female	Male
88	12

Table 2: Frequency distribution of arterial HR, SBP, and DBP during three phases (relaxed, before exam, and after exam)

Cardiovascular parameter	Mean±SD	Maximum value	Minimum value
HR			
Relaxed state	76.68±6.035049	92	60
Pre-exam	99.93±6.332943	115	80
Post-exam	78.13±3.917469	94	70
SBP			
Relaxed state	114.38±6.664818	113	100
Pre-exam	124.05±5.496326	136	102
Post-exam	108.79±5.121346	128	100
DBP			
Relaxed state	69.73±2.759209	76	62
Pre-exam	75.94±3.757336	82	68
Post-exam	69.77±2.729765	76	62

HR: Heart rate, DBP: Diastolic blood pressure,
SBP: Systolic blood pressure, SD: Standard deviation

Table 3: *t*-test: Values for change in HR, SBP, and DBP in relaxed state, pre-exam state, and post-exam state

Comparative pair groups	*t*-stat.	Sig. (2-tailed)
HR in relaxed state vis pre exam state	–26.6	0.000
HR in relaxed state vis post-exam state	–2.02	0.045
HR in pre-exam and post-exam state	29.27	0.000
SBP in relaxed state vis pre- exam state	–11.19	0.000
SBP in relaxed state vis post-exam state	6.65	0.000
SBP in pre-exam and post-exam state	20.31	0.000
DBP in relaxed state vis pre-exam state	–13.32	0.000
DBP in relaxed state vis post-exam state	–0.01	0.918
DBP in pre-exam and post-exam state	13.28	0.000

HR: Heart rate, DBP: Diastolic blood pressure,
SBP: Systolic blood pressure

DISCUSSION

The present study shows the mean value of HR in pre-examination recording (99.93) higher than the mean value of post-examination (78.13) even higher when compared to recording during relaxed state (76.68). The difference of mean of HR was significant between the values of pre-examination and post-examination recordings ($P < 0.0001$), and for relaxed state and pre-examination recording ($P < 0.0001$). The difference of mean of HR was not significant between the values of relaxed state and post-examination state ($P < 0.045$) [Tables 2 and 3].

The mean value of SBP in pre-examination recordings (124.05) is higher than the mean value of post-examination (108.79) as well the values during relaxed state (114.38). The difference of mean of SBP was significant between the values of pre-examination and post-examination recordings ($P < 0.0001$) as well as that of relaxed state values ($P < 0.0001$). Even the values were significant for the difference of mean for the values at relaxed state and post-examination state [Tables 2 and 3].

The mean value of DBP in pre-examination recording (75.94) was higher than the mean value of post-examination (69.76) even higher when compared to recording during relaxed state (69.73). The difference of mean of DBP was significant between the values of pre-examination and post-examination recordings ($P < 0.0001$) and for relaxed state and pre-examination recording ($P < 0.0001$). The difference of mean of DBP was not significant between the values of relaxed state and post-examination state ($P < 0.915$) [Tables 2 and 3].

Our results of an increase in HR, SBP, and DBP before the exam are possibly due to increase in sympathetic activities which are consistent with the findings of Freychuss *et al.*[19] and Malathi and Parulkar.[20] who contributed it to increased epinephrine levels. These values were similar to that of Sharma *et al.*[2] who showed highly significant difference in vital parameters (Pulse rate [$t = 8.89$, $P < 0.001$], SBP [$t = 3.89$, $P < 0.001$], and DBP [$t = 2.86$, $P < 0.006$]) during examination.

Increase in SBP is also shown by Acharya and Sharma.[21] who along with Siapanish.[22] Explained this increase by the stimulation of the adrenergic nervous system that leads to the release of catecholamine in particular nor-adrenaline at the postsynaptic neuron and adrenaline or epinephrine from

Table 4: Change in cardiovascular parameter as per the accommodation of student

Accommodation	Relaxed-HR	Relaxed SBP	Relaxed-DBP	Pre-exam-HR	Pre-exam-SBP	Pre-exam-DBP	Post-exam-HR	Post Exam-SBP	Post-exam-DBP
Hostel	77.0±6.0	114.7±6.5	70.0±2.8	99.3±6.5	124.2±6.3	75.4±3.9	78.6±4.4	109±5.5	70±9.8
Home	76.3±6.1	114.0±6.9	69.4±2.7	100.8±6.1	123.8±4.3	76.7±3.4	77.6±3.2	108.5±4.6	69.5±2.3

HR: Heart rate, DBP: Diastolic blood pressure, SBP: Systolic blood pressure

adrenal medulla that results in activation of α1, β1, and β2 receptors consequently elevation of SBP.

The dropping of the SBP once the student complete his examination can be explained that the reduction results from decreased in peripheral arteriolar resistance and or cardiac output by a variety of mechanism at a variety of sites such as: Dilatation of resistance vessels, the heart pumps against lower resistance, dilatation of capacitance vessels, and reduction of venous return to the heart to reduce cardiac output. Reduction of a sympathetic drive to the heart leads to lower cardiac output especially in response to stress.[21]

Not significant changes for the recording of cardiovascular parameter were observed in the study for students who resided in hostel or at their home [Figure 1 and Table 4]. It was thought that students who live in hostel might have lesser level of stress since they do encounter students of their own type within the hostel premises compared to that who live at home.

This present study showed that majority of 2nd year medical students were under stress before the examination, irrespective of their accommodation thus showed, significant increase in SBP and other cardiovascular parameters.

Limitation of Study

The study would have provided wider results if comparison as per gender would have been made which was not possible since the number of male participants was much less than that of female. Anthropometric data comparison for changes in those parameter would have been more informative.

CONCLUSION

In spite of having a strong mentoring and customized counseling program by a professional counselor, still, the majority of medical students were observed to be under stressed before the examination. Acute stress of examination produced a significant elevation in the SBP and the HR. Thus, further research in the field of mentoring and counseling techniques need to be worked on, specifically in the country like Oman who still has a higher rank of the happiness index.

ACKNOWLEDGMENT

I acknowledge and thank Dean, additional Dean, and Faculty Members of Natural Science Department for allowing me to accomplish this project. Over and above, my sincere thanks to the medical students of 2013–14 batch for participating and allowing to record the parameters at three stages, without their help this work would not have seen the light of the day.

REFERENCES

1. Selye H. The Stresses of Life. New York: MC Graw Hill; 1956. p. 523-67.
2. Sharma B, Wavare R, Deshpande A, Nigam R, Chandorkar R. A study of academic stress and its effect on vital parameters in final year medical students at SAIMS medical college, Indore, Madhya Pradesh. Biomed Res 2011;22:361-6.
3. Mannapur B, Dorle AS, Hiremath LD, Ghattargi CH, Ramadurg U, Kulkarni KR. A study of psychological stress in undergraduate medical students at S N medical college, Bagalkot, Karnataka. J Clin Diagn Res 2010;4:2869-74.
4. Dahlin M, Joneborg N, Runeson B. Stress and depression among medical students: A cross-sectional study. Med Educ 2005;39:594-604.
5. Zoccolillo M, Murphy GE, Wetzel RD. Depression among medical students. J Affect Disord 1986;11:91-6.
6. Tyssen R, Vaglum P, Grønvold NT, Ekeberg O. Suicidal ideation among medical students and young physicians: A nationwide and prospective study of prevalence and predictors. J Affect Disord 2001;64:69-79.
7. Tyssen R, Hem E, Vaglum P, Grønvold NT, Ekeberg Ø. The process of suicidal planning among medical doctors: Predictors in a longitudinal Norwegian sample. J Affect Disord 2004;80:191-8.
8. Al-Dabal BK, Koura MR, Rasheed P, Al-Sowielem L, Makki SM. A comparative study of perceived stress among female medical and non-medical university students in Dammam, Saudi Arabia. Sultan Qaboos Univ Med J 2010;10:231-40.
9. Anandarajan B, Banu KK, Muthukumar S, Atram GG. Professional examination stress induced hemodynamic changes in first year MBBS students. Int J Biomed Adv Res 2013;4:796-800.
10. Kathrotia R, Kakaiya M, Parmar D, Vidja K, Sakariya K, Mehta N. Variable response of 1st MBBS students to exam stress. Nat J Integr Res Med 2010;1:23-7.
11. Vrijkotte TG, van Doornen LJ, de Geus EJ. Effects of work stress on ambulatory blood pressure, heart rate, and heart rate variability. Hypertension 2000;35:880-6.
12. Hall M, Vasko R, Buysse D, Ombao H, Chen Q, Cashmere JD, *et al.* Acute stress affects heart rate variability during sleep. Psychosom Med 2004;66:56-62.
13. Laitinen T, Hartikainen J, Niskanen L, Geelen G, Länsimies E. Sympathovagal balance is major determinant of short-term blood pressure variability in healthy subjects. Am J Physiol 1999;276:H1245-52.
14. Rozanski A, Blumenthal JA, Kaplan J. Impact of psychological factors on the pathogenesis of cardiovascular disease and implications for therapy. Circulation 1999;99:2192-217.
15. Sgoifo A, De Boer SF, Buwalda B, Korte-Bouws G, Tuma J, Bohus B, *et al.* Vulnerability to arrhythmias during social stress in rats with different sympathovagal balance. Am J Physiol 1998;275:H460-6.
16. Rozanski A, Bairey CN, Krantz DS, Friedman J, Resser KJ, Morell M, *et al.* Mental stress and the induction of silent myocardial ischemia in patients with coronary artery disease. N Engl J Med 1988;318:1005-12.
17. Jiang W, Babyak M, Krantz DS, Waugh RA, Coleman RE, Hanson MM, *et al.* Mental stress-induced myocardial ischemia and cardiac events. JAMA 1996;275:1651-6.
18. National Center for Statistics and Information, Sultanate of Oman. Available from:http://globalstanding.ncsi.gov.om/lxvnni/global-happiness-report [Last accessed on 2018 May 28].
19. Freyschuss U, Hjemdahl P, Juhlin-Dannfelt A, Linde B. Cardiovascular and sympathoadrenal responses to mental stress: Influence of beta-blockade. Am J Physiol 1988;255:H1443-51.
20. Malathi A, Parulkar VG. Evaluation of anxiety status in medical students prior to examination stress. Indian J Physiol Pharmacol 1992;36:121-2.
21. Acharya A, Sharma M. Acute effect of examination stress on cardiovascular parameters. Int J Med Health Res 2017;3:1-3.
22. Saipanish R. Stress among medical students in a Thai medical school. Med Teach 2003;25:502-6.

How to cite this article: Dulloo P, Al-Nazwani N, Al-Lawatia YMM. Cardiovascular changes in medical students: Examination stress. Natl J Physiol Pharm Pharmacol 2018;8(11):1548-1552.

Source of Support: Nil, **Conflict of Interest:** None declared.