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The impact of the COVID-19 pandemic on the mental health of medical students

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Abstract

Background/Aim: Medical students are at high risk for mental problems with already increased levels of stress and depression. The literature shows that the COVID-19 pandemic has affected the mental health of the population including medical students. However, yet, there is insufficient data to compare the mental health of medical students before and after the pandemic. In this study, it was aimed to investigate the impact of COVID-19 pandemic on medical students' mental health.

Methods: First part of these two cross- sectional studies was conducted in 2019, before the pandemic, and the second one was performed in 2021. A sociodemographic data form, The Center for Epidemiologic Studies Depression Scale (CES-D), Perceived Stress Scale (PSS), and Maslach Burnout Inventory-Student Survey (MBI-SS) were applied to 1306 students in 2019 and 898 students in 2021, from all 6 grades studying at a Turkish medical school. Prevalence of depression, PSS and MBI-SS scale scores were compared in terms of year of the study, grades and some demographic variables.

Results: The prevalence of depression was 64.2% in 2019 and increased to 90.9% after the pandemic. Participants with a personal or family history of being COVID-19 (+) had higher scores in CES-D (P=0.002 and P=0.001, respectively) and PSS (P=0.015 and P=0.004, respectively). Regression analysis showed that female gender, studying in preclinical phases, and living alone were significant predictors of CES-D and PSS scores.

Conclusion: The COVID-19 pandemic negatively affected the mental health of medical students as well as the entire society. Preventive mental health practices are required for this vulnerable population, especially for groups determined to be at risk.

Keywords: COVID-19 pandemic, Burnout, Stress, Mental health, Depression, Medical student

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Introduction

Medical students are a vulnerable population for mental health problems. This is because most psychiatric disorders coincide with the age of onset and medical education adds its own unique stressors. All these also happen, usually at a time when they are leaving home for the first time and starting a new life. The literature is quite rich in terms of publications showing a high prevalence of mental problems in medical students. The prevalence of depression in this population has been reported as 22% – 49% [1], anxiety as 33.8% [2], suicidal ideation as 11.1% [3], and burnout as 45% – 71% [4]. According to a recent study with 3766 medical students from 12 different countries; 75% of all students had any minor psychiatric disorder assessed with General Health Questionnaire-12 (GHQ-12). Burnout rates were 78% for disengagement and 87% for exhaustion [5].

While the mental health of medical students is alarming enough, medical education, nowadays also has to deal with the effects of the pandemic. In Turkey, all faculties were transitioned to distance education with the regulation of the Council of Higher Education in March 2020. Most of the students left the dormitories or the houses where they lived with their friends and returned to their families, which caused them to leave the city or even the country they live in. While all bedside and practical lessons, laboratory sessions, and small group interactions have been postponed, theoretical lessons have started to be given online. The internship training which includes the last year of medical education and is entirely based on clinical practice has been suspended. Online education required a serious technological adaptation process for both students, educators, and faculty management. Despite the difficulties it can be said that medical faculties rapidly adopted online education, however, lack of face-to-face interaction with patients, educators, and peers led to a decrease in learning motivation.

The pandemic has affected both the medical education and mental wellbeing of medical students. Giliyaru et al. [6] stated that half of the students participated in the survey reported deterioration in their physical and mental wellbeing and 60% of them thought that the pandemic affected their decisions of their specialty goals. Another study reported that 84% of 156 medical students experienced nervousness and stress due to pandemic conditions, and new learning environment was reported as the most challenging aspect [7]. Subjective mental health status of Japanese medical students was reported to be worsened [8]. It has been shown that healthcare workers are at risk for negative mental health outcomes during the pandemic [9], on the other hand, the result of a study comparing medical students, medical staff, and the general population is so remarkable that depression, stress, and anxiety scores of medical students were higher than the general population and other medical staff [10].

Even under ordinary circumstances, medical students are known to be a high-risk group for mental health problems and this is more evident in those living in the Middle East and Asia (2). Another point to be underlined is that medical students are not successful enough to find the right ways of getting psychiatric support [11]. Considering the impact of poor mental health on the academic performance of medical students, who are the future physicians, and its indirect effect on public health, it is crucial to investigate the effect of the pandemic on this already at-risk population especially in the aforementioned regions. The main limitations of the literature in this field are the small sample sizes, lack of structured scales, and most importantly, lack of prolonged follow-ups. This study aimed to prospectively investigate depression, stress, and burn-out levels of medical students and the effect of the COVID-19 pandemic on the mental health of students.

Materials and methods

Participants

This study was primarily planned to examine and prospectively observe the mental health of the medical students studying at Gazi University Medical Faculty in Ankara, the capital city of Turkey. It was aimed to determine the annual data and the associated factors to make appropriate interventions for the mental well-being of the students. The first part of the study was performed in 2019 with 1306 participants from all grades (1st to 6th). In Turkey, 1/30 of all Turkish medical students are in Gazi University, which has the highest medical student quota in the country [12]. The authors decided to reapply the same scales in 2021 to investigate if there is a difference between the two years. Snowball sampling was used. The first page of the survey included the information about the study and consent was obtained by the participants marking their acceptance of the study on the form. Anonymity was assured as no identifying data were collected. All informed consent taken students were included in the study. It was aimed to reach the whole universe, therefore, all students were invited to the study. A total of 898 students constituted the sample of the second part of the study. 37.6% of the total number of students in the faculty was reached. Ethics Committee of Gazi University has approved the study on date 14.01.2019, number 28.

Instruments

The survey consisted of socio-demographic data form, Maslach Burnout Inventory-Student Survey (MBI-SS), Perceived Stress Scale (PSS), and The Center for Epidemiologic Studies Depression Scale (CES-D). Demographic data included questions about, gender, year of medical school, income, residency, smoking, alcohol or substance use, and psychiatric applications. Questions such as personal or family history of COVID(+), or losing a family member of being COVID(+) were added to the second part of the survey.

CES-D, a self-report scale with a four-point scale (0 to 3) was used for assessing depression [13]. Higher scores represent more depressive responses and cut-off score for indicating depressive disorder is considered as ≥16. Tatar and Saltukoğlu performed the Turkish validity and reliability [14].

PSS, a 5-Likert type, 14-item self-report scale (0 to 4) was used for assessing stress levels. [15]. Higher scores indicate increased stress levels. Turkish validity and reliability study was performed by Eskin at al. [16].

MBI-SS, a 5 – Likert type scale was used to determine burn-out levels. It consisted of three subscales and 16 items (exhaustion, cynicism, and efficacy) [17]. In the exhaustion and cynicism subscales, higher scores indicate burnout, whereas in the efficacy subscale, lower scores indicate burnout. The scale has been adapted to Turkish by Çapri et al. [18].

Statistical analysis

Statistical analysis was performed using SPSS 22.0 for Windows (SPSS, Inc.; Chicago, USA) package program. Descriptive values were stated as number (n), percentage (%), mean, standard deviation (SD). Normality of data was tested visually using the Q-Q plots and statistically using the Kolmogorov–Smirnov test. To compare categorical variables (gender, smoking, and alcohol use), the independent t-test was used, and to compare parametric variables (year of medical school, residence status, and monthly family income) the one-way ANOVA test was used. When an overall significance was observed, pairwise post hoc tests were performed using Tukey's test. Statistically significant factors in the bivariate analysis were included in the multiple linear regression analysis to determine independent predictors of PSS and CES-D scores. An overall *P*-value of less than 0.05 was considered to show a statistically significant result.

Results

The sociodemographic characteristics of the students who participated in the first (n=1306) and the second part (n=898) of the study were shown in table 1. The rate of participation was relatively high in females and in preclinical years. Monthly family income levels were grouped according to the limits of hunger and poverty stated by the Confederation of Turkish Trade Unions at the time of the study [19]. The rate of students having a family income below the limit of hunger increased from 6.4% to 8.7%. The rate of living in dormitories was decreased from 37.4% to 14.8% whereas, the rate of living with family increased from 38.9% to 68.5%. The prevalence of smoking, alcohol, and substance use were 23.7%, 31.4%, and 4.1% in 2019 and they were 18.5%, 30.5%, and 4.3% in 2021, respectively. 21.7% of the students reported psychiatric application in 2019 which was increased to 25.7% in 2021. Psychiatric drug use was reported to be increased from 8.3% to 9.6%. The mean scale scores and their changes over time can be seen in Table 1. The prevalence of depression assessed with the CES-D scores higher than the cut-off point of 16 was 64.2% in 2019 and 90.9% in 2021.

Table 1: Sociodemographic characteristics and scale scores of the participants

		2019		2021	
		n	%	n	%
Gender					
	Female	774	59.3	599	66.7
	Male	532	40.7	299	33.3
Year of Medical school (grades)					
	1	381	29.2	195	21.7
	2	263	20.1	157	17.5
	3	284	21.7	226	25.2
	4	132	10.1	122	13.6
	5	168	12.9	143	15.9
	6	78	6.0	55	6.1

Monthly Family Income (TL)	2019		2021	
	n	%	n	%
Between the limits of hunger and poverty	616	47.2	495	55.1
Above the limit of poverty	607	46.5	325	36.2
Residence				
Home - with family	508	38.9	615	68.5
On-campus housing	488	37.4	133	14.8
Home-with friend(s)	234	17.9	94	10.5
Home-alone	76	5.8	56	6.2
Smoking	309	23.7	166	18.5
Alcohol use	410	31.4	274	30.5
Substance use	54	4.1	39	4.3
Psychiatric application	283	21.7	231	25.7
Psychiatric medication use	108	8.3	86	9.6

	2019 Mean(SD)	2021 Mean (SD)
MBI-SS		
Exhaustion	15.6(4.8)	17.9(4.6)
Cynicism	10.4(3.7)	12.9(3.6)
Efficacy	11.7(3.3)	10.1(2.8)
CES-D	21.2(11.5)	33.2(12.5)
PSS	28.3(8.3)	35.0(8.2)

TL: Turkish Liras, MBI-SS: Maslach Burnout Inventory-Student Survey CES-D: The Center for Epidemiologic Studies Depression Scale, PSS: Perceived Stress Scale

To compare the scale scores according to the demographic variables of the 2021 data, independent t-test was used in categorical variables, and one-way ANOVA with post-hoc Tukey test was used in parametric variables. Female students scored significantly higher scores in MBI-SS exhaustion (P=0.013), CES-D (P<0.001), and PSS (P=0.013), (P=0.001). Efficacy scores were lower in female students which inversely shows more burnout (P=0.013), and there was no significant difference in cynicism scores between genders (P=0.074).

A statistically significant difference was found in all scales between students in preclinical and clinical phases that preclinical students had poorer results in all scales (P<0.001for all scales). We also compared all grades with each other, and the highest mean in all scales was observed in 2nd grades and lowest in 6th grades. Post hoc tests showed that 6th grades scored significantly lower than all the other grades in the CES-D (P=0.004, 0.001, <0.001, 0.027, 0.015 respectively), and lower than 1st (P<0.027), 2nd (P<0.001), and 3rd grades (P<0.001) in the PSS.

There was a significant difference in all scales according to the residence status. Post hoc tests showed that in CES-D, participants living with family (P=0.037), and living alone (P=0.005) scored higher than the ones living with friends. PSS scores of participants living with friends were significantly lower than the other groups (P=0.002, 0.047 and 0.020 respectively). Burnout levels in exhaustion and efficacy subscales were higher in students living with family (P=0.035) than the ones living with friends (P=0.028), however, in cynicism subscale, students living alone had higher scores than the others (P=0.037, 0.001, 0.017, respectively).

No significant difference was found between scale scores and family income. Students with a personal or family history of being COVID-19 (+) had significantly higher scores in CES-D (P=0.002, 0.001), and PSS (P=0.015, 0.004), and those who have lost a family member due to COVID-19 had higher scores in CES-D (P=0.015) (Table 2).

Statistically significant factors in the bivariate analysis were included in the multiple linear regression analysis to identify independent predictors of CES-D and PSS scores.

A multiple linear regression model was conducted to examine the independent effects of predictors on CES-D scores (Table 3). As a result of the analysis, it was found that a significant regression model (P<0.001), and 0.051% of the variance in CES-D scores were explained by independent variables. Female gender, studying in preclinical phases and living alone significantly predicted CES-D scores.

Table 2: Comparison of the scale scores according to demographic variables

	MBI-SS Mean (SD)			CES-D Mean(SD)	PSS Mean(SD)
	Exhaustion	Cynicism	Efficacy		
Gender					
Female	18.2(4.5)	12.7(3.6)	9.9(2.7)	34.5(12.5)	35.7(8.1)
Male	17.4(4.6)	13.2(3.7)	10.5(3.1)	30.6(12.1)	33.8(8.3)
P-value	0.013	0.074	0.007	<0.001	0.001
Study grades (years)					
Preclinical(1,2,3)	18.4(4.5)	13.3(3.6)	9.8(2.9)	34.2(12.3)	35.9(7.8)
Clinical (4,5,6)	17.0(4.5)	12.2(3.6)	10.7(2.7)	31.4(12.8)	33.4(8.6)
P-value	<0.001	<0.001	<0.001	<0.001	<0.001
Residence Status					
Home - with family	18.1(4.5)	13.0(3.6)	10.0(2.9)	33.3(12.5)	35.4(8.0)
On-campus housing	17.6(4.5)	12.2(3.8)	10.0(2.8)	33.9(12.6)	35.0(8.9)
Home- with friend(s)	16.7(4.3)	12.5(3.2)	10.9(2.7)	29.6(12.7)	32.1(8.7)
Home-alone	18.6(4.8)	14.4(3.6)	10.0(2.6)	36.6(11.5)	36.1(6.8)
P-value	0.027	0.002	0.041	0.006	0.003
Monthly Family Income (TL)					
Below the limit of hunger	17.6(4.8)	12.5(4.1)	10.1(2.2)	34.1(12.7)	36.5(7.7)
Between the limits of hunger and poverty	17.9(4.6)	13.0(3.6)	10.1(2.9)	33.7(12.5)	35.2(8.0)
Above the limit of poverty	17.9(4.4)	12.9(3.6)	10.2(2.9)	32.4(12.6)	34.5(8.6)
P-value	0.823	0.543	0.771	0.283	0.122
History of being COVID-19 (+)					
No	17.9(4.6)	12.9(3.7)	10.2(2.9)	32.7(12.6)	34.7(8.2)
Yes	18.1(4.3)	12.8(3.4)	9.9(2.6)	36.2(11.7)	36.5(7.8)
P-value	0.586	0.780	0.362	0.002	0.015
Family history of being COVID-19 (+)					
No	17.7(4.6)	12.8(3.7)	10.2(2.9)	32.1(12.6)	34.4(8.4)
Yes	18.1(4.4)	13.0(3.5)	10.0(2.7)	34.9(12.3)	36.0(7.8)
P-value	0.186	0.475	0.469	0.001	0.004
Losing a family member due to COVID-19 (+)					
No	18.0(4.5)	12.9(3.6)	10.1(2.8)	32.7(12.5)	34.9(8.2)
Yes	17.5(4.8)	12.8(3.8)	10.2(2.8)	35.2(12.4)	35.6(8.2)
P-value	0.240	0.755	0.718	0.015	0.314

TL: Turkish Liras, MBI-SS: Maslach Burnout Inventory-Student Survey CES-D: The Center for Epidemiologic Studies Depression Scale, PSS: Perceived Stress Scale

Table 3: Multiple linear regression results for predicting CES-D scores

				95% CI		
	β	SE	t	LL	UL	*P*-value
Gender[a]	4.028	0.874	1.735	2.313	5.743	<0.001
Grade[b]	2.773	0.870	3.189	1.066	4.479	0.001
Residence status[c]	5.125	1.722	4.609	1.746	8.504	0.003
Being COVID-19 (+)	2.002	1.293	2.997	-0.536	4.540	0.122
Family history of being COVID-19 (+)	1.708	0.991	1.548	-0.238	3.653	0.085
Losing a family member due to COVID-19 (+)	1.324	1.016	1.304	-0.669	3.317	0.193

Adjusted R^2= 0.051 *P*<0.001; LL, lower limit; UL, upper limit; [a] female; [b] preclinical phases; [c] living alone

A multiple linear regression model was conducted to examine the independent effects of predictors on PSS scores (Table 4). As a result of the analysis, it was found that a significant regression model (*P*<0.001), and 0.040% of the variance in PSS scores were explained by independent variables. Female gender, studying in preclinical grades, and living alone significantly predicted PSS scores.

Table 4: Multiple linear regression results for predicting PSS scores

				95% CI		
	β	SE	t	LL	UL	*P*-value
Gender[a]	1.907	0.575	3.315	0.778	3.036	0.001
Grade [b]	2.637	0.573	4.605	1.513	3.760	0.000
Residence status[c]	2.294	1.134	2.024	0.069	4.518	0.043
Being COVID-19 (+)	0.726	0.851	0.852	-0.945	2.396	0.394
Family history of being COVID-19 (+)	1.272	0.653	1.948	-0.009	2.553	0.052
Losing a family member due to COVID-19 (+)	-0.133	0.669	-0.198	-1.445	1.180	0.843

Adjusted R^2=0.040 *P*<0.001; LL, lower limit; UL, upper limit; [a] female; [b] preclinical phases; [c] living alone

Discussion

According to the results of this study, the prevalence of depression among medical students increased from 64.2% to 90.9% from 2019 to 2021 through the pandemic. There was also a significant increase in stress and burnout levels.

Despite scientific advances in the treatment and prevention of COVID-19, people all over the world are still struggling to cope with the risks posed by the disease itself and the related measures. As a result, a high prevalence of psychiatric symptoms is reported in the general population such as 81.9% stress, 50.9 anxiety, 48.3% depression, or 53.8% post-traumatic stress disorder [20]. It is thought to be crucial from a public health perspective to identify risk groups in order to address mental health interventions correctly in such conditions which almost lead to mental health crises. Children, adolescents, elder people, patients with prior physical and psychiatric diseases, and healthcare workers are stated at risk in COVID-19 pandemic [21]. We believe that medical students, particularly, are a vulnerable population with already high baseline levels of stress and prone to have psychiatric symptoms and it can be hypothesized that they would report higher levels of stress and burnout in these unprecedented times. On one hand, they are exposing to the common aspects of the pandemic that affected all human-kind, and on the other hand, they had to deal with the difficulties related to medical education.

With the progress of the pandemic, as one of the lockdown measures, online education was started in medical faculties in Turkey like the rest of the world. This brought some challenges for both students and faculty staff despite some advantages such as freedom of time and place. The nature of medical education requires some on-site clinical practices that online lessons will not be adequate enough to form a qualified doctor identity. One of the compounds of this identity is gaining good communication skills with colleagues and patients which was interrupted by digital learning. Cancellation of the practical exams, changes in preset timetables and curricula, with the uncertainty and constant changes of these, may have increased the stress levels of the students day by day [22]. Adapting to a new system that requires advanced technological skills, devices, and connectivity may also have been difficult for those of different socioeconomic levels. According to a study investigating medical students' attitudes towards online learning, 64.7% of the students reported facing a challenge and 54.8% thought that online learning was not useful for clinical aspects [23].

In addition to the qualification problems of online education, there have also been social implications. With the lockdown measures and closure of the dormitories, most of the students have had to return to their families and the city or even the country they lived in has changed. In our study, while the rate of those staying in a dormitory or living with friends decreased, the rate of living with family has almost doubled with the pandemic. This situation resulted in a loss of peer interaction, social isolation, and a lack of attachment to the faculty. It is also a remarkable result that the proportion of those having a family income below the hunger limit has increased from 6.4% to 8.7% and those above the poverty limit have decreased from 46.5% to 36.2%. Pandemics have economic impacts and put an extra burden on the students with the social consequences.

The reflection of these conditions can be seen in the literature that is reporting alarming rates of mental problems in medical students. A study from Germany reported high distress levels measured by STAI and mild anxious and depressive

symptoms [24]. Moderate levels of psychological distress and deterioration in mental well-being were reported from two-thirds of Australian medical students [25]. In the United Arab Emirates, half of the medical students reported mild to moderate/severe anxiety according to GAD-7 [26]. Another study using DASS-21 reported a prevalence of 70.5% depression, 53.6% anxiety, and 47.8% stress in Egyptian medical students [27]. Aker et al. stated that 52.4% of medical students reported feeling mentally unwell in a different region of our country [28].

Two studies using the same scale, PHQ-4, have prospectively examined the mental state of all college students before and after the pandemic and reported an increase in symptoms of anxiety and depression [29,30]. Isralowitz et al. followed up Russian medical students from May to November 2020 without any data from the pre-pandemic period, and found a significant decrease in the Fear of COVID-19 Scale [31]. Another study from the UK reported a significant decrease in medical students' mood, however, this was based on participants' verbal statement of a decline in their mood after the onset of pandemic instead of a prospective examination by the researchers [32]. The cross-sectional studies provide important knowledge revealing the mental health of medical students but the literature lacks prospective research that will give more decisive data about the effect of the pandemic on the students' mental health. To our knowledge, the only prospective study is from India. Saraswathi et al., prospectively investigated 217 medical students with DASS-21 before and during the pandemic. They found the 6-month incidence of anxiety as 11.98% stress as 4.15%, and depression as 2.3%. In this study, the prevalence of baseline depression was 33.2% which was increased to 35.5% during the pandemic. It was also stated that during COVID-19, 44.7%, 41.01%, and 65.44% of the study population scored higher in depression, anxiety, and stress sub scores, respectively [22]. Compared to these results, 90% prevalence of depression found in our study seems quite high. Using different scales and the time of their application may be effective for this outcome. Saraswathi used DASS-21 in June 2020, however, we measured depression with CES-D between January- April 2021. The intervening time between two studies may have led to the cumulative effect of the pandemic, causing the students to be more affected and an increase in depressive symptoms in our study. Besides, the unique systems of the faculties and sociocultural differences may also have affected the results. In a recent study investigating cultural variations in wellbeing and burnout of medical students in 12 countries including India, the rate of minor psychiatric disorders in Indian medical students was found to be lower compared to many other countries before the pandemic [5]. Since it is known that sources of stress and related mental problems in medical students vary across the countries, their levels of being affected by the pandemic may also vary accordingly. Further knowledge can be obtained in cross-cultural studies focusing on this issue.

When looking at the overall correlates of scale scores; female gender, preclinical phases, living alone and living with family, having a history of being COVID-19 (+), having a family member of being COVID-19 (+), or losing a family member due to COVID-19 were associated with higher levels of depression, stress, and burnout. Regression analyses showed that female gender, preclinical phases, and living alone were significant predictors of stress and depression. Being infected with COVID-19 (+) has a major impact on mental health not only for direct neuropsychiatric consequences but also experiences such as quarantine, concerns about the prognosis of the disease, or stigmatization. As a result, it is reported to be strongly associated with depression [33]. Besides the catastrophic effects of having a family member or losing him/her due to COVID-19 (+), pandemic conditions have also disrupted grieving processes and coping mechanisms. Because of the contagiousness, family members could not be with each other during illness and death, funeral procedures did not work in the usual process. All these together have a synergistic effect on increasing the risk of depression and stress in such individuals, as can be seen from the results of our study which are compatible with the literature [27, 34].

We found the female gender as a significant predictor of stress and depression. A recent meta-analysis with 96 thousand participants showed that the female gender was positively associated with higher levels of stress and depression [35]. Except for a few contradictory results [22], studies with medical students are also compatible in this respect, that being a female medical student may increase the risk of anxiety [26]; depression, anxiety, and stress [27]; depression and anxiety [36]; and distress [25].

While being a 4th-grade student was found as a predictor for depression and stress in our first study before the pandemic [37], highest scale scores were found to be in preclinical phases, particularly in 2nd grades, after the pandemic. Saddik et al. [26] reported that students in their clinical years, as in contact with COVID-19 patients, reported higher anxiety levels. Lyons et al. [25] stated that 1st grades had the highest score of psychological distress but found no significant difference between year groups. At the time of our study, all lessons including practical ones were conducted online and the students had no direct contact with the COVID-19 patients. This can be one reason for relatively lower levels of depression and stress in clinical phase students. The other reason may be the psychosocial interventions performed by the student mental health unit of our faculty such as psychoeducation conferences, or online support meetings. These interventions were planned and have been conducting since the first results of the study in 2019, so the upper grades had more chance to benefit from them. As the year of medical education passes, the increase in the level of knowledge about the diseases may also be a protective factor for clinical phase students.

Limitations

The results of this study should be interpreted with some limitations. First, this study is in longitudinal nature, however, the samples of the two parts of this study did not consist of the same participants. The large sample size and issues of anonymity and confidentiality appeared as barriers to follow up the same students hence it was not possible to calculate incidence or odd ratios. Second, it was aimed to reach the whole universe but this could not have been achieved in all two parts of the study because students were not forced and participation was based on giving consent. Therefore, the large sample size may reduce this effect, despite the ability of generalization of the

results to all faculty is limited. The response bias should also be mentioned in these studies that participants with mental health problems or interested in these issues may be more open and willing to participate and this will result in higher scale scores than expected. Besides, in both two parts of our study, low rates of participation in male students and clinical phases may have restricted their representation. The instruments used in this study are screening scales and may not reflect the real prevalence. Longitudinal studies in which the same students are routinely screened with scales and the ones above the cut-off point are evaluated clinically will yield better results.

Conclusion

This two-year prospective study shows a 17% increase in the prevalence of depression with a significant increase in stress and burnout levels in medical students after the COVID-19 pandemic. Students with female gender, studying at preclinical phases and living alone have higher levels of stress and depression. Medical students can be considered as a high-risk population with high baseline levels of mental health problems and prone to be affected by the pandemic. Because of these risk factors and the importance of the mental health of these future doctors for public health, it is crucial to prioritize protective mental health practices at the university and government level. It is thought to be beneficial for medical faculties from different countries and cultures to share their experiences for promoting the wellbeing of medical students. From our perspective, constituting separate mental health units in medical faculties in collaboration with public health, psychiatry, medical education departments, and the dean's office, and conducting educations, meetings, routine screening programs to protect the mental health of the students may be helpful. It is also necessary to ensure psychiatric support that students can easily apply without stigmatization.

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