ORIGINAL RESEARCH

Physical Activity, Dietary Habits and Factors Associated with Depression Among Medical Students of Sindh, Pakistan, During the COVID-19 Pandemic

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Objective: To find out the association of physical activity, dietary habits and factors associated with depression among medical students of Sindh, Pakistan, during the coronavirus disease 2019 (COVID-19) pandemic.

Methods: An online cross-sectional study was conducted between June and August, 2020, on medical students from three medical institutions of Sindh, Pakistan. The study comprised three structured questionnaires related to demographic details, physical activity, dietary and sleep habits, COVID-19 pandemic-associated factors and patient health questionnaire, PHQ-9. A total of 864 students completed the questionnaires and participated in the study. The data was analysed on SPSS version 23.

Results: Our study showed that 244 (28.2%) medical students had mild depression, 192 (22.2%) had moderate depression, 80 (9.3%) had moderately severe depression and 80 (9.3%) had severe depression during the COVID-19 pandemic. Out of 864 students, 268 (31%) had no depression. Socioeconomic status, body mass index (BMI), chronic disease/comorbidity, addiction and non-medical prescription drug use were found to be statistically significant predictors of depression among medical students. On multilogistic regression analysis, physical activity, social media/app use and sleeping habits during COVID-19 were associated with depression (p-value < 0.05).

Conclusion: The COVID-19 pandemic adversely affected physical activity and sleeping habits in association with depression among medical students. Promoting healthy eating habits, adequate physical activity, and a healthy lifestyle, particularly among students during lockdowns, is a critical component of coping with mental stress and depression. The findings of this study will aid in future research and campaign design in preparation for future pandemics and lockdowns.

Keywords: COVID-19, depression, dietary habits, physical activity

Introduction

Depression is defined as a mental illness and characterized by lack of interest, low energy, inability to feel pleasure (anhedonia), feeling guilt and low self-esteem, which may be accompanied by disturbed sleep and poor appetite and concentration. It affects people globally, with a prevalence of 3.2% among general population.[1,2] Students at medical institutions are subject to various factors during their academic years, which contribute to an increased prevalence of depression among them. The various stresses include academic prerequisites, increased workload, time pressure and management, greater assessments and pressure related to clinical work in final years. Approximately one-third of medical students are affected by depression worldwide, which is far greater than expected in the general population.[3]

The coronavirus disease 2019 (COVID-19) infected over 422 million people worldwide and killed over 5.8 million people between the beginning of the pandemic and February 20th, 2022.[4] Due to the rapid global spread of the COVID-19 outbreak, the World Health Organization (WHO) has recommended the implementation of public health measures such as the isolation of all individuals suspected of infection with this disease for a 14-day quarantine period, while respective governments have also implemented "social distancing" and "lock-downs" of entire populations of varying severity to mitigate the spread of COVID-19.[5–10] These approaches impede individuals' mobility, daily activities,[11,12] and social interactions.[13] As a result, an increase in the prevalence of psychological distress and disorder symptoms (eg, depression, anxiety, negative feelings, emotional exhaustion, somatic symptoms, panic disorder) has been widely reported in people subjected to quarantine.[11,12] Participation in acute and chronic physical activity, which has been shown to improve overall health, may be compromised during confinement periods.[11–14] A change in dietary intake, such as overeating or increased frequency of meals, was another effect of prolonged quarantine. Many people respond to chronic stress by consuming high energy and less nutritious food items (such as soft drinks, fast food etc). Furthermore, being isolated during quarantine resulted in a lack of emotional support from family and friends, which is associated with stress-related dietary behaviors.[15]

The rapid shutdown of educational institutions, particularly medical colleges and universities, during COVID-19 had a devastating impact on the global education system. Online teaching was facilitated to overcome educational loss; yet, in underdeveloped countries such as Pakistan, e-learning deployment was difficult and challenging. The majority of Pakistan's population was unprepared for the transition from physical to online classes, which elevated their stress levels and led to depression symptoms.[16]

Given that lifestyle and education system was altered during COVID-19 pandemic, this study was conducted to assess the depression related to these factors among medical students of Sindh, Pakistan.

Methods

An online cross-sectional study was conducted between June and August, 2020, with medical students from three medical institutions of Sindh, Pakistan: (i) Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, (ii) Bilawal Medical College (BMC), Jamshoro, and (iii) Khairpur Medical College (KMC), Khairpur Mirs, after approval from the Ethical Review Committee. A questionnaire was drafted in Google Survey form and distributed to all medical and dental students from first year to final year using social media apps (WhatsApp, Facebook, and email). Before filling in the online questionnaires, the study purpose was explained on the online form. The volunteer students consented to participate in the study by filling up an informed consent letter presented in the beginning of the e- questionnaire and confidentiality maintained by anonymizing the students. It was assured that questionnaire was rotated during the period when there was no online exam/unit test announced, neither they had to appear for tests/exam for at least 2 weeks after filling a questionnaire and have not got exam/test results at least 2 weeks prior.

The study comprised of three structured e-questionnaires that were pilot tested in a group of n=102 students.

Questionnaire I comprised of demographic details, physical activity, dietary and sleep habits. The physical activity was evaluated by the short version International Physical Activity Questionnaire (IPAQ).[17] This is an internationally validated questionnaire that estimates the physical activity levels over a period of last one week/7 days (available online: https://sites.google.com/site/theipaq/questionnaire_links). The level of physical activity was ordered into 3 categories for analysis purpose: (a) minimal to highly active (≥3 days/week vigorous activities for at least 20 minutes/day or ≥5 days/week moderate intensity activity or walking for at least 30 minutes/day); (b) irregularly active (physical activity less than recommended for minimal or highly active category); and (c) inactive (no physical activity for at least 10 uninterrupted minutes in a week). Dietary habits were assessed by questions from previous validated questionnaires and studies evaluating frequency of meals, frequency of consumption of fast food and soft drinks.[18,19] Questions about sleep habits (duration, time spent in bed before sleep, screen time duration, sleep medications) were developed following a literature review[20,21] and consultation with field experts (n=5). The reliability and validity of questions were confirmed after a pilot study (n=102) and obtained 81% Cronbach's α.

The closed-ended questionnaire II was developed with an emphasis on concerns about acquiring COVID-19 and associated isolation, the impact of COVID-19 on studies, and difficulties encountered while taking online classes. We

examined face validity and test–retest reliability for the questionnaire. Between the test and retest on the pilot group (n=102), Spearman rank correlation coefficients were 0.703 to 0.983.

Questionnaire III: Pretested self-administered patient health questionnaire PHQ-9 to assess the frequency of depressed mood and anhedonia over the previous 2 weeks. It was used to determine whether the students meet the criteria for a depressive disorder or not. The arrangement of the questions is as Likert items and ranked from 0–3 (0: not at all, 1: several days, 2: more than half the days, and 3: nearly every day). The Likert items are calculated in a range from 0–27 score (none: 0–4, mild: 5–9, moderate: 10–14, moderately severe: 15–19, severe: 20–27). The questionnaire is available online at: https://patient.info/doctor/patient-health-questionnaire-phq-9.

A total of n=957 students volunteered to participate in the study. Out of 957 students, 93 students did not fill the complete questionnaire and were excluded. So, the final sample size was n=864. The data was analysed on SPSS version 23. Categorical variables were presented as frequencies and percentages and continuous variables as means and standard deviations (SD). Independent variables with $p < 0.05$ on bivariate analysis were further analysed using multivariate analysis. The association of variables with depressive symptoms was analysed by multivariate logistic regressions. The associations were presented as odds ratios (OR) with 95% confidence intervals (CI). For all statistical tests, a *p*- value <0.05 was considered significant.

Results

Prevalence of Depression Among Medical Students During the COVID-19 Pandemic

Figure 1 shows the prevalence of depression among medical students during COVID-19, based on responses to the 9 items of the PHQ-9. According to our findings, 244 (28.2%) medical students had mild depression, 192 (22.2%) had moderate depression, 80 (9.3%) had moderately severe depression and 80 (9.3%) had severe depression. Out of 864 students, 268 (31%) had no depression. For further analysis, a cut-off of >4 was used to distinguish the presence and absence of depression. So, almost three-fourths (69%) of medical students had depression during the COVID-19 pandemic.
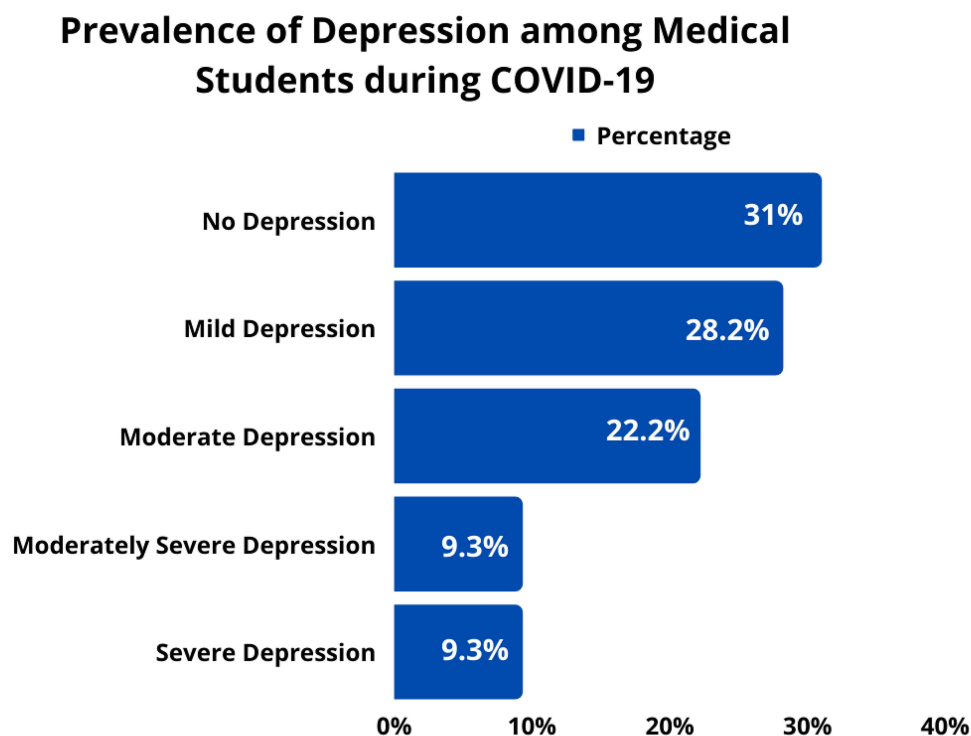

Figure 1 Prevalence of depression among medical students during COVID-19.

Sociodemographic Characteristics of the Medical Students

A total of 864 students participated and the response rate was 90.3%. The mean age of the students was 19.81, with a standard deviation (SD) of 1.378. The highest proportion of the students (498, 57.6%) were males. The majority of the students (827, 95.7%) were single and in their first year (551, 63.8%). Regarding the socioeconomic status of the participants, 85% belonged to middle class families and 56.8% were urban residents. It showed that only 40% of the students had a normal body mass index (BMI). It was noted that 17.1% of the students had some kind of addiction; smoking n=56 (37.8%), betel nuts n=16 (10.8%), nicotine n=12 (8.1%), caffeine 8 (5.4%), social media, apps, games and movies n= 40 (27.1%), whereas 16 (10.8%) had some other type of addictions.

To find out the association and the relative effect of individual independent variables against the dependent variable (depression), initially binary logistic regression analysis was performed. Among all independent variables, gender, socioeconomic status, BMI (obese II), history of chronic disease/comorbidity, addiction and non-medical prescription drug use were found to have an association (p-value <0.05) with depression and became eligible for multilogistic regression analysis. The socioeconomic status, BMI (obese II), history of chronic disease/comorbidity, addiction and non-medical prescription drug use were found to be statistically significant predictors of depression among medical students under multilogistic regression analysis. Figure 2 shows distribution of medical students with depression on the basis of sociodemographic characteristics.

The odds of having depression were around 2 times higher among female medical students as compared with male students [AOR = 1.919; 95% CI (1.385–2.66)]. Based on socioeconomic status, the odds of developing depression among middle class was 2.8 times [AOR = 2.843; 95% CI (1.676–4.822)] and lower class was 2.7 [AOR = 2.752; 95% CI (1.203–6.292)] times compared to the upper class.

Medical students who were obese II were significantly more likely to have depression compared to normal or other BMI categories [AOR = 2.718; 95% CI (1.238–5.966)]. The odds of depression among medical students with chronic disease/comorbidities was 6.5 times higher [AOR = 6.471; 95% CI (2.753–15.208)], addiction 2.6 times higher [AOR = 2.583; 95% CI (1.584–4.211)] and use of non-medical prescription drugs 5.4 times higher [AOR = 5.412; 95% CI (2.111–13.874)] as compared to students with no such history (Table 1).
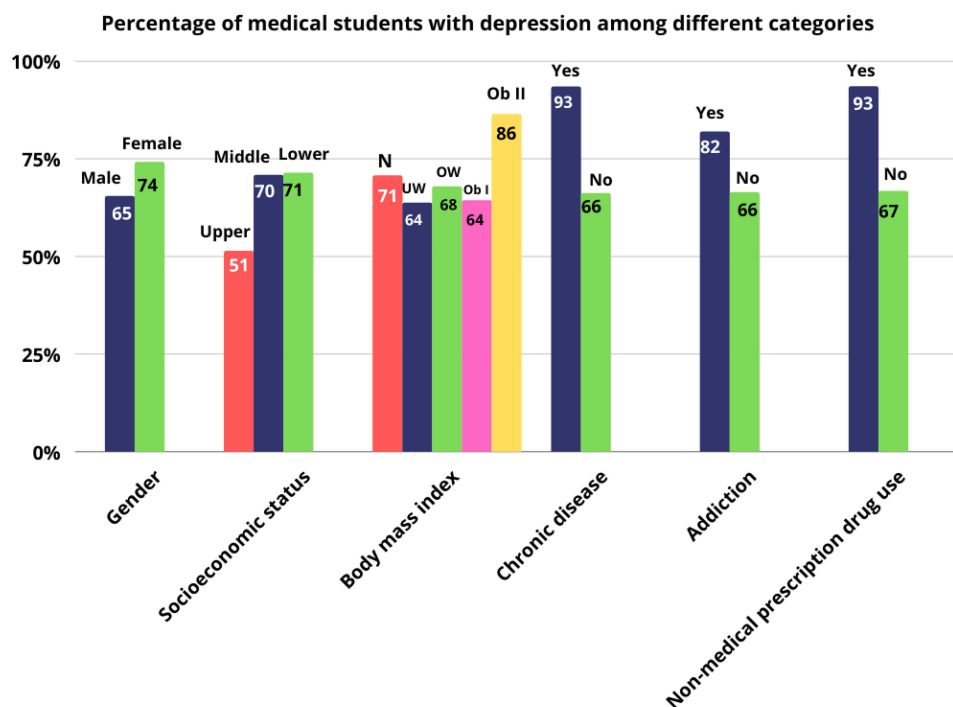

Figure 2 Distribution of medical students with depression during COVID-19 among different categories of sociodemographic characteristics.
Abbreviations: N, normal; UW, underweight; OW, overweight; Ob I, obese I; ob II, obese II.

Table 1 Medical Students' Selected Variables and Their Association with Depression During COVID-19

Variables	Total n (%)	Depression		COR (95% CI)	P-value	AOR (95% CI)	P value
		Yes (n=596)	No (n=268)				
Gender							
Male	498 (57.6)	325 (37.6)	173 (20)	Ref	0.006	Ref	**<0.0001**
Female	366 (42.4)	271 (31.4)	95 (11)	1.518 (1.127–2.045)		1.919 (1.385–2.66)	
Marital status							
Single	827 (95.7)	569 (65.9)	258 (29.8)	Ref	0.592	–	–
Married/Engaged	37 (4.3)	27 (3.1)	10 (1.2)	1.2243 (0.583–2.566)		–	
Year of study							
First year	551 (63.8)	360 (41.7)	191 (22.1)	1.021 (0.508–2.051)	0.954	–	–
Second year	146 (16.9)	117 (13.5)	29 (3.4)	2.185 (0.994–4.805)	0.052	–	–
Third year	90 (10.4)	69 (8)	21 (2.4)	1.78 (0.774–4.094)	0.175	–	–
Fourth year	40 (4.6)	26 (3)	14 (1.6)	1.006 (0.394–2.567)	0.990	–	–
Final year	37 (4.3)	24 (2.8)	13 (1.5)	Ref		–	–
Socioeconomic status							
Upper	78 (9)	40 (4.6)	38 (4.4)	Ref		Ref	
Middle	734 (85)	519 (60.1)	215 (24.9)	2.293 (1.431–3.675)	0.001	2.843 (1.676–4.822)	**<0.0001**
Lower	52 (6)	37 (4.3)	15 (1.7)	2.343 (1.111–4.943)	0.025	2.752 (1.203–6.292)	**0.016**
Residence							
Urban	491 (56.8)	337 (39)	154 (17.8)	Ref		–	–
Rural	373 (43.2)	259 (30)	114 (13.2)	1.038 (0.776–1.389)	0.8	–	–
BMI (Kg/m^2)							
Normal (18.5–22.9)	345 (40)	244 (28.3)	101 (11.7)	Ref			
Underweight (<18.5)	182 (21)	116 (13.4)	66 (7.6)	0.728 (0.497–1.065)	0.102	0.763 (0.510–1.143)	0.19
Overweight (23–24.9)	131 (15.2)	89 (10.3)	42 (4.9)	0.877 (0.568–1.354)	0.554	1.061 (0.663–1.699)	0.805
Obese I (25–29.9)	140 (16.2)	90 (10.4)	50 (5.8)	0.745 (0.491–1.13)	0.166	0.784 (0.501–1.229)	0.289
Obese II (≥30)	66 (7.6)	57 (6.6)	9 (1)	2.622 (1.25–5.496)	0.011	2.718 (1.238–5.966)	**0.013**
History of chronic disease/comorbidity							
Yes	90 (10.4)	84 (9.7)	6 (0.7)	7.164 (3.088–16.62)	<0.0001	6.471 (2.753–15.208)	**<0.0001**
No	774 (89.6)	512 (59.3)	262 (30.3)	Ref		Ref	
Addiction							
Yes	148 (17.1)	121 (14)	27 (3.1)	2.274 (1.457–3.548)	<0.0001	2.583 (1.584–4.211)	**<0.0001**
No	716 (82.9)	475 (55)	241 (27.9)	Ref		Ref	

(*Continued*)

Table 1 (Continued).

Variables	Total n (%)	Depression		COR (95% CI)	P-value	AOR (95% CI)	P value
		Yes (n=596)	No (n=268)				
Non-medical prescription drug use							
Yes	76 (8.8)	71 (8.2)	5 (0.6)	7.114 (2.838–17.83)	<0.0001	5.412 (2.111–13.874)	**<0.0001**
No	788 (91.2)	525 (60.8)	263 (30.4)	Ref		Ref	

Notes: Bold font: significant P-value; tests: binary and multiple logistic regression models.
Abbreviations: AOR, adjusted odds ratio; BMI, body mass index; CI, confidence interval; COR, crude odds ratio; Kg, kilogram; m^2, meter square; Ref, reference group.

Physical Activity and Dietary Habits of the Medical Students

Concerning physical activity, more than one–third (42.7%) of the medical students were classified as inactive during COVID-19 pandemic, followed by irregularly active (31.1%) and minimal to highly active (26.2%). Around half (55.6%) of students reported eating fast food less than 3 times per week, while nearly half reported taking soft drinks and eating three meals per day (47% and 52%, respectively). During COVID-19, 41.9% of medical students used social media and watched television for between 2 and 4 hours per day, followed by greater than four hours (32.2%). The majority of medical students had a normal sleep duration of 6 to 8 hours per day (66%), spent less time before sleep (52.1%), and had never used sleep induction medications (90.5%). Figure 3 shows distribution of medical students with depression on the basis of physical activity, dietary and sleep habits.

Among the independent variables, physical activity, fast food consumption, social media/app usage and sleep habits showed an association (p-value <0.05) with depression. On multilogistic regression analysis, fast food consumption did not show association with depression; however, the remaining variables showed statistically significant prediction for depression.

Depression was 1.7 times more prevalent in physically inactive individuals [AOR = 1.766; 95% CI (1.183–2.636)] compared to students who were moderately to highly active. Social media/apps/TV usage was significantly associated with depression, with lower odds of having depression among those who used less than 2 hours and between 2 and 4
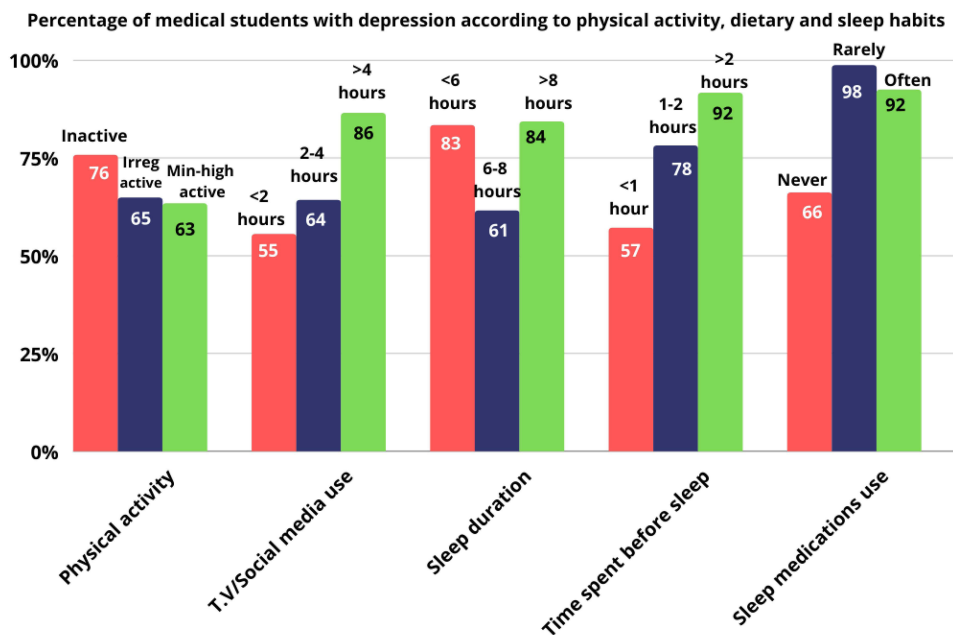

Figure 3 Distribution of medical students with depression during COVID-19 among different categories of physical activity, dietary and sleep habits.
Abbreviations: Irreg, irregularly; Min, minimum.

hours [AOR = 0.312; 95% CI (0.19–0.514); AOR = 0.408; 95% CI (0.26–0.642), respectively]. In comparison to students with sleep duration ranging from 6 to 8 hours, students with sleep duration of less than 6 or greater than 8 hours had greater odds of having depression [AOR = 3.052; 95% CI (1.856–5.02); AOR = 2.79; 95% CI (1.661–4.686), respectively]. Similarly, lower odds of depression were observed among medical students who spent less than an hour in bed before sleeping [AOR = 0.501; 95% CI (0.346–0.725)]. Students who never used hypnotics for sleep induction were less prone to depression [AOR = 0.053; 95% CI (0.007–0.389)] (Table 2).

Distribution of medical students according to severity of depression during COVID-19 based on different variables is provided in Supplementary Tables (a) and (b).

Table 2 Physical Activity, Dietary and Sleep Habits of Medical Students During COVID-19 and Their Association with Depression

Variables	Total % n (%)	Depression		COR (95% CI)	P-value	AOR (95% CI)	P value
		Yes (n=596)	No (n=268)				
Physical activity per week							
Inactive	369 (42.7)	279 (32.3)	90 (10.4)	1.799 (1.255–2.579)	0.001	1.766 (1.183–2.636)	**0.005**
Irregularly active	269 (31.1)	174 (20.1)	95 (11)	1.063 (0.736–1.536)	0.745	1.039 (0.687–1.571)	0.856
Minimally to highly active	226 (26.2)	143 (16.6)	83 (9.6)	Ref		Ref	
Fast food consumption per week							
No	284 (32.9)	181 (20.9)	103 (12)	0.586 (0.351–0.979)	0.041	1.073 (0.603–1.909)	0.811
Less than 3 times	480 (55.6)	340 (39.4)	140 (16.2)	0.81 (0.494–1.326)	0.401	1.045 (0.602–1.812)	0.876
Greater than 3 times	100 (11.5)	75 (8.7)	25 (2.8)	Ref		Ref	
Soft drinks consumption per week							
No	458 (53)	302 (34.9)	156 (18.1)	0.673 (0.431–1.052)	0.082	–	–
Less than 3 times	282 (32.6)	202 (23.4)	80 (9.2)	0.878 (0.544–1.417)	0.595	–	–
Greater than 3 times	124 (14.4)	92 (10.7)	32 (3.7)	Ref			
Number of meals intake in one day							
1–2 times	298 (34.5)	214 (24.8)	84 (9.7)	1.274 (0.804–2.017)	0.302	–	–
3 times	449 (52)	304 (35.2)	145 (16.8)	1.048 (0.68–1.615)	0.831	–	–
Greater than 3 times	117 (13.5)	78 (9)	39 (4.5)	Ref			
TV/ Social media app usage duration per day							
Less than 2 hours	224 (25.9)	124 (14.3)	100 (11.6)	0.196 (0.127–0.302)	<0.0001	0.312 (0.19–0.514)	**<0.0001**
2 to 4 hours	362 (41.9)	232 (26.9)	130 (15)	0.283 (0.189–0.423)	<0.0001	0.408 (0.26–0.642)	**<0.0001**
Greater than 4 hours	278 (32.2)	240 (27.8)	38 (4.4)	Ref		Ref	
Sleep duration per day							
Less than 6 hours	149 (17.2)	124 (14.3)	25 (2.9)	3.118 (1.965–4.947)	<0.0001	3.052 (1.856–5.020)	**<0.0001**
6 to 8 hours	570 (66)	350 (40.5)	220 (25.5)	Ref		Ref	
Greater than 8 hours	145 (16.8)	122 (14.1)	23 (2.7)	3.334 (2.071–5.369)	<0.0001	2.79 (1.661–4.686)	**<0.0001**

(*Continued*)

Table 2 (Continued).

Variables	Total % n (%)	Depression		COR (95% CI)	P-value	AOR (95% CI)	P value
		Yes (n=596)	No (n=268)				
Hours spent in bed before sleeping							
Less than I hour	450 (52.1)	257 (29.8)	193 (22.3)	0.373 (0.268–0.52)	<0.0001	0.501 (0.346–0.725)	**<0.0001**
I to 2 hours	297 (34.4)	232 (26.9)	65 (7.5)	Ref		Ref	
Greater than 2 hours	117 (13.5)	107 (12.4)	10 (1.1)	2.998 (1.483–6.061)	0.002	1.542 (0.725–3.282)	0.261
Medications taken for sleep							
Never	782 (90.5)	516 (59.7)	266 (30.8)	0.029 (0.004–0.207)	<0.0001	0.053 (0.007–0.389)	**0.004**
Rarely	69 (8)	68 (7.9)	1 (0.1)	Ref		Ref	
Often	13 (1.5)	12 (1.4)	1 (0.1)	0.176 (0.01–3.017)	0.231	0.334 (0.018–6.211)	0.462

Notes: Bold font: significant P value; tests: binary and multiple logistic regression models.
Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio; Ref, reference group.

Response of Participants on Perception of Medical Studies and Related Habits During COVID-19

The majority of students (82.6%) expressed no regret about their decision to study medicine. Concerning the COVID-19 pandemic, 31% of students expressed concern about contracting the virus, while a nearly identical proportion (35.2%) had relatives or friends who had been diagnosed with COVID-19. The majority of students expressed concerns about self-isolation, absence from labs/wards, and a negative impact on semester GPA. While the majority of students (41.6%) studied for more than 4 hours per day, 48.7% and 44.1% expressed moderate to low satisfaction with online classes during the COVID-19 pandemic, respectively. Only 24.1% of students had prior experience with online education; however, the majority of students reported frequent use of gadgets for purposes other than education prior to the pandemic. More than two-thirds of students encountered difficulties in online classes during lockdown (Table 3).

Table 3 Responses of Medical Students on Their Perception of Medical Studies During COVID-19 Pandemic

Questions and Responses	Frequency	%
Do you regret studying medicine?		
Yes	150	17.4
No	714	82.6
Are you concerned about acquiring COVID-19 infection?		
Yes	267	31
No	597	69
Do you have a relative or friend that has been diagnosed with Covid-19?		
Yes	304	35.2
No	560	64.8

(*Continued*)

Table 3 (Continued).

Questions and Responses	Frequency	%
Do you have concerns about self-isolation?		
Yes	538	62.3
No	326	37.7
Do you have concerns about not attending labs, wards and demonstrations?		
Yes	510	59
No	354	41
Do you think online classes will negatively impact your semester GPA?		
Yes	668	77.3
No	196	22.7
How many hours do you study/day during COVID-19?		
Less than 2 hours	220	25.5
2 to 4 hours	284	32.9
Greater than 4 hours	360	41.6
How much are you satisfied with online education system during pandemic?		
Low	381	44.1
Moderate	421	48.7
High	62	7.2
Did you attend online education (certifications, course, tuitions) prior to this pandemic?		
Yes	208	24.1
No	656	75.9
Do you have access to online learning resources during pandemic?		
Yes	864	100
No	0	0
Were gadgets for attending online classes in your frequent use before pandemic?		
Yes	720	83.3
No	144	16.7
How frequently did you face problems during online classes?		
Frequently	340	39.4
Rarely	250	28.9
Never	274	31.7

Abbreviations: COVID-19: coronavirus disease 2019; GPA, grade point average.

Discussion

This study aimed to address the impact of COVID-19 pandemic on physical activity, dietary habits and other factors associated with depression among medical students in Pakistan. The effects of COVID-19 pandemic had a significant

negative impact on the mental health of not only the general population globally, but also on medical students and health care professionals.[22] The devastating psychological conditions might have resulted from changes in physical activities, dietary habits, online education, and social restrictions imposed by higher authorities during the COVID-19 pandemic.[23] It has been observed that, after admission to medical schools, students' mental health begins to deteriorate,[24] and the effects of the pandemic on the mental health of medical students are expected to be greater due to increased vulnerability, risk of exposure, and awareness.[25]

In this study, we found higher prevalence of depression (69%) as comparable to the medical students of Iran (27.6%),[26] Malaysia (36%)[27] and United States (66%),[25] during COVID-19 pandemic. We found higher odds for depression among female medical students as compared to male students that is consistent with most literature that has proven the presence of more depressive symptoms in the female gender that could be attributed to the biological difference.[28] According to some studies, the depression increases as the study years advance,[29] whereas other studies suggest a decrease in the level of depression as students progress from basic subjects in pre-clinical years to clinical years.[30] However, during the COVID-19 pandemic our study observed no difference in prevalence of depression among different years of medical students.

Medical and dental studies are challenging and stressful; furthermore, stressors such as lower socioeconomic status may increase the risk of developing depression. Based on our findings, socioeconomic status was significantly associated with depression with higher odds among middle and lower classes. It has been reported that socioeconomic status strongly correlates with depression, whereby lower socioeconomic status has been associated with higher psychiatric morbidity and disability in addition to lack of access to health care.[31]

Depression and obesity remain the major public health concerns that have exhibited a bidirectional relationship within individuals, ie the presence of one factor increases the risk of occurrence of the other variable. Consistently, this study found that medical students who were obese II were significantly more than two times more likely to develop depression as compared to others. It has been reported in literature that major depressive symptoms predict a higher BMI in adult life when compared to those who are not depressed, with the risk increasing further in the female gender. Furthermore, the genetic susceptibility to both depression and obesity may be influenced by environmental factors. Further research on the exploration of this relationship would help to find mechanisms and strategies for prevention and treatment.[32,33]

The prevalence and risk ratio of depression increase with the presence of comorbidities and multiple chronic diseases[34] that has been found consistent with the findings of this study. Additionally, odds of depression among medical students with addiction were 2.6 times higher compared to non-users. Previously, various studies have linked depression with substance abuse among students who develop an addiction to cope with stress.[35,36] Additionally, it has been linked to suicidal thoughts and attempts[35] and, more recently, an increase in the suicide rate among medical students in Pakistan,[37] implying grave concern for our future generation.

Previously, few studies have been conducted to find a significant association between non-medical prescription drug use and depressive symptoms and suicidality. In this study, the odds of having depression were increased more than fivefold in non-medical prescription drug users compared to non-users. Furthermore, the increased use among medical students suggest the inappropriate self-medication of students to cope with psychological distress and other conditions.[38]

It is important to identify modifiable risk factors in the development of depression among adolescents. Among the early risk factors, less physical activity and a more sedentary lifestyle may have an impact on an individual's mental health.[39] Antunes et al[40] reported that 31.8% adults engaged in lower, 49.6% in moderate and 18.5% in higher physical activity during COVID-19. In contrast, our study observed that the majority of students were physically inactive or irregularly active, whereas less than one-third were minimally to highly active during COVID-19 pandemic. These findings are especially significant in light of the literature's recognition of the beneficial effects of physical activity on mental health, particularly during periods of social isolation and quarantine. A recent study found that increased physical activity was associated with decreased anxiety during COVID-19.[10] The mental health, physical activity, and health-related quality of life among US adolescents during COVID-19 showed that female athletes, team sports participants, and individuals with lower socioeconomic status experienced greater symptoms of anxiety and depression.[41]

In view of the nutritional aspects of this research, around half of students reported eating fast food less than 3 times per week, while nearly half reported having soft drinks and eating 3 meals a day during COVID-19 pandemic, including in

lockdown era. However, our study found no correlation between eating patterns during COVID-19 and depression among medical students. In contrast, other studies have found that increased fast food and soft drink consumption is associated with increased anxiety and depression. Altered eating habits during COVID-19, such as eating more frequently, in larger portions, and without careful food selection, increased the risk of depression and anxiety, as evidenced by studies.[40,42] Alfawaz et al[15] discovered significant changes in food consumption patterns. Participants who were previously interested in healthy diets demonstrated a significant decrease in interest during the quarantine, whereas other groups demonstrated a shift in food habits from fast food to healthy diets. During quarantine, frequency of meal and snack consumption increased as well.

During COVID-19, more people relied on social media for health information and statistics regarding the rise of COVID-19 infection. Although easy access to social media for health-related information has empowered the public regarding awareness and taking precautionary measures against COVID-19, it does have some serious adverse effects on mental health. The study results showed that excessive use of social media was linked to depression and secondary trauma.[43] This was consistent with our study findings, as those medical students who spent less time on social media and TV during the COVID-19 pandemic were more protected from depression.

Adequate and good quality sleep is essential for students as it has a significant impact on academic performance and physical and mental health. The Pandemic against LifeStyle (PaLS) study of Polish students showed higher rates of insomnia during COVID-19. Approximately 30% of students reported sleeping 7 hours, 30% less than 7 hours and 40% more than 7 hours per day. About 23% of students spent more than 8 hours per day in front of a screen.[44] In comparison, majority of students in our study had 6 to 8 hours of sleep and 2 to 4 hours of screen time during quarantine. A research conducted on Polish young adults observed a significant association of insomnia with depression.[45] In addition to that, insomnia was found to be associated with stress in 23% of Hungarian students[46] and 19.7% of Polish students.[47] These findings corroborate our results showing correlation of depression with sleep quantity and quality.

Despite academic challenges, most of our students did not regret studying medicine. Intriguingly, a similar proportion of students expressed concern about COVID-19 infection as those who had COVID-19 among family or friends. The percentage was lower in our study than in another similar study, which found that 66% of medical students expressed fear of a pandemic.[22] The majority of students expressed concern about self-isolation, semester GPA and absence from labs/wards that may additionally contribute to high stress and depression levels. Even during a pandemic, most medical students studied for more than 4 hours per day; however the majority expressed moderate to low satisfaction with online courses. Some students found it challenging to adapt abruptly to new online teaching methods, which made them feel behind their peers, affecting their mental health.

The authors are aware of several limitations. First, the self-reported questionnaire was lengthy, which may have impacted participants' response rates. Second, the majority of students enrolled in the study were in their pre-clinical years (1st and 2nd year), which may have underestimated the magnitude of the problem addressed in clinical years. Third, the results of the study may not be generalized to entire Pakistani population as it comprises only medical students studying in Sindh province. Fourth, the online questionnaire could have resulted in recall and volunteer bias. Finally, because the participants' body weight and height were self-reported, the BMI may not accurately reflect the actual measured values.

The COVID-19 pandemic is a global health crisis associated with various mood states, such as stress, anxiety and depression. A long-term plan is required to prepare for such a crisis, particularly in the future to avoid adverse effects on education while minimizing psychological stress on medical students. Anticipating lifestyle changes, virtual training in developing countries, the availability of gadgets to access online education, time management strategies, screening medical students for psychological issues and mental health, organizing seminars and awareness campaigns and establishing an online social support system with mental health teams and clinics staffed by psychologists and psychiatrists at medical schools are all effective strategies for coping with a pandemic crisis.

Conclusion

COVID-19 pandemic adversely affected physical activity and sleeping habits in association with depression among medical students. Promoting healthy eating habits, adequate physical activity, and a healthy lifestyle, particularly among students during lockdowns, are critical components of coping with mental stress and depression. The findings of this study will aid in

future research and campaign design in preparation for future pandemics and lockdowns. Additional research is required to confirm our findings in diverse populations in order to determine the effects of the COVID-19 pandemic.

Research Ethics

The study is in accordance with the Declaration of Helsinki, and the Ethics Committee of Liaquat University of Medical and Health Sciences approved this research (No. LUMHS/REC/-780).

Disclosure

The authors report no conflicts of interest in this study.

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