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Hypertension and Depression in Medical Students: Assessing Prevalence and Association

Jonas Müller[1], Fabian Richter[1], Leon Hoffmann[1]*

[1]Department of Digital Medicine, Faculty of Medicine, University of Hamburg, Hamburg, Germany.

***E-mail** ✉ leon.hoffmann.dm@gmail.com

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ABSTRACT

Medical students have been reported to experience elevated rates of both hypertension and depression. Research indicates a potential two-way relationship, with depression increasing the risk of hypertension and hypertension being linked to higher rates of depression. This study aimed to determine how common hypertension and depression are among medical students and to explore whether depressive symptoms contribute to the presence of hypertension.This study involved medical students from Jordan's largest medical school. Participants had their blood pressure and heart rate recorded following a standardized protocol. To evaluate depressive symptoms, the 9-item Patient Health Questionnaire (PHQ-9) was administered. The dataset was first explored using univariate analyses, and factors influencing mean arterial pressure were subsequently examined through linear regression modeling. The study included 354 medical students with an average age of 21 years. Of these, 196 (55.4%) were female and 158 (44.6%) were male. Among female students, the majority (70.9%) had normal blood pressure, while smaller proportions exhibited elevated BP (3.6%), stage 1 hypertension (22.4%), or stage 2 hypertension (3.1%). In contrast, male students showed lower rates of normal BP (38.0%) and higher rates of elevated BP (17.1%), stage 1 hypertension (34.8%), and stage 2 hypertension (10.1%). Assessment of depressive symptoms revealed that 32.2% of participants had minimal or no depression, 55.6% had mild to moderate depression, and 12.1% had moderately severe to severe depression. Higher depression scores were found to correlate with increased diastolic blood pressure. Our findings indicate a considerable prevalence of both hypertension and depression among the participants. Elevated depression scores were associated with higher diastolic blood pressure. These results underscore the importance of routinely screening hypertensive patients for depression, and conversely, evaluating individuals with depression for hypertension. We also advocate for the implementation of comprehensive screening programs for both conditions in the general population.

Keywords: Depression, Blood pressure, Hypertension, Medical Students

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Introduction

The relationship between hypertension (HTN) and depression has been explored extensively over the past several decades, yet findings regarding their correlation remain inconsistent. Several studies suggest that depression should be considered an independent risk factor for hypertension [1]. Globally, depression affects over 260 million individuals across all age groups [2], with college students representing a substantial portion of this population [3]. Medical students, in particular, have been shown to exhibit higher rates of depression compared to peers in other academic disciplines [4].

The prevalence of depression among medical students worldwide is estimated at 28% [5], while studies in Asian medical schools report a prevalence of approximately 11% [6]. Evidence indicates a bidirectional relationship between depression and hypertension, with each condition being more common in patients affected by the other [7]. This association may be influenced by factors such as sympathetic nervous system hyperactivity and genetic

predisposition [7]. Additionally, certain antidepressant medications can impact blood pressure regulation and may contribute to orthostatic hypotension [7].
Depression may also increase the risk of uncontrolled hypertension [8], highlighting the importance of monitoring blood pressure when managing depressive disorders [9]. In the present study, we aimed to determine the prevalence of both hypertension and depression among medical students and to investigate the potential association between these two conditions.

Materials and Methods

The study was carried out in accordance with the most recent version of the Declaration of Helsinki and received approval from the Institutional Review Board (IRB) of the University of Jordan. Data collection took place between June 2020 and May 2021 at Jordan University Hospital (JUH), a tertiary care center located in Amman, Jordan.

Participants
Participants were recruited through announcements posted on the Faculty of Medicine notice boards and relevant social media platforms. The study targeted medical students in their clinical years. All students who consented to participate provided written informed consent. Individuals with a prior diagnosis of hypertension were excluded. The initial sample comprised 360 students, of whom six were excluded due to pre-existing hypertension, resulting in a final sample of 354 participants.

Blood pressure measurement
Blood pressure and heart rate were measured using a validated automated upper-arm device (Omron 705IT) [10]. Participants were instructed to avoid caffeine, smoking, and exercise for at least 30 minutes prior to measurement. Four of the authors (B.A., N.H., R.A., and S.A.) received training on standardized blood pressure measurement procedures, including having participants sit quietly for at least five minutes, removing clothing from the measurement arm, and ensuring proper support of the arm and back. Measurements were taken on the left arm twice, with 1–2 minutes between readings, on two separate days. The readings from each day were averaged, and the final value was calculated as the mean of these two daily averages. Blood pressure categories were defined according to the most recent American Heart Association/American College of Cardiology (AHA/ACC) guidelines [11].

Demographic and depression questionnaire
Participants completed the 9-item Patient Health Questionnaire (PHQ-9) [12], a widely validated and reliable tool for depression screening in the general population [12, 13]. For analysis, participants were classified into three groups: those with ‘no or minimal depression,’ those with ‘mild to moderate depression,’ and those with ‘moderately severe to severe depression’ [14]. Additional data collected included age, gender, weight, height, and household status (living with or without family).

Statistical analysis
Statistical analyses were conducted using SPSS version 26.0 (Chicago, USA). Continuous variables were summarized as means ± standard deviation, while categorical variables were expressed as counts and frequencies. Univariate analyses were performed to examine associations between various factors and depression. To explore the relationship between mean arterial pressure (MAP) and depression, regression analysis was conducted.
ANOVA tests were used to compare depression scores across different BMI categories, as well as to assess differences in blood pressure and heart rate across the three depression groups. Data normality was evaluated using histograms and Q-Q plots, and Levene’s test confirmed that assumptions for parametric analyses were met. Independent samples t-tests were employed to examine the effects of gender, household status, and BMI on PHQ-9 scores.
To minimize multicollinearity in the regression analysis, MAP for the left arm was calculated and used as the dependent variable, since including both systolic and diastolic blood pressure would introduce collinearity bias. MAP was calculated using the formula:

$$MAP = DP + 1/3(SP - DP) \quad (1)$$

Linear regression analysis was then performed to identify factors influencing MAP. Only variables with a significance level of ≤0.1 in univariate analyses were included, and a significance threshold of 0.05 was applied for the final regression model.

Results and Discussion

The study comprised 354 medical students, with ages ranging from 19 to 27 years (mean ± SD: 21.16 ± 0.9). The sample included 196 females (55.4%) and 158 males (44.6%). Most participants, 258 (72.9%), lived with their families, while the remaining 96 (27.1%) lived independently or in student housing. **Table 1** summarizes the demographic and clinical profile of the cohort, and **Table 2** provides detailed distributions for BMI, depression severity, and blood pressure categories.

Table 1. The demographic and clinical characteristics of participants.

	Gender			
	Male		**Female**	
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**
Age:	21.28	1.12	21.06	0.86
Height: (Meters)	1.76	0.07	1.63	0.06
Weight: (Kgs)	77.07	15.22	58.56	9.56
BMI:	24.70	4.60	22.03	3.29
Depression scale score "calculated":	7.63	5.20	8.05	5.15
SBP	121.91	12.77	109.32	9.89
DBP	77.34	8.84	74.75	7.41
Heart rate: (Beat/min)	77.16	12.79	83.87	11.86

BMI: Body mass index; DBP: Diastolic blood pressure; SBP: Systolic blood pressure.

Table 2. Detailed frequencies (and percent) of each BMI, Depression, and blood pressure category.

		Frequency	**Percent**
BMI	Underweight (BMI <18.5 kg/m^2)	33	9.3
	Normal (BMI ≥18.5 to 24.9 kg/m^2)	222	62.7
	Overweight (BMI ≥25 to 29.9 kg/m^2)	81	22.9
	moderate obesity (BMI 30 to 34.9 kg/m^2)	14	4.0
	severe obesity (BMI 35 to 39.9 kg/m^2)	2	0.6
	very severe obesity (BMI ≥40 kg/m^2)	2	0.6
	Total	*354*	*100.0*
Depression score	Minimal (Depression score 0–4)	114	32.2
	Mild-moderate (Depression score 5–14)	197	55.6
	Moderately severe-severe (Depression score 15–27)	43	12.1
	Total	*354*	*100.0*
Hypertension status-Females	Normal (<120mmHg)	139	70.9
	Elevated blood pressure (120-129mmHg)	7	3.6
	Stage 1 HTN (130-139mmHg)	44	22.4
	Stage 2 HTN (>140mmHg)	6	3.1
	Total	*196*	*100.0*
Hypertension status- Males	Normal (<120mmHg)	60	38.0
	Elevated blood pressure (120-129mmHg)	27	17.1
	Stage 1 HTN (130-139mmHg)	55	34.8
	Stage 2 HTN (>140mmHg)	16	10.1
	Total	*158*	*100.0*

Using the latest AHA/ACC guidelines [11], participants' blood pressure was classified into standard categories **(Table 2).** Among females, the majority had normal blood pressure (70.9%), while smaller proportions were classified as elevated (3.6%), stage 1 hypertension (22.4%), or stage 2 hypertension (3.1%). In contrast, male

participants showed a lower prevalence of normal BP (38.0%) and higher rates of elevated BP (17.1%), stage 1 hypertension (34.8%), and stage 2 hypertension (10.1%).

Depression severity was also assessed, with 32.2% of participants reporting minimal or no depression, 55.6% classified as having mild to moderate depression, and 12.1% falling into the moderately severe to severe category **(Table 2).** Statistical analysis revealed a significant variation in diastolic blood pressure among the three depression groups ($p = 0.035$). Post-hoc Tukey testing indicated that participants with moderately severe to severe depression had higher diastolic BP than those in the no–minimal group (difference: 3.86 mmHg, 95% CI: 0.45–7.27, $p = 0.022$) and those in the mild–moderate group (difference: 3.46 mmHg, 95% CI: 0.25–6.67, $p = 0.031$). Differences in systolic BP, diastolic BP, and heart rate across depression categories are summarized in **Table 3**, and **Figure 1** illustrates the relationship between depression severity and blood pressure.

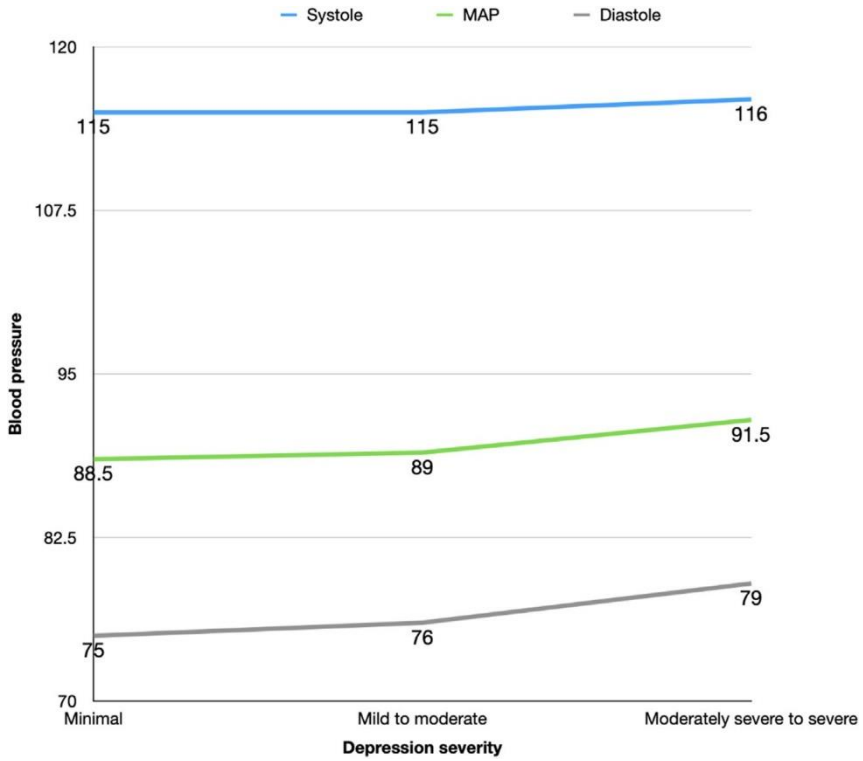

Figure 1. Comparison of systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) across depression severity categories, illustrating the relationship between depressive symptoms and blood pressure levels.

Table 3. Hemodynamic parameters (SBP, DBP, and heart rate) stratified by depression severity, showing differences among the three depression groups.

Parameter	Depression Category	n	Mean ± SD	Min	Max	p-value
Systolic BP (mmHg)	Minimal	114	114.96 ± 13.69	89	163	0.738
	Mild–Moderate	197	114.65 ± 12.52	86	161	
	Moderately Severe–Severe	43	116.19 ± 12.47	84	143	
	Total	354	114.94 ± 12.88	84	163	
Diastolic BP (mmHg)	Minimal	114	75.21 ± 8.06	50	94	0.035*
	Mild–Moderate	197	75.61 ± 7.91	57	102	
	Moderately Severe–Severe	43	79.07 ± 9.09	61	96	
	Total	354	75.90 ± 8.17	50	102	
Heart Rate (bpm)	Minimal	114	80.11 ± 13.20	54	111	0.238
	Mild–Moderate	197	80.66 ± 12.35	47	120	
	Moderately Severe–Severe	43	83.88 ± 12.87	63	108	
	Total	354	80.88 ± 12.71	47	120	

∗P-value of 0.05 or lower was considered statistically significant.

Linear regression analysis was performed to identify predictors of elevated blood pressure, with mean arterial pressure (MAP) as the dependent variable. The regression models were statistically significant for both the left and right arms ($p < 0.001$), with adjusted R^2 values of 0.205 and 0.224, respectively. Three variables emerged as significant predictors: gender, BMI, and depression scores. Specifically, being male, having a higher BMI, and elevated depression scores were associated with increased MAP **(Table 4).**

Table 4. Linear regression results showing factors associated with mean arterial pressure (MAP).

	P value**		B coefficient		95% CI	
	Left	**Right**	**Left**	**Right**	**Left**	**Right**
Gender*	<0.001	<0.001	-4.291	-4.510	-6.02 to -2.56	-6.19 to -2.83
BMI*	<0.001	<0.001	0.635	0.644	0.43 to 0.84	0.44 to 0.85
Depression scale score*	0.027	0.029	0.179	0.172	0.02 to 0.34	0.02 to 0.33

* Variables showing a univariate association with $p \leq 0.1$ were entered into the regression model.
** The final linear regression analysis considered $p < 0.05$ as the threshold for statistical significance.

The prevalence of both hypertension and depression was notably high in our sample. We observed a statistically significant difference in diastolic blood pressure across the three depression categories ($p = 0.035$), with higher depression scores associated with elevated diastolic blood pressure. Previous research at the same institution also reported high rates of hypertension among otherwise healthy university students; however, depression screening was not performed in that study [15]. In our cohort, only approximately 32% of students exhibited no or minimal depression, leaving nearly 68% with some degree of depressive symptoms, and about 12% classified as having moderately severe to severe depression.

Globally, over 300 million people are affected by depression, according to the World Health Organization (2017) [16]. Studies in the region report high prevalence rates among medical and health sciences students, including 65% in a single-center study in Egypt [17] and 45% among medical science students in Saudi Arabia [18]. Major depression is associated with various cognitive and psychological stressors [19], which may dysregulate the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis [20, 21], potentially contributing to hypertension [19, 22]. Behavioral factors often linked to depression, such as increased smoking and physical inactivity, may further elevate the risk of hypertension [23]. Clinicians treating depression should monitor blood pressure closely, as some antidepressant medications can influence hemodynamic parameters [9].

Previous studies have shown that patients with moderate to severe depression tend to have higher systolic and diastolic blood pressure, as well as increased mean arterial pressure, compared to those with no or mild depression [24]. Acute psychological stress can elevate pro-inflammatory cytokines, leading to increased heart rate and systolic blood pressure [25]. Additionally, depressive symptoms may be associated with reduced left ventricular ejection fraction, potentially serving as a precursor for coronary artery disease [25].

In our study, participants with elevated blood pressure were advised to follow up at the university primary care clinic, while those with moderately severe to severe depression were referred for psychiatric evaluation.

This study has some limitations, including a relatively small sample size. Nevertheless, the findings were statistically and clinically significant. Data collection occurred during the COVID-19 pandemic, which may have contributed to the higher rates of depression observed. Future longitudinal, multicenter studies are warranted to evaluate the benefits of screening hypertensive patients for depression (and vice versa) and to assess the potential value of implementing broader screening programs for both conditions.

Conclusion

Our findings indicate a high prevalence of both hypertension and depression in the study population, with higher depression scores being associated with elevated diastolic blood pressure. These results highlight the importance of routinely screening hypertensive patients for depression, and conversely, assessing blood pressure in individuals with depression. We further recommend implementing broader screening programs for both conditions, given their significant impact as major health risk factors.

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Conflict of Interest: None

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Ethics Statement: The study was carried out in accordance with the most recent version of the Declaration of Helsinki and received approval from the Institutional Review Board (IRB) of the University of Jordan. Written informed consent was obtained from all participants prior to enrollment.

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