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ORIGINAL RESEARCH

Comparison of Baseline and Test Day Cardiovascular Parameters, Anxiety Scores and Coffee Consumption Among Medical Students Undergoing Objective Structured Clinical Examinations in Jordan

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Introduction: Objective Structured Clinical Examinations (OSCEs) are considered an integral part of the assessment process of many schools of medicine worldwide. Close monitoring by examiners, scrutinized interactions with patients, and fear of the unknown, among other factors have been reported to cause psychological stress among students during the examinations period. In this study, we aimed to assess changes in cardiovascular parameters, anxiety scores, and lifestyle patterns of medical students during their OSCEs as compared to their baseline.

Materials and Methods: We recruited healthy medical students from our institution's medical school. General demographics, academic, and baseline lifestyle characteristics were collected 1–2 months before the OSCE day. The Generalized Anxiety Disorder 7-item (GAD-7) scale was used to measure anxiety symptoms. Data related to coffee consumption in addition to systolic, diastolic blood pressure and heart rate measurements were collected both at baseline and on OSCE day.

Results: This study included 325 students (144 (44.3%) males and 181 (55.7%) females). The mean systolic blood pressure, diastolic blood pressure, and heart rate measurements were significantly higher on OSCE day as compared to the baseline. In addition, the daily consumption of coffee increased significantly during OSCE day as compared to the baseline. Although the anxiety score increased during OSCE day compared to the baseline, the difference was not statistically significant. However, the change in anxiety score (OSCE day – baseline) was significantly higher in females compared to males.

Conclusion: In our study, we observed significant increases in blood pressure, heart rate, and coffee intake on the day of the test compared to baseline measurements. These findings underscore the significance of implementing measures to reduce the harmful effects of stress on students during exam preparations and medical school assessments.

Keywords: blood pressure, anxiety, stress, objective structured clinical examination, OSCE

Introduction

To assess medical students' medical education comprehensively, their theoretical knowledge and clinical and communication skills must be examined. To properly examine their clinical and communication skills, many medical schools conduct Objective Structured Clinical Examinations (OSCEs) on standardized patients.[1] Medical examinations are a source of stress for students, and while students view OSCEs positively, they have been shown to be more stressful than other examination formats like multiple choice questions (MCQs) and essays.[2] Reasons for this increased stress include close monitoring by examiners, interactions with patients and examiners, and significantly higher expectations to

pass these exams.[2,3] A study conducted recently revealed that the mental well-being of students declines during the exam season, but it improves afterward.[4]

During exam season, students were noted to have significantly higher blood pressure because of mental stress, when compared to regular class days or vacations.[5] This increased stress can lead to more serious forms of psychological distress such as anxiety and depression, which can result in poorer academic performance.[6] This stress also affects students' physical health, directly resulting in weaker immune systems, elevated hypertension, and indirectly contributing to poor physical behaviors such as emotional eating and decreased physical activity.[6]

To the best of our understanding, no studies have evaluated the impact of OSCEs on the lifestyle patterns, anxiety levels, and cardiovascular parameters of medical students in comparison to their non-OSCE period. Therefore, our objective was to conduct a study to examine any changes in students' physical health and behaviors caused by the stress of OSCEs. Furthermore, we aimed to explore their psychological distress, with the goal of identifying potential areas that should be addressed to improve the well-being of the students.

Methods

Conducted within the School of Medicine at the University of Jordan, this study was designed as a cross-sectional study. Ethical approval was obtained from the University of Jordan Institutional Review Board committee (approval number 67/2018/2458), ensuring compliance with the latest guidelines outlined in the Declaration of Helsinki. Informed consent was obtained from all participating individuals after providing a thorough explanation of the study's objectives and procedures. The study was carried out at the University of Jordan from April 2021 to May 2022.

Participants

Healthy medical students were recruited for this study through announcements posted on the faculty of medicine news boards and relevant social media websites. To ensure the inclusion of only healthy individuals, we specifically selected subjects who had no previous diagnoses of hypertension, diabetes, or cardiac diseases based on a comprehensive evaluation of their medical history and a thorough review of their medical records.

Assessment

At our medical school, OSCEs take place every eight weeks for clinical-year medical students (in their fourth, fifth, and sixth years). These OSCEs are not accompanied by a written exam immediately before or after. They are overseen by attending physicians and medical school staff. In our research, we excluded the initial OSCE because students tend to be more stressed during their first OSCE experience.

Every eligible participant was requested to complete a survey approximately 1–2 months prior to the OSCE covering a range of topics including general demographic information, academic background, and baseline lifestyle characteristics. The information collected included age, gender, household composition, smoking status, coffee consumption, GPA (Grade Point Average), and other relevant factors. Additionally, participants were asked to fill out the Generalized Anxiety Disorder 7-item (GAD-7) scale, which assesses anxiety symptoms. Additionally, during the same instance 1–2 months before the OSCE, measurements of BMI (Body Mass Index), baseline blood pressure, and baseline heart rate were taken.

The blood pressure measurement process followed proper steps to ensure accuracy and reliability. Participants were instructed to sit and relax for a minimum of 5 minutes before the blood pressure readings were taken. All clothing covering the arm was removed; the blood pressure cuff was positioned at the level of the heart, and the participant's arm and back were properly supported. Blood pressure readings were obtained on two different days, with a one-week interval between measurements. Each day, blood pressure in the left arm was measured twice, with a five-minute interval between readings. The average of the readings was used to estimate each participant's blood pressure level. For blood pressure measurement, an upper arm automated device, specifically the Omron 705IT (HEM-759-E), was utilized, a validated blood pressure measurement tool.[7]

On the day of the test, the measurement of blood pressure, heart rate, inquiry about coffee intake, and completion of the anxiety score survey were repeated, following the same procedure as before.

Statistical Analysis

Data collection was conducted using a computerized database, and Statistical Package for the Social Science software version 26 (SPSS Inc., Chicago, IL, USA) was utilized for analysis. The sample distributions of demographic and clinical characteristics were assessed through standard descriptive statistics. Continuous variables were summarized using medians and interquartile ranges, while categorical variables were described using frequencies and percentages. The normal distribution of quantitative variables was evaluated using the Shapiro–Wilk test. Chi-square test was used to compare baseline qualitative factors between males and females. Paired sample *T*-test was used to compare the average systolic and diastolic blood pressure heart rate, anxiety score, and daily cups of coffee consumption between OSCE day and baseline. This comparison was performed among males only, among females only, and among the whole sample. Independent samples *T*-test was used to compare the average change (OSCE day – Baseline) of systolic and diastolic blood pressure heart rate, anxiety score, and daily cups of coffee consumption between males and females. A statistical significance level of 0.05 was established.

Results

This study included 325 students (144 (44.3%) males and 181 (55.7%) females). Their age ranged from 19 to 27 year with a mean (SD) of 21.2 (1.0) year. Table 1 shows the demographic, anthropometric, and relevant characteristics of participants. Overall, 236 (72.6%) of students were living with their families. Of all male and female students, 22 (15.3%) and one (0.6%) were cigarettes smokers, respectively. About 16 (11.1%) of males and 11 (6.1%) of females were water pipe smokers.

The mean readings of systolic blood pressure, diastolic blood pressure, and heart rate were significantly higher during the OSCE day as compared to the means of these variables at the baseline. Figure 1 shows SBP, DBP, and heart rate on OSCE day compared to the baseline. Although the GAD-7 anxiety score increased during OSCE day compared to the baseline, the difference was not statistically significant (Table 2). Moreover, the daily consumption of coffee increased significantly during OSCE day as compared to the baseline. After adjustment for gender, age, and BMI, the change in the means of systolic blood pressure, diastolic blood pressure, heart rate and daily consumption of coffee remained significant. The change in the anxiety score remained non-significant after adjustment for gender, age, and BMI.

Table 1 Demographic, Anthropometric, and Relevant Characteristics of Participants at Baseline

Variable	Male		Female		p value
Age, mean (SD)	21.3	1.1	21.1	0.9	0.110
BMI, mean (SD)	24.8	4.7	22.0	3.3	<0.001
GPA, mean (SD)	3.3	0.4	3.1	0.5	0.024
Household, n (%)					0.403
With Family	104	72.2%	132	72.9%	
Alone	32	22.2%	33	18.2%	
Student Housing	8	5.6%	16	8.8%	
Smoking, n (%)					<0.001
Non smoker	100	69.4%	166	91.7%	
Cigarettes smoking	22	15.3%	1	0.6%	
Waterpipe smoking	16	11.1%	11	6.1%	
Ex-smoking	6	4.2%	3	1.7%	

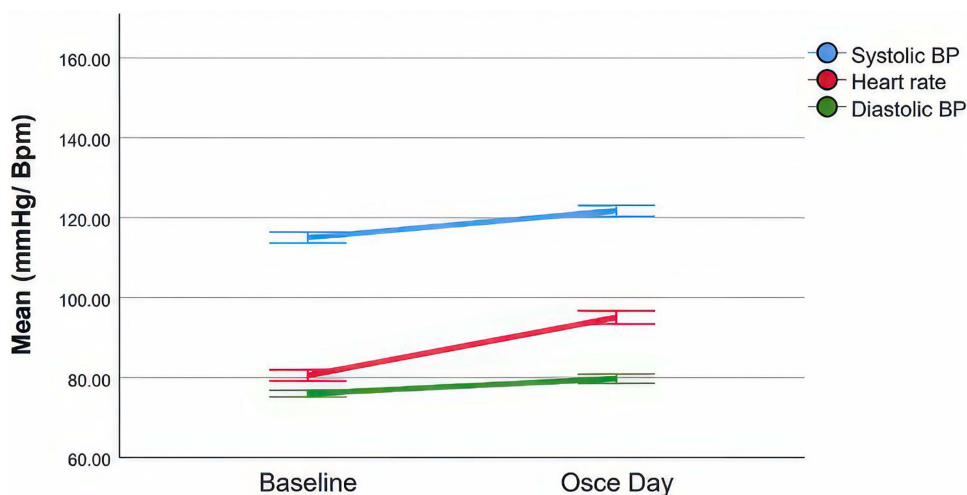**Abbreviation**: GPA, Grade Point Average.

Figure 1 Systolic blood pressure, diastolic blood pressure, and heart rate on OSCE day compared to baseline.

Looking at gender specific estimates (Table 3), the means of systolic blood pressure, diastolic blood pressure, and heart rate remained significantly higher in both males and females. However, the daily consumption of coffee did not differ significantly in both genders. Furthermore, GAD-7 anxiety scores were not significantly different between OSCE day and baseline in both genders. Table 4 shows the average change (OSCE day – baseline) in systolic and

Table 2 The Difference in the Means of Systolic Blood Pressure, Diastolic Blood Pressure, Heart Rate, Anxiety Score, and Daily Cups of Coffee Between the OSCE Day and Baseline

Variable	Baseline		OSCE Day		Univariate Analysis	Multivariate Analysis*
	Mean	SD	Mean	SD	p-value	p-value
Systolic blood pressure	114.99	12.88	121.73	12.53	<0.001	0.027
Diastolic blood pressure	75.98	8.13	79.69	10.45	<0.001	0.002
Heart rate	80.55	12.59	95.03	15.28	<0.001	<0.001
Anxiety score	6.64	4.64	6.74	4.70	0.676	0.636
Daily cups of coffee	0.56	0.59	0.70	1.05	0.026	0.045

Note: *Adjusted for gender, age, and body mass index.
Abbreviation: OSCE, Objective Structured Clinical Examination.

Table 3 The Difference in the Means of Systolic Blood Pressure, Diastolic Blood Pressure, Heart Rate, Anxiety Score, and Daily Cups of Coffee Between the OSCE Day and Baseline According to Gender

Variable	Male					Female				
	Baseline		OSCE Day		p-value	Baseline		OSCE Day		p-value
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Systolic blood pressure	122.08	12.83	128.35	11.29	<0.001	109.36	9.80	116.46	10.87	<0.001
Diastolic blood pressure	77.33	8.81	79.85	9.70	0.006	74.91	7.40	79.56	11.04	<0.001
Heart rate	77.00	12.45	90.81	14.20	<0.001	83.37	12.01	98.39	15.32	<0.001
Anxiety score	6.06	4.69	5.56	4.28	0.109	7.10	4.57	7.67	4.81	0.098
Daily cups of coffee	0.54	0.57	0.72	1.07	0.060	0.58	0.61	0.69	1.03	0.191

Abbreviation: OSCE, Objective Structured Clinical Examination.

Table 4 The Average Change (OSCE Day – Baseline) in Systolic and Diastolic Blood Pressure, Heart Rate, Anxiety Score, and Daily Cups of Coffee for Males and Females

Variable	Gender						p-value (Male vs Female)
	Male		Female		Total		
	Mean	SD	Mean	SD	Mean	SD	
Systolic blood pressure	6.28	11.16	7.10	10.69	6.74	10.89	0.497
Diastolic blood pressure	2.51	10.83	4.65	10.89	3.70	10.90	0.080
Heart rate	13.81	15.15	15.02	14.18	14.48	14.61	0.457
Anxiety score	−0.49	3.67	0.57	4.61	0.10	4.25	0.025
Daily cups of coffee	0.18	1.14	0.11	1.13	0.14	1.14	0.582

Abbreviation: OSCE, Objective Structured Clinical Examination.

diastolic blood pressure, heart rate, anxiety score, and daily cups of coffee consumption in males and females. There were no significant differences in the means change of blood pressure, heart rate, and cups of coffee consumed between males and females. However, the change in anxiety score (OSCE day – baseline) was significantly higher in females compared to males.

Discussion

The association between anxiety and exam periods has been well studied, including many studies with particular focus on OSCE.[3,8] In addition, the relationship between psychological stressors and cardiovascular parameters including blood pressure and heart has been explored by many researchers,[9,10] including some with interest in the exam period related stress.[5] To the best of our knowledge, this article is the first to explore changes in lifestyle patterns, anxiety scores, and cardiovascular parameters among medical students undergoing the OSCE by comparing baseline levels to test day ones.

The first key finding of our study is the significantly higher systolic blood pressure, diastolic blood pressure, and heart rate on OSCE day as compared to the baseline measurements. Our results are consistent with the results of De Oliveira et al, which found higher systolic blood pressure, diastolic blood pressure, and heart rate measurements on exam days when compared to ordinary class days.[5] Ayda et al noted that stress has the potential to stimulate the sympathetic nervous system, leading to subsequent catecholamines medicated vaso-constriction and an increased heart rate.[9] This psychological stress when experienced on a chronic scale has been associated with the development of hypertension.[11]

The second key observation was the significantly increased intake of coffee on OSCE day, when compared to the baseline intake of coffee. This finding reinforces the results of Khalil and Antoun who reported a significantly greater intake of caffeine during exam days among students at the American University of Beirut, in which almost half of participants exceeded the safe level of daily intake.[12] The top two reported reasons of coffee and energy drinks intake among students were that it helps them focus their attention and enables them to stay awake.[12] Furthermore, a study by Shepard et al reported that blood pressure measurements increase with caffeine intake among medical students during exam periods, but more interestingly, the combination of stress and caffeine caused additive increases in blood pressure.[13] In light of such findings, we speculate that caffeine intake, alongside psychological stress, could have been one of the factors leading to the increased blood pressure measurements on OSCE day when compared to baseline.

Although we found that the anxiety scores increased during OSCE day compared to the baseline, the difference was not statistically significant. Interestingly, the change in anxiety score (OSCE day – baseline) was significantly higher in females compared to males. OSCEs have been found to be highly anxiogenic, which was related to multiple factors including the fear of lacking competence and fear of the unknown, in addition to overvaluing the output.[14] Our finding of non-significant difference between OSCE day and baseline, could

suggest a high anxiety baseline among medical students, as baseline scores were relatively high. This finding is alarming, and hints toward the need of action to alleviate such anxiety to protect students from the negative effects of long-standing stress. Many researchers suggested several methods to decrease student anxiety during OSCEs including deep breathing relaxation techniques and implementing peer learning in the preparation process.[15,16]

Similar to our observation of greater difference in anxiety score (OSCE day – baseline) in females compared to males, Kalantari et al have found that females had higher OSCE related anxiety scores when compared to males, in which females perceived examinations and grades more stressful than males.[17] On the other hand, other studies did not find a significant difference in OSCE related anxiety scores between males and females.[8,18] These differences could be due to differences in study major or cultural variations.

In a recent systematic review, OSCE related anxiety has not been shown to influence students' performances.[19] This suggests that the much of the benefit of tackling exam anxiety among medical students is related to preventing the psychological and physiological effects of stress and related changes in lifestyle, rather than improvement of academic performance.

In a study conducted at The University of Jordan, it was found that a significant number of healthy medical students had undiagnosed high blood pressure.[20] Additionally, another study conducted at the same institution revealed a strong association between moderate and moderate-to-severe depression and elevated diastolic blood pressure among healthy medical students.[21]

It is indeed pertinent to discuss again the relationship between stress and hypertension, as well as the potential benefits of managing stress in reducing blood pressure. Stress can lead to recurring increases in blood pressure by impacting factors such as cardiac output, heart rate, and the release of vasoconstriction hormones like cortisol and aldosterone. This, in turn, can contribute to the development of chronic hypertension, particularly in susceptible individuals.[9,11,22,23] Conversely, effectively managing stress has been shown to have a positive impact on lowering blood pressure.[22,23] After the completion of the examination period, the students psychological pressure will be released.[4] Therefore, it can be suggested that stress management may help mitigate the various mechanisms triggered by stress that contribute to high blood pressure.

Medical students showed a higher prevalence of mental health disorders, including anxiety and depression, when compared to individuals of the same age within the general non-student population.[24] Multiple risk factors, which include academic, psychological, lifestyle, biological, and social elements, were associated with a higher prevalence of anxiety and depression among university students.[24] Female students exhibited a greater prevalence of anxiety and depression in comparison to male students.[24]

Participants identified as having significant anxiety symptoms were instructed to arrange a follow-up at the primary care clinics. Furthermore, they were provided with the option of undergoing psychiatric evaluation at the psychiatric clinic.

Our study does have certain limitations that should be acknowledged. Firstly, the sample size used in our study was relatively small. Despite this, we were able to identify statistically and clinically significant results. Another limitation is the lack of follow-up data on the participants. It would have been valuable to obtain data on the long-term outcomes, specifically to determine if any of the participants developed chronic hypertension over time. Additionally, exploring the potential benefits of stress management in preventing the development of chronic hypertension would have been insightful. We would like to mention that in our society, coffee stands out as one of the most commonly consumed caffeinated beverages. However, it is important to note that we did not inquire about other sources of caffeinated drinks such as energy drinks, cola, or other similar products. We did not include questions about the participants' sleep patterns on the night before the OSCE, which could also have an impact on their cardiovascular parameters and anxiety levels. Lastly, the cohort displayed varying ages, which could have resulted in different coping mechanisms and experiences with the OSCE.

Further longitudinal multicenter studies are necessary to evaluate the potential health benefits in terms of morbidity and mortality by screening students for exam or stress-induced high blood pressure in general. Additionally, such studies

can help determine if exam or stress-induced hypertension could be a risk factor for the development of chronic hypertension.

Conclusion

In our study, we observed significant increases in blood pressure, heart rate, and coffee intake on the day of the test compared to baseline measurements. These findings underscore the significance of implementing measures to reduce the harmful effects of stress on students during exam preparations and medical school assessments.

Data Sharing Statement

The data that support the findings of this study are available on request from the corresponding author, Hussein Alhawari, MD.

Consent for Publication

A consent for publications was obtained from all participants.

Disclosure

The authors declare that they have no competing interests to disclose for this work.

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