

Prevalence of Depression among Medical Students in Aden, Yemen: A Cross-Sectional Study

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Abstract

Background

The prevalence of depressive disorder has increased among different populations, including university students, particularly medical students. This study aimed to determine the prevalence of depression among medical students in Aden, Yemen.

Method

A cross-sectional study was conducted among 204 medical students. Depression was assessed using the PHQ-9 scale. Data were collected through a structured questionnaire and face-to-face interviews with students and were subsequently analysed using R and SPSS software.

Results

The overall prevalence of depression among medical students was 175 (85.8%). Significantly higher rates of depression were observed among students who lived alone, those in the first and second years of study, and those with high income ($p = 0.001$, 0.004 , and 0.029 , respectively). Regarding the severity of depression, 76 (37.3%) had moderately severe to severe depression, 55 (27.0%) had mild depression, and 44 (21.6%) had moderate depression. There were no significant links between depression and other sociodemographic factors.

Conclusion

This study found a high prevalence of depression among medical students in Aden, Yemen, compared with rates reported in several previous studies. Living alone, studying in the first or second academic year, and having a high-income status were significantly associated with depressive symptoms in this study population.

Introduction

Depression is one of the most common psychological disorders and a critical health problem worldwide [1]. It affects the well-being and quality of life of depressed individuals, who may suffer from body weight loss and appetite, disruption of sleep, and inability to think and make decisions, as well as reduced self-confidence [2–5]. This condition affects about 4% of the population globally [6]. The depression disorder is increasing among different groups, including university students, particularly medical students [7]. Medical education is one of the most difficult specializations because future physicians must be equipped with adequate knowledge and skills to care for their patients and promote public health [8]. Development of professional skills requires prolonged study and training hours, competitive

environments, input overload, and frequent examinations, resulting in sleep deprivation, thereby exposing individuals to depression [7]. It is estimated that up to sixty percent of university students are leaving or have not completed their university studies due to depression [9, 10]. The overall global prevalent rate of depression among medical students ranged from 1.4% to 100% [11, 12].

In Yemen, three studies were conducted among medical students that revealed the prevalence of depression disorder was 73.67%, 48.4%, and 100% [12, 13, 14]. There is still a lack of context-specific data regarding the impact of depression disorders on medical students in Aden, Yemen. This research is the first to be conducted among medical students in this government. Therefore, this study aimed to determine the prevalence of depression among medical students in Aden, Yemen, and identify associated sociodemographic factors that may contribute to increasing the prevalence of depression among those students using multiple linear regression and ordinal logistic regression with bootstrap adjustment.

Subjects and Methods

Study design and period

A cross-sectional study was conducted in Aden Governorate, Yemen, among medical students who agreed to participate in the study during the period from 15 October 2025 to 1 May 2026.

Sample size

The sample size was calculated using Stephen Thompson's formula:

$$N = \frac{Z^2 P(1 - P)}{d^2}$$

Based on a previous study conducted among medical students in Saudi Arabia, the prevalence of depression was reported to be 83.4% [15]. Accordingly, the calculated sample size was:

$$N = \frac{Z^2 P(1 - P)}{d^2} = \frac{(1.96)^2 \times 83.4\%(1 - 83.4\%)}{(5\%)^2} = 213 \text{ students.}$$

After adding a 10% non-response rate, the total sample size was 235 students. However, the number of medical students who accepted to participate in our study was 204, with an acceptance rate of 86.8%.

Data collection

Data were collected using a modified structured questionnaire adapted from a previous study conducted in Saudi Arabia [15], in addition to the Patient Health Questionnaire-9 (PHQ-9), a validated tool used to

assess depression and its severity among students. The PHQ-9 consists of nine items, each scored from 0 to 3, giving a total score ranging from 0 to 27. Scores were categorized as follows: 0–4 indicating no depression; 5–9 mild depression, 10–14 moderate depression, 15–19 moderately severe depression, and 20–27 severe depression [16, 17].

Inclusion and exclusion criteria

All students studying medical sciences in different universities in Aden, Yemen, were included in this study. The study population comprised students from the following specialties: medicine, dentistry, pharmacy, medical laboratory sciences, and other related medical science programs. Students from non-medical specialties, as well as doctors and lecturers, were excluded from the study.

Statistical Analysis

Data were analyzed using R version 4.3.1 (R Core Team, 2024) and SPSS version 23.0 (IBM Corp., Armonk, NY, USA). Microsoft Excel 2013 was used for figure preparation. A two-sided p-value < 0.05 was considered statistically significant for all analyses unless otherwise specified. Associations between sociodemographic factors and depression (PHQ-9 $\geq$ 10) were initially examined using bivariate analyses. Multivariable binary logistic regression with bootstrap validation was performed to identify factors independently associated with clinical depression and ordinal logistic regression for depression severity. E-value analysis was used to quantify the robustness of the primary findings to potential unmeasured confounding. Sensitivity analysis was also used to evaluate the consistency of the living alone–depression association across different groups.

Results

Of two hundred and four medical students who agreed to participate in the study, 102 (50%) were aged < 22 years and 102 (50%) were aged $\geq$ 22 years. The majority were female, 136 (66.7%), and single, 183 (89.7%). Regarding residence, 132 (64.7%) lived with family members. In terms of academic level, 68 (33.3%) were in the first year, and 37 (18.1%) were in the second year, while the remaining students were distributed across other levels. Most participants, 159 (77.9%), reported a medium socioeconomic status (Table 1).

Table 1
Sociodemographic characteristics of study
participants (n = 204)

Item	Frequency	Percent (%)
Age		
< 22 years	102	50.0
≥ 22 years	102	50.0
Sex		
Male	68	33.3
Female	136	66.7
Marital status		
Single	183	89.7
Married	16	7.8
Divorced	5	2.5
Living condition		
Alone	72	35.3
Family members	132	64.7
Specialty		
Medicine	68	33.3
Dentistry	59	28.9
Pharmacy	24	11.8
Medical Laboratories	30	14.7
Other	23	11.3
Education year		
First	35	17.2
Second	37	18.1
Third	36	17.6
Fourth	34	16.7
Fifth	34	16.7
Sixth	28	13.7

Item	Frequency	Percent (%)
Income		
Low	38	18.6
Medium	159	77.9
High	7	3.4

Using broader criteria, the overall rate of depression among medical students was 175 (85.8%) (Fig. 1). Based on the standard PHQ-9 severity classification of depression severity among medical students, the distribution of depression severity among the 204 participants was as follows: no depression (score 0–4: 29, 14.2%), mild depression (score 5–9: 55, 27.0%), moderate depression (score 10–14: 44, 21.6%), and moderately severe to severe depression (score ≥ 15 : 76, 37.3%). The overall prevalence of clinical depression, defined as a PHQ-9 score ≥ 10 , was therefore 58.8% (120/204). The majority of students, 99 (75.0%), had severe depression (including moderately severe and severe categories), followed by 30 (22.7%) with moderate depression, while 3 (2.3%) had mild depression (Fig. 2).

Bivariate analysis revealed that the highest significant rate of depression was among students who lived alone, 57 (79.2%, $p = 0.001$), followed by students in the first- and second-year levels, 28 (80.0%) and 29 (78.4%), respectively ($p = 0.004$). In addition, a higher rate of depression was observed among high-income students, 6 (85.7%, $p = 0.029$) (Table 2).

Table 2
Bivariate Association Between Depression (PHQ-9 ≥ 10)
and Sociodemographic Factors ($n = 240$)

Item	Depression		P
	No	%	
Age group			
< 22 years (n = 102)	62	60.8	0.153
≥ 22 years (n = 102)	70	68.6	
Sex			
Male (n = 68)	40	58.8	0.139
Female (n = 136)	92	67.6	
Marital status			
Single (n = 183)	118	64.5	0.920
Married (n = 16)	11	68.8	
Divorced (n = 5)	3	60.0	
Living condition			
Alone (n = 72)	57	79.2	0.001
Family members (n = 132)	75	56.8	
Specialty			
Medicine (n = 68)	37	54.4	0.052
Dentistry (n = 59)	41	69.5	

Item	Depression		P
	No	%	
Pharmacy (n = 24)	21	87.5	0.004
Medical Laboratories (n = 30)	19	63.3	
Other(n = 23)	14	80.9	
Education year			
First (n = 35)	28	80.0	
Second (n = 37)	29	78.4	
Third (n = 36)	24	66.7	
Fourth(n = 34)	23	67.6	
Fifth (n = 34)	16	47.1	
Sixth (n = 28)	12	42.9	
Income			
Low (n = 38)	18	47.4	
Medium (n = 159)	108	67.9	
High (n = 7)	6	85.7	

The bivariate associations observed that academic year and income did not persist after multivariable adjustment. Compared to first-year students, none of the higher academic years showed statistically significant differences: second year (aOR = 0.88, 95% CI: 0.31–2.49, p = 0.807), third year (aOR = 0.64, 95% CI: 0.22–1.84, p = 0.406), fourth year (aOR = 1.04, 95% CI: 0.39–2.77, p = 0.942), fifth year (aOR = 0.96, 95% CI: 0.36–2.54, p = 0.930), and sixth year (aOR = 0.82, 95% CI: 0.29–2.33, p = 0.710). Similarly, income was not significantly associated with depression: medium income (aOR = 0.79, 95% CI: 0.43–1.47, p = 0.463) and high income (aOR = 0.45, 95% CI: 0.13–1.58, p = 0.213). Other variables also failed to reach statistical significance: age $\geq$ 22 years (aOR = 1.48, 95% CI: 0.82–2.68, p = 0.194), female sex (aOR = 1.25, 95% CI: 0.70–2.24, p = 0.456), and married status (aOR = 0.54, 95% CI: 0.12–2.35, p = 0.410) (Table 3).

Table 3
Multivariable Binary Logistic Regression for Clinical Depression (PHQ-9 ≥ 10)

Predictor	Comparison	aOR	95% CI	p-value	E-value*
Living alone	Alone vs family	2.45	1.35–4.45	0.003	3.35 (1.98)
Age group	≥ 22 vs < 22 years	1.48	0.82–2.68	0.194	-
Sex	Female vs male	1.25	0.70–2.24	0.456	-
Marital status	Married vs single	0.54	0.12–2.35	0.410	-
Income	Medium vs low	0.79	0.43–1.47	0.463	-
Income	High vs low	0.45	0.13–1.58	0.213	-
Academic year	Second vs first	0.88	0.31–2.49	0.807	-
Academic year	Third vs first	0.64	0.22–1.84	0.406	-
Academic year	Fourth vs first	1.04	0.39–2.77	0.942	-
Academic year	Fifth vs first	0.96	0.36–2.54	0.930	-
Academic year	Sixth vs first	0.82	0.29–2.33	0.710	-

*E-value for point estimate (lower CI bound). Model adjusted for all variables in the table plus specialty. Hosmer-Lemeshow test: $\chi^2 = 8.24$, $df = 8$, $p = 0.411$. Nagelkerke $R^2 = 0.087$.

The E-value of **3.35** (with a lower confidence bound of **1.98**) quantifies the minimum strength of association that an unmeasured confounder would need to have with both living alone and depression to fully explain away the observed adjusted odds ratio of 2.45.

For an unmeasured confounder to negate our findings, it would need to increase the odds of living alone by at least 3.35-fold and simultaneously increase the odds of depression by 3.35-fold, above and beyond all measured covariates. To contextualize this threshold, Table 5.1 compares the E-value with effect sizes of established depression risk factors from the literature. The E-value of 3.35 exceeds the typical effect sizes of all established risk factors listed above. It was established that risk factors for depression generally have effect sizes below the E-value threshold of 3.35. This includes family history of depression (typical OR range: 1.5–2.5), childhood adversity (OR range: 1.8–2.8), low social support (OR range: 1.5–2.2), chronic medical illness (OR range: 1.6–2.4), and even previous depressive episodes (OR range: 2.0–3.0). Therefore, while residual confounding cannot be entirely ruled out, the E-value suggests that such confounding would need to be implausibly strong—stronger than any known risk factor—to explain away the observed association. The lower bound of the E-value (1.98) indicates that even under conservative assumptions, an unmeasured confounder would need to at least double the odds of both exposure and outcome. Given the absence of known confounders of this magnitude in the medical student depression literature, our findings demonstrate moderate to strong robustness against unmeasured confounding (Table 4).

Table 4
Comparison of E-value with Established Risk Factors for Depression

Risk Factor	Typical OR Range	Compared to E-value (3.35)
Family history of depression	1.5–2.5	Below threshold
Childhood adversity	1.8–2.8	Below threshold
Low social support	1.5–2.2	Below threshold
Chronic medical illness	1.6–2.4	Below threshold
Previous depressive episode	2.0–3.0	Below threshold
Required unmeasured confounder	≥ 3.35	Above all known factors

**Note: OR ranges are derived from meta-analyses and large cohort studies in depression epidemiology.*

Among students with depression (using the broader definition of any symptoms), significant differences in severity distribution were observed by sex and academic year. The highest significant prevalence of severe depression was observed among female students, accounting for 75 out of 92 cases (81.5%) among depressed females ($p = 0.004$). Additionally, students in the third and fourth academic years showed high proportions of severe depression, with 21/24 (87.5%) and 20/23 (87.0%) cases, respectively ($p = 0.0001$). Other associations with severity were not statistically significant (Table 5).

To examine factors associated with greater depression severity while adjusting for covariates, ordinal logistic regression was performed with the four-level severity variable as the outcome (none-minimal → mild → moderate → severe) among all 204 participants. The proportional odds assumption was formally tested using the Brant test and was satisfied ($\chi^2 = 8.47$, $df = 7$, $p = 0.287$), indicating that the effect of each predictor is consistent across the cumulative logits. Living alone was significantly associated with higher depression severity. Students living alone had 2.27 times higher odds of being in a higher severity category compared to those living with family (odds ratio [OR] = 2.27, 95% CI: 1.26–4.09, $p = 0.006$). This indicates that among all students, those living alone were more likely to fall into the moderate or severe categories rather than the none-minimal or mild categories. No other variables demonstrated significant associations with severity, confirming that the bivariate associations observed for sex and academic year were confounded by other factors (Table 5).

Table 5
Ordinal Logistic Regression for Depression Severity (n = 204)

Predictor	Comparison	OR	95% CI	p-value
Living alone	Alone vs family	2.27	1.26–4.09	0.006
Age group	≥ 22 vs < 22 years	1.27	0.73–2.21	0.392
Sex	Female vs male	0.84	0.48–1.46	0.521
Marital status	Married vs single	0.57	0.08–3.93	0.568
Income	Medium vs low	0.66	0.36–1.22	0.186
Income	High vs low	0.51	0.13–1.94	0.324
<i>Note: Outcome is four-level severity (none-minimal → mild → moderate → severe). Brant test for proportional odds: $\chi^2 = 8.47$, $df = 7$, $p = 0.287$. Pseudo R^2 (McFadden) = 0.041.</i>				

To address potential violations of normality and to obtain more robust standard errors, bootstrapping was performed with 1,000 resamples using the bias-corrected and accelerated (BCa) method. The bootstrap results strongly confirmed the primary findings: the bootstrap confidence interval for living alone (1.02–4.80) did not include zero, and the close agreement between original and bootstrap coefficients (2.89 vs. 2.91) indicated minimal bias (Table 6).

Table 6
Multiple Linear Regression with Bootstrap Validation (n = 204)

Predictor	Comparison	β (unstd)	SE	Standardized β	p-value	Bootstrap β / BCa 95% CI
Living alone	Alone vs family	2.89	0.98	0.21	0.004	2.91 (1.02–4.80)
Age group	≥ 22 vs < 22 years	1.52	0.97	0.11	0.118	1.48 (-0.41–3.37)
Sex	Female vs male	1.08	0.97	0.08	0.265	1.12 (-0.80–3.04)
Marital status	Married vs single	-0.92	1.65	-0.04	0.582	-0.88 (-4.15–2.39)
Income	Medium vs low	-1.24	1.03	-0.09	0.229	-1.20 (-3.22–0.82)
Income	High vs low	-2.61	1.91	-0.10	0.173	-2.58 (-6.42–1.26)
<i>*Model: $F(13,190) = 1.48$, $p = 0.042$, adjusted $R^2 = 0.092$. Bootstrap based on 1,000 resamples, BCa = bias-corrected and accelerated.*</i>						

The association between living alone and depression remained consistently elevated across all cutoffs, with aORs ranging from 2.12 to 2.45. Although the estimate for PHQ-9 ≥ 5 did not reach conventional statistical significance ($p = 0.068$). This is likely attributable to the very high baseline prevalence (85.8%), limiting variability and statistical power for detecting associations. At the strictest cutoff (PHQ-9 ≥ 20), the association remained elevated (aOR = 2.31) but did not reach statistical significance ($p = 0.057$), likely due to the reduced sample size ($n = 35$ in the depressed group) limiting statistical power. Living alone is a genuine risk factor for clinically significant depression (Table 7).

Table 7
Sensitivity Analysis Across PHQ-9 Cutoffs

Depression Definition	Cutoff	Prevalence	Living Alone aOR	95% CI	p-value
Any symptoms	≥ 5	85.8% (175/204)	2.12	0.95–4.73	0.068
Clinical depression (primary)	≥ 10	58.8% (120/204)	2.45	1.35–4.45	0.003
Moderately severe	≥ 15	37.3% (76/204)	2.18	1.11–4.28	0.024
Severe only	≥ 20	17.2% (35/204)	2.31	0.98–5.45	0.057
<i>Note: The association remained elevated across all cutoffs. The lack of statistical significance at the strictest cutoff (≥ 20) is likely attributable to reduced sample size ($n = 35$ in the depressed group) limiting statistical power, rather than a true absence of effect.</i>					

Discussion

In the current study, 85.7% of medical students had depression. A study conducted among medical students in Saudi Arabia reported that 83.4% of students had depression [15]. Similar global studies found lower prevalence rates than ours, such as 73.67% in Yemen [13], 70% in Pakistan [18], 65.2% in Sudan [19], 62.5% in Egypt [7], 61.4% in Thailand [20], 49.1% in India [21], 48.4% in Yemen [14], 41.9% in Malaysia [22], 36.0% in northeast Brazil [23], 35.1% in Pakistan [24], 31% in Nepal [25], 30.6% in Cameroon [26], 23.3% and 15.1% in Nigeria [27, 28], 23.3% in Peru [29], 21.5% in Uganda [30], 16.4% in United States (US) students [31], 15.2% in Vietnam [32], and 1.4% in Germany [11]. One of the highest results was found in Taiz, Yemen, where all enrolled students had depressive symptoms [12]. The variations are related to differences in socio-demographic characteristics, culture, university teaching strategies, and the tools used to evaluate depression [7].

The current study showed a significantly higher rate of depression (79.2%) among students living alone ($p = 0.001$). This finding was also confirmed by multivariable binary logistic regression ($p = 0.003$). It was in agreement with that recorded among Saudi medical students [15]. A study among Nigerian students revealed no significant association [28]. The lack of support from family members during study difficulties may decrease self-confidence among medical students, thereby increasing depressive symptoms [33, 34, 35].

The current data demonstrated that students in the first and second years of education had depression rates of 80% and 78.4%, respectively, with a statistically significant association ($p = 0.004$). Similar findings were recorded among Brazilian and US medical students [36, 37]. Previous studies have shown the highest depression rates among students in the second and third years [30], the third year [38], third and fourth years [28], fourth and fifth years [15], and the final years of education [39]. The first year of medical education is a transitional stage from undergraduate learning to a highly compressed and complex curriculum, where the English language is a major challenge for students, especially Arabic-speaking students, in addition to Latin and Greek medical terminology. Students face a new study environment characterized by an increase in arduous daily activities, spending long hours in classes, and not enough time for leisure, sleep, and other social activities [33]. In the second year, students encounter more difficult biomedical courses such as anatomy, biochemistry, physiology, microbiology, pharmacology, pathology, and immunology, which require them to increase their efforts and study hours [30].

These data revealed the highest significant depression rate (85.7%) among students who had high income ($p = 0.029$). Sacramento et al. found that students with low to medium income had the highest rates [23]. Suraj et al. noticed no significant association, despite increased rates among low-income students [28]. Increased familial expectations and pressure, irregular sleep patterns, limited family interaction, emotional neglect, or social isolation may increase depression among high-income students.

Our study showed no difference in the frequency of depressive symptoms according to other sociodemographic factors among students, including age group, sex, and marital status. A study conducted among medical students revealed no association between depression and marital status [15]. Two studies from Brazil and Nepal showed no difference between age groups and depression. However, a significant association was observed among female students [23, 25]. The lack of significant results in our study may be attributed to the small sample size.

Regarding the severity of depression in this study, the majority (37.3%) of medical students had moderately severe to severe depression, followed by mild depression (27.0%), and 21.6% had moderate depression. Different global and regional studies reported varying severity rates of depression among medical students [7, 13, 23, 26]. Variations in the study populations, scoring techniques, and sample sizes may explain these differences worldwide.

Strengths and Limitations

The present study has several important strengths. First, it is the first study among medical students in Aden, Yemen, critical for filling the gap in the literature. Second, the validated tool (PHQ-9) was used where Cronbach's $\alpha = 0.87$ (excellent reliability and validity). Third, using different and advanced statistical methods and tests, including ordinal logistic and multiple linear regression with bootstrap adjustment, E-value analysis, interaction analysis, and sensitivity analysis—represents a methodological advance over most previous studies in this field. Fourth, the E-value analysis is robust against

unmeasured confounding, addressing a common criticism of observational studies. Conversely, the limitations of this study include the cross-sectional study design that precludes causal inference. The study was conducted only among students in Aden as an urban area, which may not be representative of all Yemeni medical students, particularly those in rural areas. In addition, the study was limited to assessing the association between depression severity and sociodemographic characteristics of students without evaluating the educational system or other related factors. Other psychological disorders, such as anxiety and stress, were also not assessed in this study.

Conclusions

The prevalence of depression among medical students in Aden, Yemen, was relatively high compared with rates reported in several other studies. Depression in this sample was significantly associated with living alone, being in the first and second academic years, and having a high-income status. However, no statistically significant differences were found between the presence of depressive symptoms and other sociodemographic characteristics of the students. Further research and targeted mental health support for medical students are recommended.

Declarations

Ethical Considerations

Ethical approval: The ethical approval of this study was obtained from the Ethics Committee of the College of Medicine and Health Science at the University of Science and Technology; MEC No. (MEC /AD0170). It was based on the standards of the Helsinki Declaration. The written consent form was obtained from each woman before performing any procedure.

Consent for publication

Not applicable.

Availability of data and materials

All data generated during this study are included in this manuscript. Additional information can be made available upon reasonable request.

Conflict of interest

The authors declared no conflicts of interest.

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Authors' contributions

ANMG and NTA supervised the study and performed final manuscript editing. AA, SA, FE, ABN, ST, and H.A.A.M. contributed to the introduction, methodology, and data analysis. AA, SA, FE, ABN, and ST were involved in data collection and preparation of tables and figures of results. ANMG, NTA, and H.A.A.M. analyzed and discussed the results. All authors participated in reference formatting and manuscript revision and approved the final version.

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In writing this manuscript, the authors used Grammarly to assist with language editing, proofreading, and improving the clarity of the text. These tools were not used in the study design, data analysis, or interpretation of results. The authors carefully reviewed, verified, and approved all content and take full responsibility for the final manuscript.

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Figures

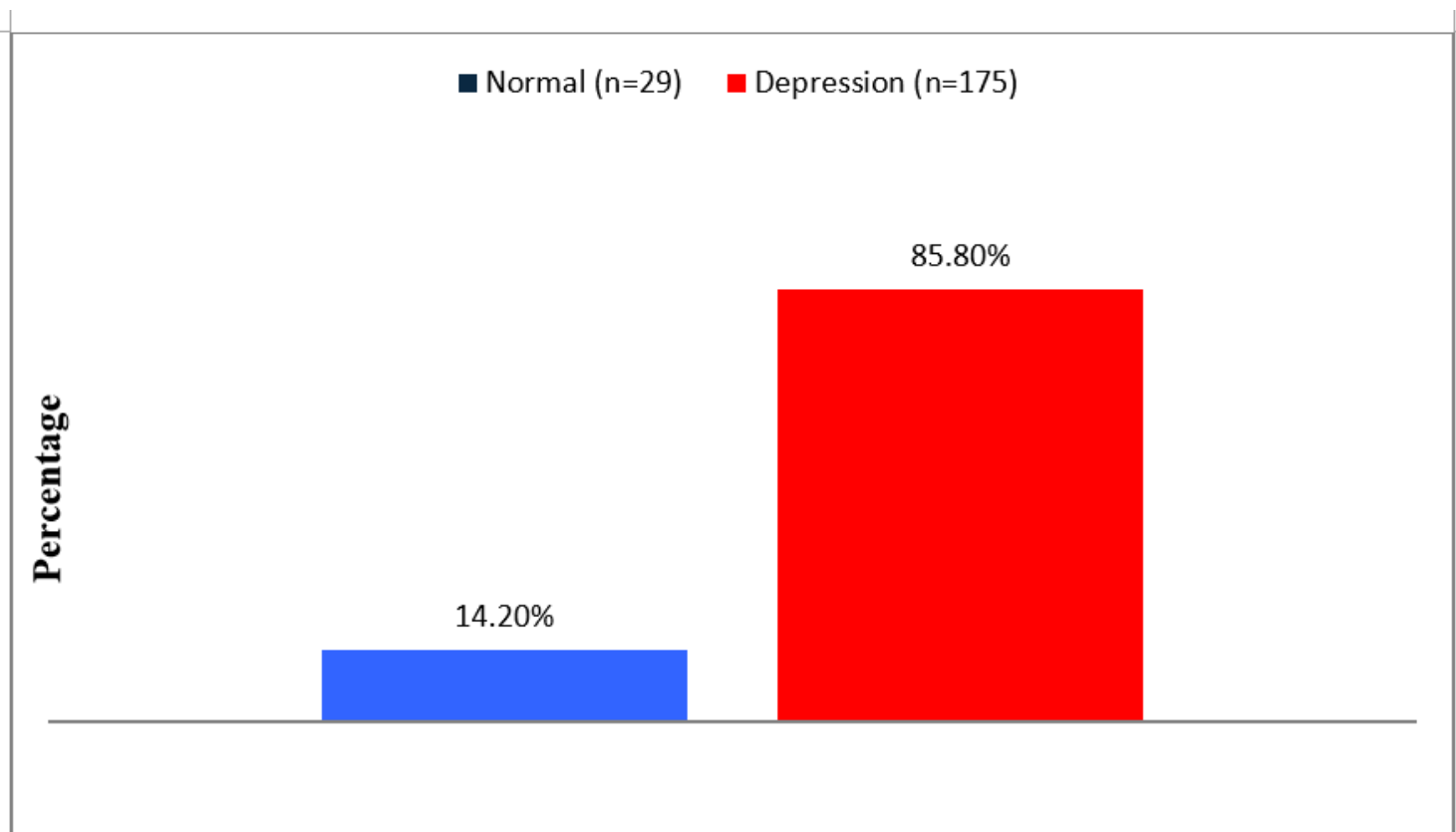


Figure 1

The prevalence of depression among medical students in Aden, Yemen (n = 204)

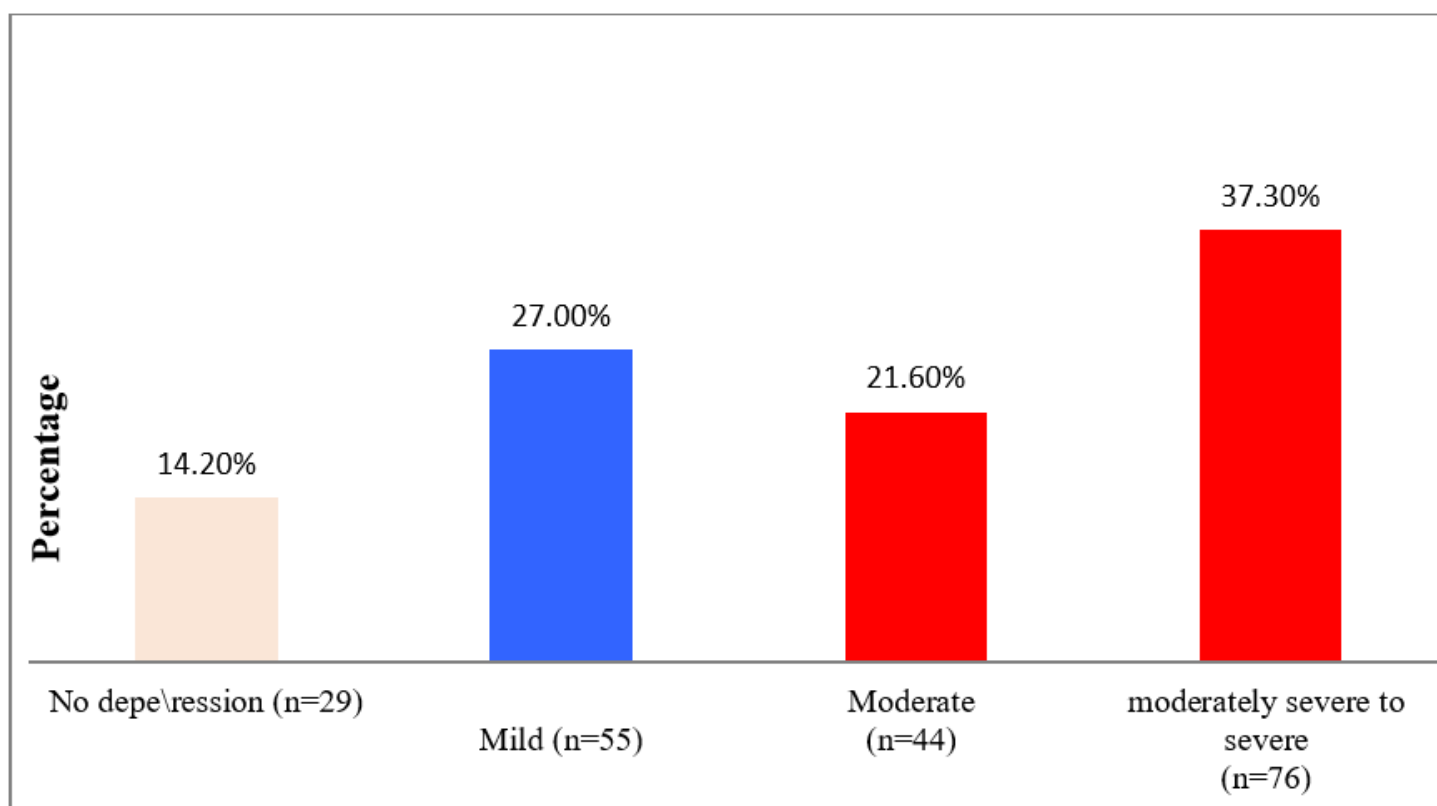


Figure 2

Severity of depression among medical students in Aden, Yemen (n = 204)

