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Impact of COVID-19 pandemic on stress and coping strategies among medical students: A cross-sectional study

Fahad Abdulaziz Alrashed [1,*], Tauseef Ahmad [2], Kamaran Sattar [2], Mishal M. Aldaihan [3], Muneera M. Almurdi [3], Leen Khalid Alrashed [2], Afaf A. M. Shaheen [3], Abdulrahman M. Alsubiheen [3]

[1]*Department of Cardiac Sciences, College of Medicine, King Saud University, Riyadh, Saudi Arabia*
[2]*College of Medicine, King Saud University, Riyadh, Saudi Arabia*
[3]*Department of Health Rehabilitation Sciences, College of Applied Medical Sciences, King Saud University, P.O. Box 10219, Riyadh 11433, Saudi Arabia*

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ABSTRACT

The COVID-19 pandemic has presented significant challenges and stressors for medical students, potentially affecting their emotional well-being. This study aimed to explore the influence of stress during and after the COVID-19 pandemic on medical students' sociodemographic characteristics and their coping strategies. A cross-sectional study was conducted among 1st to 5th-year medical students utilizing a self-administered questionnaire, alongside the Kessler 10 Psychological Distress questionnaire, to collect data on perceived stress and coping variables. The findings revealed a notable gender disparity in stress levels during the COVID-19 period, with female medical students experiencing significantly higher stress prevalence (38.5%) compared to their male counterparts (16.2%). However, in the post-COVID period, medical students reported slightly lower stress levels, with female students at 26.9% and male students at 12.8%, compared to the COVID-19 phase. Nonetheless, stress levels were found to be significantly higher post-COVID compared to the during-COVID period. Furthermore, the study identified that stress severity varied across different medical school years, with 3rd-year students experiencing the highest stress levels (OR=8.9; P<0.0001), followed by 5th-year (OR=6.6; P=0.0004), 1st-year (OR=3.9; P=0.008), and 4th-year (OR=2.4; P=0.01) students. Among the coping strategies adopted by medical students to manage moderate to severe stress, "Religious activities" emerged as the most effective approach (OR=0.44; P=0.0001). Furthermore, the study highlighted a noteworthy increase in stress levels among female students during the transitional year of medical school, i.e., the third medical year, which marks the transition from preclinical to clinical training. Considering the study's findings, a support program is proposed, aiming to integrate psychological, organizational, and instrumental assistance. This program aligns with the participatory model of intervention and is designed to address the unique stressors faced by medical students during and after the COVID-19 pandemic.

1. Introduction

Recently, a new respiratory viral infection, known as SARS-CoV-2 or COVID-19, originating in Wuhan, China, has emerged, posing significant risks to human health. Owing to the diverse epidemiological characteristics of COVID-19, this pandemic represents a more formidable threat to human lives compared to previous illnesses caused by SARS-CoV and MERS-CoV (Abdulghani et al., 2020a). Globally, more than 98 million COVID-19 infections have been reported since the beginning of October 2021, killing more than 4.9 million people (JHU, 2020). As soon as COVID-19 was categorized as a pandemic by the World Health Organization, countries implemented comprehensive control measures to mitigate its spread and impact (WHO, 2020b). Transportation and travel bans were enacted from certain locations, while certain institutions and borders were closed, and quarantine, self-isolation, and social distancing

* Corresponding Author.
Email Address: faaalrashed@ksu.edu.sa (F. A. Alrashed)
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Corresponding author's ORCID profile:
https://orcid.org/0000-0001-5975-3275

measures were put into effect (Abdulghani et al., 2021). COVID-19 contained by measures taken were justified, but they had a negative impact on the psychosocial, economic, and political factors of the population around the globe (WBG, 2020; WHO, 2020a). Exposure to infection, the transmission of infection to family members and loved ones, prolonged quarantine, concern about relatives' death, concerns about educational advancement, and other fears have increased tremendously. COVID-19, then, can have devastating effects on individuals, including students around the world (Mohammed et al., 2020; WHO, 2020a). The spread of the COVID-19 virus forced the closure of schools and universities worldwide, resulting in massive anxiety and uncertainty (UNESCO, 2020b). Students are faced with a new situation as a consequence of social distancing measures and the cessation of face-to-face teaching at higher educational institutions, compromising their daily lives (UNESCO, 2020a). There is a particularly high rate of loneliness among university and college students, as well as anxiety and depression (Diehl et al., 2018; Rahman et al., 2012). Social isolation, uncertainty, and abrupt transitions are likely to worsen students' feelings of isolation and insecurity during the COVID-19 era (CAPS, 2020). There has been a delay in regular teaching activities during the current COVID-19 pandemic. There appears to be a challenge with health education and health education is currently interrupted (Alrashed et al., 2021; Rose, 2020). It was decided to terminate in-person classes and replace them with video lectures or live streams (Ahmad et al., 2020). Medical students may suffer from impaired cognitive functioning and learning due to high-stress levels (Ferrel and Ryan, 2020; Abdulghani et al., 2014a). College students' mental health may be significantly impacted by how well they fulfill their roles. Students' mental health is directly related to their satisfaction and academic performance, according to Anbari et al. (2013).

There is high anxiety among medical students (Peterlini et al., 2002). In addition, a 2020 study found that the COVID-19 pandemic and its physical limitations have negatively impacted students' mental health. As a student, you might receive social support from family, friends, classmates, teachers, or a significant other due to the social connections you have with other people and groups (Cooke et al., 1988; Ye et al., 2020). Social support has been found to be inversely related to depression, anxiety, irritability, sleep quality, and loneliness among individuals experiencing emotional isolation and distancing during the COVID-19 pandemic in 2020. Higher levels of social support reduce depression risk and improve sleep quality (Grey et al., 2020). Problem-focused coping and emotion-focused coping differ in their effectiveness (Ahmad et al., 2020). As a result of coping strategies, people are able to cope with stressful or uncomfortable situations or change their responses in the face of such situations (Alrashed et al., 2022). Education has been affected by the current pandemic. Coping strategies are cognitive and behavioral skills (developed in response to a stressful event) that reduce momentary aversive effects and enhance the sense of control. As a result, students also experienced their own worries, insecurities, and fears. People's physical health, medical condition, and emotional well-being are affected by how they deal with a stressful event, such as the COVID-19 crisis (Awoke et al., 2021). Although existing studies have already provided an overview of COVID-19's psychological effects in Saudi Arabia, to our knowledge, no local studies have been conducted that contextualized medical college students' stress, mental welling, and coping strategies during and after COVID. In addition, students' normal lives and psychological well-being cannot be ignored. In this study, the main objective is to examine how stress during and after COVID impacts sociodemographic characteristics and what coping strategies medical students use to cope with COVID, during and after COVID.

Social support has been found to be inversely related to depression, anxiety, irritability, sleep quality, and loneliness among individuals experiencing emotional isolation and distancing during the COVID-19 pandemic in 2020. Higher levels of social support reduce depression risk and improve sleep quality.

2. Method

A quantitative approach was employed to gather data for a descriptive study conducted at King Saud University, Riyadh, Saudi Arabia. The study focused on medical students enrolled in the first to fifth years of the College of Medicine. Participation in the study was voluntary, and written informed consent was obtained from all participants. Prior to filling out the online study questionnaire, participants were provided with information about the research objectives and were required to indicate their consent by checking the option 'I consent to participate.'

Both online learning and regular class participants were assured of their privacy and given the opportunity to freely express their viewpoints during the study, which took place between March and October 2021.

Following an extensive literature review, a self-administered questionnaire comprising twenty items was developed to fulfill the study's objectives. A panel consisting of two family medicine consultants and one medical education expert engaged in detailed discussions to refine the questionnaire, resulting in the agreement on fourteen items after two meetings. The panel, along with the ethical team, recommended conducting a pilot study before the final data collection. The pilot study involved 25 to 35 participants and was conducted to ensure the questionnaire's internal consistency. The Cronbach's alpha reliability coefficient for all fourteen questions in the instrument was found to be 0.859, indicating high reliability.

To assess stress levels, the study utilized the validated 'Kessler 10 Psychological Distress (K10)' questionnaire, available in bilingual versions in both German and Arabic (Kessler et al., 2002). In this research, a Google form was employed as the means of disseminating the questionnaires to medical students. The study received a total of 453 responses from medical students enrolled in the 1st to 5th years of their respective programs. Prior to their participation, all medical students were provided with a comprehensive assent form, which elucidated the study's objectives and clarified the contents of the questionnaire.

The questionnaire itself was structured into three parts. The first part focused on collecting participants' demographic information, while the second part involved monitoring the online activities of medical students during the course, using the Kessler 10 Psychological Distress (K10) instrument to measure psychological distress. Lastly, the third part consisted of seven items that assessed the coping strategies adopted by students both during and after the COVID-19 pandemic, specifically considering the time when government restrictions were in effect.

For the purpose of examining psychological distress in this study, the Kessler-10 (K10) instrument, developed by Kessler and Andrews (2002), was utilized. The K10 has been widely translated into various languages, including Arabic, and has been employed in epidemiological studies to gauge the severity of psychological symptoms associated with stress (Abdulghani et al., 2011; 2014b). According to the K10, ten questions are asked, categorizing side effects from "none of the time" to "always," with corresponding responses ranging from 1 to 5. According to their absolute scores, these questions were ranked. Specifically, a score of 20 indicates no stress, a score of 20-24 indicates mild stress, a score of 25-29 indicates moderate stress and a score of 30-50 indicates severe stress (Kessler et al., 2002).

SPSS Statistics 22.0 (IBM Corporation, Armonk, NY, USA) was used to enter and analyze the numerical data in Microsoft Excel. With the help of 95% confidence intervals, a result variable's prevalence was estimated. To determine and quantify the relationships between a categorical outcome and the variables under study, Pearson's chi-square test and odds ratios (ORs) were used. The statistical significance level throughout the study has been set at $P<0.05$.

3. Results

Participants were requested to furnish demographic information encompassing gender, age, marital status, place of residence, and year of study. A total of 507 participants expressed their willingness to partake in the study. Upon a thorough assessment, 453 completed responses were deemed valid for analysis, resulting in an overall response rate of 89.3%.

Among the participants, 453 were medical students, with 297 (65.5%) being male and 156 (34.4%) female. The mean age of the participants was 20.8±1.4 (mean±standard deviation [SD]). The K10 stress scores exhibited a normal distribution (Table 1) and were observed to vary based on the students' respective years of study.

During the COVID-19 period, 243 respondents (53.6%) reported experiencing no stress, while 102 (22.5%) reported mild stress, 51 (11.3%) reported moderate stress and 57 (12.6%) reported severe stress. In the post-COVID period, the stress levels slightly shifted, with 289 respondents (63.8%) reporting no stress, 84 (18.5%) reporting mild stress, 39 (8.6%) reporting moderate stress, and 41 (9.1%) reporting severe stress (Table 1).

Table 1: Demographic characteristics

Participants	Characteristics	n (%)
Age group	18 to 21	259(57.2)
	22 to 25	193(42.6)
	26 and above	1 (0.2)
Gender	Male	297(65.6)
	Female	156(34.4)
Marital status	Single	430(94.9)
	Married	19(4.2)
	Divorced	4(0.9)
Residences	Urban	430(94.9)
	Ruler	23(5.1)
Year of study	1st	103(22.7)
	2nd	114(25.2)
	3rd	74(16.3)
	4th	104(23.0)
	5th	58(12.8)
Stress level during COVID	No	243(53.6)
	Mild	102(22.5)
	Moderate	51(11.3)
	Severe	57(12.6)
Stress level towards the post-COVID*	No	289(63.8)
	Mild	84(18.5)
	Moderate	39(8.6)
	Severe	41(9.1)

*: About normal with limited restriction as per the government law

The prevalence of overall stress among female medical students during the COVID-19 period was significantly higher (38.5%) compared to their male counterparts (16.2%) ($\chi2=53.2$; $P<0.000$). Following the COVID-19 period, medical students, including both female (26.9%) and male students (12.8%), reported slightly lower levels of stress than during the peak of the pandemic.

Among medical students, the highest stress levels were observed in the third year (47.3%), followed by the fifth year (32.7%), the first year (24.3%), the fourth year (17.3%), and the second year (9.6%) ($\chi2=130.3$; $P<0.000$). The same order of stress levels was maintained in the post-COVID-19 period, with stress being relatively less, but still showing a similar pattern ($\chi2=133.0$; $P<0.000$) (Table 2).

In comparison to other age groups surveyed, individuals aged 18 to 21 years exhibited significantly higher stress levels (1.49 times higher) during the COVID-19 period (OR=1.49; P=0.07). Even after transitioning to a post-COVID normal situation, this younger age group (18 to 21 years) continued to experience nearly similar and elevated stress levels (OR=1.46; P=0.13) (Table 3).

Table 2: Overall stress level in medical students with demographic information (during and post-COVID-19 situation)

Participants	Total n(%)	During COVID-19			Post-COVID-19		
		No n(%)	Yes n(%)	χ2 (p-value)	No n(%)	Yes n(%)	χ2 (p-value)
Age group							
18 to 21	259(57.2)	187(72.2)	72(27.8)	16.0(0.014)	206(79.5)	53(20.4)	22.4(0.001)
22 to 25	193(42.6)	157(81.3)	36(18.6)		166(86.0)	27(13.9)	
26 and more	1(0.22)	1(100)	0(0.0)		1(100)	0(0.00)	
Gender							
Male	297(65.6)	249(83.8)	48(16.2)	53.2(<0.000)	259(87.2)	38(12.8)	38.3(0.000)
Female	156(34.4)	96(61.5)	60(38.5)		114(73.0)	42(26.9)	
Marital status							
Single	430(94.9)	344(80.0)	86(20)	152.2(<0.000)	367(85.3)	63(14.6)	124(0.000)
Married	19(4.2)	1(5.2)	18(94.4)		5(26.3)	14(73.6)	
Divorced	4(0.9)	0(0.0)	4(100)		1(25.0)	3(75.0)	
Residences							
Urban	430(94.9)	322(74.8)	108(25.1)	18.6(<0.000)	350(81.39)	80(18.6)	7.73(0.052)
Ruler	23(5.1)	23(100)	0(0.0)		23(100)	0(0.0)	
Year of study							
1st	103(22.7)	78(75.7)	25(24.3)	130.3(<0.000)	85(82.5)	18(17.47)	133.0(<0.000)
2nd	114(25.2)	103(90.3)	11(9.6)		109(95.6)	5(4.38)	
3rd	74(16.3)	39(52.7)	35(47.3)		45(60.8)	29(39.1)	
4th	104(23.0)	86(82.7)	18(17.3)		93(89.4)	11(10.5)	
5th	58(12.8)	39(67.2)	19(32.7)		41(70.7)	17(29.3)	

Notably, during the COVID-19 period, female medical students reported significantly more severe stress than their male counterparts (OR=2.37; P=<0.0001). Although the post-COVID period witnessed a slight reduction in stress levels among female students, their stress remained substantially high (OR=2.1; P=0.002) (Table 3).

Regarding the academic year, during the COVID-19 situation, stress was most prevalent among 3rd-year medical students (OR=4.9; P<0.001), followed by 5th-year students (OR=3.4; P=0.003), 1st-year students (OR=2.5; P=0.01), and 2nd-year students (OR=2.03; P=0.19). Similarly, in the post-COVID situation, stress levels were significantly higher for medical students compared to the during-COVID period. Among the academic years, 3rd-year students experienced the most severe stress (OR=8.9; P<0.0001), followed by 5th-year (OR=6.6; P=0.0004), 1st-year (OR=3.9; P=0.008), and 4th-year students (OR=2.4; P=0.01) (Table 3).

In response to the COVID-19 situation, medical students adopted various coping strategies to manage stress. Notably, the most effective strategies for coping with moderate/severe stress were "exercise" (OR=0.66; P=0.05), "time with family and friends" (OR=0.77; P=0.17), "religious activities" (OR=0.44; P=0.0001), "accepting the COVID situation" (OR=0.63; P=0.01), and maintaining low expectations (OR=0.72; P=0.06) (Table 3). Conversely, those who resisted accepting the COVID situation experienced 1.4 times higher stress levels (OR=1.4; P=0.24) compared to other coping strategies. The post-COVID stress coping strategies among medical students were also examined (Table 3). Among students experiencing moderate/severe stress, the most effective coping mechanisms were "exercise" (OR=0.69; P=0.13), "time with family and friends" (OR=0.82; P=0.36), "religious activities" (OR=0.44; P=0.0006), and "accepting the COVID guidelines or situation" (OR=0.63; P=0.02). On the other hand, those who refused to accept the COVID situation faced approximately 1.5 times higher stress levels, even in the post-COVID environment (OR=1.47; P=0.22).

4. Discussion

A thriving community places significant emphasis on the well-being and safety of its inhabitants. The advent of the COVID-19 pandemic has initiated a profound psychosocial experiment affecting both physical and mental health. Consequently, students' educational attitudes and strategies have undergone considerable shifts in response to this global crisis.

Several countries responded to the Coronavirus outbreak in December by urging citizens to isolate at home or in designated facilities. While the current COVID-19 situation is approaching stabilization in Saudi Arabia, strict adherence to numerous guidelines remains crucial for students. In particular, medical students appear to face a higher susceptibility to encountering mental and physical health challenges compared to their non-medical counterparts.

According to the findings of our study, a significant proportion of students, particularly medical students, have reported experiencing stress. Specifically, a majority (73%) of medical students indicated that they were under stress during this period (Saravanan and Wilks, 2014). The academic aspect of medical study places them at risk for depression and anxiety. An epidemic can further aggravate these negative feelings. The stress they experience negatively affects their mental, physical, and emotional health (Alrashed et al., 2022). A high level of stress can negatively impact cognition and learning abilities (Abdulghani et al., 2014b). Approximately one-fourth of medical students were depressed during the quarantine period, according to our previous study (Abdulghani et al., 2020a; 2020b; Ahmad et al., 2020).Students are experiencing a significant change in their learning needs and teaching patterns during their third year of study (from preclinical to clinical). This has a direct impact on their well-being. This transition is particularly challenging for those students who are close to becoming doctors, a change that is widely acknowledged as difficult (Teagle et al., 2017).

Table 3: Associations of students' stress and coping strategies

		During COVID-19						Post- COVID-19					
		Stress (No)			Stress (Yes)			Stress (No)			Stress (Yes)		
Categories	Total n(%)	* (%)	OR (95% CI)	P-value	** (%)	OR (95% CI)	P-value	* (%)	OR (95% CI)	P-value	** (%)	OR (95% CI)	P-value
Age													
18 to 21	259(57.2)	187(72.2)	0.88(0.67- 1.17)	0.4	72(27.8)	1.49(0.95- 2.31)	0.07	206(79.5)	0.92(0.70- 1.21)	0.57	53(20.4)	1.46(0.88- 2.41)	0.13
22 to 25	193(42.6)	157(81.3)	|		36(18.6)	|		166(86.0)	|		27(13.9)	|	
26 and above	1(0.22)	1(100)	0		0(0.00)	0		1(100)	0		0(0.00)	0	
Gender													
Male	297(65.6)	249(83.8)	1.36(1.0- 1.84)	0.04	48(16.2)	|		259(87.2)	1.1(0.8- 1.6)	0.23	38(12.8)	|	
Female	156(34.4)	96(61.5)	|		60(38.5)	2.37(1.5- 3.64)	0.0001	114(73.0)	|		42(26.9)	2.1(1.3- 3.3)	0.002
Year of study													
1st	103(22.7)	78(75.7)	0.88(0.5- 1.2)	0.38	25(24.3)	2.5(1.1- 5.3)	0.01	85(82.5)	0.86(0.58- 1.2)	0.4	18(17.47)	3.9(1.4- 11.1)	0.008
2nd	114(25.2)	103(90.3)	|		11(9.6)	|		109(95.6)	|		5(4.38)	|	
3rd	74(16.3)	39(52.7)	0.58(0.36- 0.93)	0.02	35(47.3)	4.9(2.3- 10.2)	<0.001	45(60.8)	0.63(0.40- 1.0)	0.05	29(39.1)	8.9(3.3- 24.1)	<0.0001
4th	104(23.0)	86(82.7)	0.91(0.6- 1.3)	0.65	18(17.3)	1.8(0.8- 3.9)	0.15	93(89.4)	0.93(0.63- 1.3)	0.73	11(10.5)	2.41(0.81- 7.1)	0.011
5th	58(12.8)	39(67.2)	0.74(0.4- 1.2)	0.23	19(32.7)	3.4(1.5- 7.6)	0.003	41(70.7)	0.73(0.45- 1.19)	0.21	17(29.3)	6.6(2.3- 19.0)	0.0004
Coping strategies													
Exercise	200(44.2)	156(78)	1.17(0.8- 1.5)	0.3	44(22)	0.66(0.4- 1.0)	0.05	166(83)	1.09(0.8- 1.47)	0.52	34(17)	0.69(0.4- 1.11)	0.13
Spending time with family and friends	335(74)	248(74.0)	1.11(0.8- 1.4)	0.45	87(25.9)	0.77(0.5- 1.1)	0.17	267(79.7)	1.05(0.8- 1.37)	0.68	68(20.2)	0.82(0.5- 1.24)	0.36
Religious activities	330(72.8)	281(85.2)	1.27(0.9- 1.6)	0.07	49(14.8)	0.44(0.2- 0.67)	0.0001	294(89.0)	1.18(0.9- 1.53)	0.21	36(10.9)	0.44(0.2- 0.70)	0.0006
Accept the COVID	404 (89.2)	318(78.7)	1.18(0.9- 1.5)	0.21	86(21.3)	0.63(0.4- 0.91)	0.01	341(84.4)	1.11(0.8- 1.44)	0.38	63(15.5)	0.63(0.4- 0.95)	0.02
Refusing to COVID	47(10.4)	25(53.1)	0.79(0.4-1.3)	0.4	22(46.8)	1.4(0.7- 2.49)	0.24	30(63.8)	0.84(0.5- 1.39)	0.51	17(36.2)	1.47(0.7- 2.78)	0.22
take distance from the source of stress	204(45)	136(66.7)	|		68(33.4)	|		154(75.5)	|		50(24.5)	|	
Low my expectations	424(93.6)	322(75.0)	1.13(0.8- 1.4)	0.32	102(23.8)	0.72(0.5- 1.0)	0.06	347(81.8)	1.08(0.8- 1.39)	0.53	77(18.1)	0.74(0.5- 1.09)	0.13

Only we take those responders they say "Yes"; *No Stress=No stress + Mild stress; ** Stress=Moderate + Severe stress

We also found that stress incidence was highest amongst 3rd-year students both during and after COVID, as they exhibited significantly higher levels of severe stress. Several factors make the third year of medical education more challenging for students. Due to students transitioning from pre-clinical to clinical year, this is undoubtedly one factor for stress. According to a study (Saravanan and Wilks, 2014), Second and Third MBBS students were significantly more stressed than First MBBS students (p=0.05). Previously published studies found that 3rd-year medical students have more stress (Atherley et al., 2016; Seetan et al., 2021). Medical symptoms and psychological symptoms of stress are strongly related to students' gender. In the current study, we found, the stress levels of female students were significantly higher during COVID and post-COVID than those of male students. Maybe females are socialized to be emotionally engaged and to seek out support in interpersonal relationships. Conversely, males are taught to solve problems on their own or use humor to do so. Females from non-medical and medical courses are significantly more stressed than their male counterparts. The proportion of female medical students reporting being frequently stressed by their studies was higher than the proportion of non-medical students (46.5%) (Al-Dabal et al., 2010). Among the international studies, there was a significant difference between females and males in regard to depression, re-experience, and avoidance, as well as depression (Abdulghani et al., 2021; 2022b; Schwartz et al., 2021).

Effective coping strategies are essential for managing distress and fostering resilience during a crisis, such as the COVID-19 outbreak. There is evidence that the type of stress coping used in such circumstances impacts health differently, leading to either poor or better health outcomes (Abdulghani et al., 2022a; Polizzi et al., 2020). According to Abdulghani et al. (2020a), and Khan (2021) coping strategies are considered important in the fight against stress, and their context is shaped by social support, particularly within the family, and emotional, with the passions of the medical student being of paramount importance. Different coping mechanisms are used by each individual in challenging situations. For medical students, it is always a challenge to cope while unprepared (Haq et al., 2022; Murray et al., 2018). In the current study, as a coping strategy to deal with severe stress, religious activities were found to be the most effective during COVID and post-COVID by the majority of "severely stressed" students. A similar finding was reported in the internationally published study, the highest mean score was achieved by religion in coping with stress, followed by planning and acceptance (Awoke et al., 2021; Fadhel and Adawi, 2020). Stress can be dealt with on cognitive, emotional, or behavioral levels. According to another study, certain groups may benefit more from religious participation when they are stressors in their lives (Ahrens et al., 2010; Haq et al., 2021). In the current study during and post-COVID situation, we observed "Exercise," "time with family and friends," "low expectations for the current condition," and accepting the COVID condition" were good coping strategies (Gao et al., 2020). There is a high level of stress among students who refuse the COVID condition, and they do not cope with stress in any way.

This study identified coping strategies among students in order to identify coping mechanisms. Designing support strategies for universities can be facilitated by identifying coping strategies. Future empirical studies can include a more detailed examination of the relationships between specific coping strategies adopted by students in light of the present results. Further studies are necessary on the mental health impacts of the later stages of the pandemic, as the consequences of this difficult situation may persist long after the pandemic reaches its peak intensity.

5. Limitations

The data collection process employed in this study was confined to a single region within Saudi Arabia, which limits the generalizability of the findings to a broader population. It is essential to acknowledge the presence of a selection bias resulting from the specific sampling technique utilized in the interpretation of the results. Additionally, the authors utilized COVID-19 as the sole measure of perceived stress, while coping strategies were assessed using an existing scale. The use of such instruments warrants careful consideration in the context of the study's objectives and research question. Furthermore, this study exclusively focused on medical students from one particular university, thereby potentially limiting the scope and diversity of the participant pool. To overcome this limitation, we recommend conducting further exploratory research events that encompass students from various disciplines, both during and after the COVID-19 period. Such an approach will enhance the comprehensiveness of the study and provide valuable insights into the broader student population's experiences and coping strategies.

6. Conclusion

This research examined stress levels among medical students in Riyadh, Saudi Arabia, with a focus on factors associated with the COVID-19 outbreak and the effectiveness of coping strategies. To gain a comprehensive understanding of students' coping mechanisms, further investigations are warranted to assess their experiences both during and after the pandemic. Notably, the study highlighted that young students at the initial stages of their academic journeys tend to manage stress less effectively. Additionally, female students consistently reported higher stress levels even in the post-COVID period. A significant finding of this study was that regular engagement in religious meditation was linked to lower stress levels. Furthermore,

stress levels slightly diminished for students during and after COVID, with marginal differences observed between the two periods. Nevertheless, it is essential for university administrators to remain vigilant, particularly towards students experiencing moderate and severe stress. As part of an effective strategy, incorporating a mandatory coping skills course within the first-year curriculum could contribute to enhancing students' competence, overall well-being, and resilience. To ensure the readiness of administrators and faculty members in handling stressful academic situations in the event of future pandemics, continuous preparedness measures must be in place. By adopting a proactive approach, educational institutions can better support their students during challenging circumstances.

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Compliance with ethical standards

Ethics approval and consent to participate

Institutional review board approval was obtained from the College of Medicine at KSU for the study protocol. Participants were required to consent to participate in the study before completing the questionnaires.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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