RESEARCH ARTICLE

REVISED Medical students' relative immunity, or lack thereof, against COVID-19 emotional distress and psychological challenges; a descriptive study from Jordan [version 2; peer review: 3 approved]

Khalid Kheirallah[1], Sarah Bloukh[2], Wasim Khasawneh[3], Jomana Alsulaiman[4], Adi Khassawneh[1], Abdel-Hameed Al-Mistarehi[1], Mohammad Alqudah[5], Lina Elsalem[6], Samir Al Bashir[5], Hasan H. Awad[1], Tariq Al-Shatanawi[7], Tareq Saleh[2]

[1]Department of Public Health, Faculty of Medicine, Jordan University of Science and Technology, Irbid, Jordan
[2]Department of Basic Medical Sciences, Faculty of Medicine at The Hashemite University, Zarqa, Jordan
[3]Department of Pediatrics and Neonatology, Medical School of Jordan University of Science and Technology, Irbid, Jordan
[4]Department of Pediatrics, Faculty of Medicine at Yarmouk University, Irbid, Jordan
[5]Department of Pathology and Microbiology, Medical School of Jordan University of Science and Technology, Irbid, Jordan
[6]Department of Pharmacology, Medical School of Jordan University of Science and Technology, Irbid, Jordan
[7]Department of Public Health, Faculty of Medicine at Al-Balqa Applied University, Al-Salt, Jordan

v2 **First published:** 19 Apr 2021, **10**:297
https://doi.org/10.12688/f1000research.52051.1
Latest published: 24 May 2021, **10**:297
https://doi.org/10.12688/f1000research.52051.2

Abstract

Background: Emotional distress is a major impact of COVID-19 among not only the general public but also healthcare workers including medical students. This study aimed at describing self-reported changes in emotional reactions associated with COVID-19 among medical students in Jordan and to assessing the potential effect of social media utilization on emotional distress among this group.

Methods: A cross-sectional design was utilized to collect data early on during the outbreak in Jordan. All medical students in Jordan were eligible to complete an online questionnaire assessing self-reported emotional reactions to COVID-19 that covered four main domains: negative emotion (anxiety, worry, depression, panic, loneliness, and nervousness), positive emotion (happiness, joy, and excitement), sleep disorders (insomnia, shallow sleep, nightmares, and insufficient sleep), and aggression (verbal argument and physical fighting). The frequency of social media utilization as a main source of COVID-19 information was also assessed.

Results: 59.9% of participants were females, 64.9% were enrolled at the two major medical schools in Jordan, and 59.6% were in the pre-

Open Peer Review

Reviewer Status ✓ ✓ ✓

	Invited Reviewers		
	1	**2**	**3**
version 2 (revision) 24 May 2021	✓ report	✓ report	
version 1 19 Apr 2021	✓ report	? report	✓ report

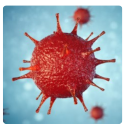
1. **Nedal Alnawaiseh**, University of Mutah, Al-Karak, Jordan

2. **Tariq Kewan**, Cleveland Clinic Fairview Hospital, Cleveland, USA
Translational Hematology and Oncology, Cleveland Clinic, Cleveland, USA

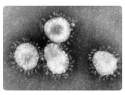
clinical stage (years). A significant proportion of participants self-reported increased negative emotional levels of anxiety (49.2%), worry (72.4%), depression (23.1%), panic (22.6%), and nervousness (38.2%) and decreased positive emotional levels of happiness (44.8%), joy (47.3%), and feelings of excitement (45.1%). Self-reported sleep disorders were not as common (less than 15% for any of the four items), while arguing with others was at 26.7%. Significant differences by gender and academic year were detected. Almost half of participants reported using social media as a main source of COVID-19 information "most/all-the-times" with a significant effect of such on reducing emotional distress.

Conclusion: The results suggest a potential effect of COVID-19 on the emotional distress of medical students. Addressing and mitigating such effects is crucial. The potential buffering effect of social media should be further investigated.

Keywords
COVID-19, emotional distress, emotional changes, medical students, Jordan, social media, medical school, SARS-CoV-2.



This article is included in the Disease Outbreaks gateway.



This article is included in the Coronavirus collection.

3. **Walid Alali**, Kuwait University, Safat, Kuwait

Any reports and responses or comments on the article can be found at the end of the article.

Corresponding authors: Khalid Kheirallah (kkheiral@gmail.com), Tareq Saleh (tareq@hu.edu.jo)

Author roles: Kheirallah K: Conceptualization, Formal Analysis, Methodology, Project Administration, Supervision, Validation, Visualization, Writing – Review & Editing; **Bloukh S**: Conceptualization, Project Administration, Supervision, Validation, Writing – Original Draft Preparation; **Khasawneh W**: Project Administration, Resources, Validation, Visualization, Writing – Review & Editing; **Alsulaiman J**: Investigation, Methodology, Project Administration, Writing – Review & Editing; **Khassawneh A**: Project Administration, Supervision, Validation, Writing – Review & Editing; **Al-Mistarehi AH**: Investigation, Methodology, Project Administration, Resources, Supervision, Validation, Visualization, Writing – Review & Editing; **Alqudah M**: Conceptualization, Project Administration, Supervision, Writing – Review & Editing; **Elsalem L**: Project Administration, Resources, Validation, Writing – Review & Editing; **Al Bashir S**: Investigation, Methodology, Project Administration, Supervision, Writing – Review & Editing; **Awad HH**: Investigation, Project Administration, Supervision, Validation, Visualization; **Al-Shatanawi T**: Project Administration, Validation, Writing – Review & Editing; **Saleh T**: Conceptualization, Methodology, Validation, Visualization, Writing – Original Draft Preparation

Competing interests: No competing interests were disclosed.

Grant information: The author(s) declared that no grants were involved in supporting this work.

How to cite this article: Kheirallah K, Bloukh S, Khasawneh W *et al.* **Medical students' relative immunity, or lack thereof, against COVID-19 emotional distress and psychological challenges; a descriptive study from Jordan [version 2; peer review: 3 approved]** F1000Research 2021, **10**:297 https://doi.org/10.12688/f1000research.52051.2

First published: 19 Apr 2021, **10**:297 https://doi.org/10.12688/f1000research.52051.1

REVISED **Amendments from Version 1**

The manuscript has been updated with some technical notes such as response rate. As well, the buffering effect of social media on mental health domains investigated is only a suggested direction for future research and is not a mere conclusion of the article.

Any further responses from the reviewers can be found at the end of the article

Introduction

COVID-19 is shadowing its effect on almost all individuals living today. The health, safety, and well-being of individuals and communities are all expected to be affected. These effects may include anxiety, fear, frustration, loneliness, anger, boredom, depression, stress, and avoidance behaviour (Talevi *et al.*, 2020) and may simply translate into emotional disturbances not only among those with the disease but also the general population and other sub-groups (Pfefferbaum & North, 2020).

Certain population subgroups may be more vulnerable than others to the psychosocial effects of COVID-19. Healthcare workers, including medical students, especially in resource-limited countries, are particularly vulnerable to emotional distress during COVID-19 given their high risk of exposure to the infection, potential shortage of personal protective equipment, longer work hours, and involvement in emotionally and ethically fraught resource-allocation decisions (Greenberg, 2020; Loch *et al.*, 2020; Samrah, Al-Mistarehi, Aleshawi, *et al.*, 2020; Talevi *et al.*, 2020; Vindegaard & Eriksen Benros, 2020).

Studies have reported that medical schools have one of the most demanding academic programs (Wolf, 1994) and include students at higher risk for developing anxiety disorders, compared to the general population, even under normal circumstances (Quek *et al.*, 2019). Medical emergencies destabilize medical students' already vulnerable psychological status leading to unfavourable effects on their learning journey (Al-Rabiaah *et al.*, 2020), physical and mental health, and their professional identity formation (Chandratre, 2020). While medical students may experience increasing level of anxiety and stress due to the COVID-19 disruption (Lasheras *et al.*, 2020; Ullah & Amin, 2020), they are the least likely to seek support for mental health problems (Chandratre, 2020).

During outbreaks, medical students are expected to become part of the frontline workforce (Kinder & Harvey, 2020; O'Byrne *et al.*, 2020), which may further expose them to psychological distress. Therefore, it is important to assess and safeguard medical students' mental health status and to implement proper strategies to support their mental well-being. Providing a clear understanding of the extent of psychological impact of COVID-19 infection should, then, be clearly established.

Jordan is a developing country in the Middle East region and reported its first case of SARS-CoV-2 infection in early March, 2020 (Samrah, Al-Mistarehi, Ibnian, *et al.*, 2020). A series of *strict* non-pharmaceutical intervention (NPI) measures were then implemented (Kheirallah *et al.*, 2020; Samrah, Al-Mistarehi, Aleshawi, *et al.*, 2020) that included a curfew and a total shutdown. By mid-March, 2020, all educational institutions, including medical schools, were ordered closed and online education was, suddenly, the only option (Sindiani *et al.*, 2020). This may have increased the level of psychological distress among medical students (Elsalem *et al.*, 2020). The current study described the self-reported changes in emotional reactions associated with COVID-19 among medical students in Jordan and investigated the potential effect of utilizing social media as a main source of COVID-19 information on these emotional changes.

Methods

A descriptive cross-sectional design collected data on medical students between March 17 and 20, 2020, shortly after Jordan initiated the NPI measures stated earlier. Data were collected from all medical schools (N = 6) in Jordan and included all years (year 1 to year 6). The 6-year program consists of two stages: preclinical, the first three years of the program, and clinical, the last three years. *The minimum sample size required to detect a 10% difference in any of the emotional items under investigations was estimated at 600 students (alpha = 0.05, power = 0.8).* Considering a response rate of around 20% for online questionnaires among the sample population (Khasawneh *et al.*, 2020), an online data collection tool, using Google forms, was utilized and a link was emailed to a randomly selected sample (N = 3,000 out of the total estimated number of medical students in Jordan) that was proportionate to the year of study and the medical school.

Participants' emotional reactions to COVID-19 pandemic were self-reported using 15 items covering four main domains: negative emotions (anxiety, worry, depression, panic, loneliness, and nervousness), positive emotions (happiness, joy, and excitement), sleep disorders (insomnia, shallow sleep, nightmares, and insufficient sleep), and aggression (verbal argument and physical fighting). Medical students compared the frequency of each item after the onset of the pandemic with before the pandemic using a three-point scale (from "1 = less compared to the days before the pandemic" to "3 = more compared to the days before the pandemic"). For selected items, responses were randomized. Participants were also asked to assess their usage of social media as a main source of information for COVID-19 using a three-point Likert scale (from *"1 = never" to "3 = most/all the time"*). The questionnaire was reviewed by expert panel before being piloted on 20 students.

The Institutional Review Boards of The Hashemite University (5/2/2019/2020) and Al-Balqa Applied University (26/3/1/804) approved this study. An online consent form was obtained by all participants prior to being directed to take the questionnaire.

Each emotional item was reported overall and by gender, academic level and by social media utilization using numbers and percentages. A Chi-squared test was used to compare percentages for each emotional item. The Alpha level was set at 0.05.

Results

A total of 1,404 students participated in the current study (response rate = 46.8%). The distribution of participants by gender, university, and year is presented in Table 1. About two-thirds (59.9%) of participants were females, 64.9% were enrolled at the two well-established medical schools at the University of Jordan (39.1%) and Jordan University of Science and Technology (JUST) (25.8%), and 59.6% were in the pre-clinical stage of their medical education.

Overall, almost half of the participants (49.2%) self-reported that they experienced increased levels of anxiety. This was significantly more prevalent among females (58.6%) than males (35.5%) ($p<0.0001$). Self-reported worry, which was the most commonly reported negative emotion experienced among all participants (72.4%), was significantly more prevalent

Table 1. Study participants' background characteristics.

		Number	*Percent*
Gender			
	Female	836	*59.5*
	Male	568	*40.5*
	Total	**1,404**	***100.0***
University			
	Al-Balqa`	117	*8.4*
	Hashemite	192	*13.7*
	Jordan	550	*39.1*
	JUST	362	*25.8*
	Mutah	62	*4.4*
	Yarmouk	121	*8.6*
	Total	**1,404**	***100.0***
School Year			
Pre-clinical	1st year	145	*10.3*
	2nd year	348	*24.8*
	3rd year	343	*24.5*
Clinical	4th year	264	*18.8*
	5th year	176	*12.5*
	6th year	128	*9.1*
	Total	**1,404**	***100.0***

Table 2. Distribution of study participants by study items and by gender and academic study level (N = 1,404).

			Total (N = 1,404)		Female (N = 835)		Male (N = 569)		*P-Value*	Pre-clinical (N = 837)		Clinical (N = 567)		*P-Value*
	Item	**Response**	**n**	**%**	**n**	**%**	**n**	**%**		**n**	**%**	**n**	**%**	
Negative emotions	Anxiety	No	713	*50.8%*	346	*41.4%*	367	*64.5%*	*0.000*	414	*49.5%*	299	*52.7%*	*0.232*
		Yes Increased	691	*49.2%*	489	*58.6%*	202	*35.5%*		423	*50.5%*	268	*47.3%*	
	Worry	No	387	*27.6%*	170	*20.4%*	217	*38.1%*	*0.000*	218	*26.0%*	169	*29.8%*	*0.128*
		Yes Increased	1,017	*72.4%*	665	*79.6%*	352	*61.9%*		619	*74.0%*	398	*70.2%*	
	Depression	No	1,079	*76.9%*	611	*73.2%*	468	*82.2%*	*0.000*	620	*74.1%*	459	*81.0%*	*0.003*
		Yes Increased	325	*23.1%*	224	*26.8%*	101	*17.8%*		217	*25.9%*	108	*19.0%*	
	Panic	No	1,087	*77.4%*	594	*71.1%*	493	*86.6%*	*0.000*	613	*73.2%*	474	*83.6%*	*0.000*
		Yes Increased	317	*22.6%*	241	*28.9%*	76	*13.4%*		224	*26.8%*	93	*16.4%*	
	Loneliness	No	909	*64.7%*	565	*67.7%*	344	*60.5%*	*0.006*	522	*62.4%*	387	*68.3%*	*0.026*
		Yes Increased	495	*35.3%*	270	*32.3%*	225	*39.5%*		315	*37.6%*	180	*31.7%*	
	Nervousness	No	868	*61.8%*	452	*54.1%*	416	*73.1%*	*0.000*	481	*57.5%*	387	*68.3%*	*0.000*
		Yes Increased	536	*38.2%*	383	*45.9%*	153	*26.9%*		356	*42.5%*	180	*31.7%*	
Sleep disorders	Insomnia	No	1,231	*87.7%*	720	*86.2%*	511	*89.8%*	*0.047*	715	*85.4%*	516	*91.0%*	*0.002*
		Yes Increased	173	*12.3%*	115	*13.8%*	58	*10.2%*		122	*14.6%*	51	*9.0%*	
	Shallow sleep	No	1,222	*87.0%*	712	*85.3%*	510	*89.6%*	*0.019*	715	*85.4%*	507	*89.4%*	*0.029*
		Yes Increased	182	*13.0%*	123	*14.7%*	59	*10.4%*		122	*14.6%*	60	*10.6%*	
	Nightmares	No	1,256	*89.5%*	726	*86.9%*	530	*93.1%*	*0.000*	739	*88.3%*	517	*91.2%*	*0.092*
		Yes Increased	148	*10.5%*	109	*13.1%*	39	*6.9%*		98	*11.7%*	50	*8.8%*	
	Insufficient sleep	No	1,230	*87.6%*	717	*85.9%*	513	*90.2%*	*0.017*	717	*85.7%*	513	*90.5%*	*0.008*
		Yes Increased	174	*12.4%*	118	*14.1%*	56	*9.8%*		120	*14.3%*	54	*9.5%*	
Aggression	Argue with others	No	1,029	*73.3%*	610	*73.1%*	419	*73.6%*	*0.854*	587	*70.1%*	442	*78.0%*	*0.001*
		Yes Increased	375	*26.7%*	225	*26.9%*	150	*26.4%*		250	*29.9%*	125	*22.0%*	
	Physical fight	No	1,333	*94.9%*	787	*94.3%*	546	*96.0%*	*0.173*	778	*93.0%*	555	*97.9%*	*0.000*
		Yes Increased	71	*5.1%*	48	*5.7%*	23	*4.0%*		59	*7.0%*	12	*2.1%*	
Positive emotions	Happiness	No	775	*55.2%*	445	*53.3%*	330	*58.0%*	*0.090*	457	*54.6%*	318	*56.1%*	*0.585*
		Yes Decreased	629	*44.8%*	390	*46.7%*	239	*42.0%*		380	*45.4%*	249	*43.9%*	
	Joy	No	740	*52.7%*	416	*49.8%*	324	*56.9%*	*0.009*	433	*51.7%*	307	*54.1%*	*0.384*
		Yes Decreased	664	*47.3%*	419	*50.2%*	245	*43.1%*		404	*48.3%*	260	*45.9%*	
	Feeling excitement	No	771	*54.9%*	418	*50.1%*	353	*62.0%*	*0.000*	447	*53.4%*	324	*57.1%*	*0.172*
		Yes Decreased	633	*45.1%*	417	*49.9%*	216	*38.0%*		390	*46.6%*	243	*42.9%*	

among females than males (79.5% *vs* 61.9%, p<0.0001). Similarly, self-reported depression and panic, respectively, were more prevalent among females (26.8% and 28.9%) compared with males (17.8% and 13.4%) (p-value for both comparisons <0.0001) (Table 2).

About 35% and 38% of surveyed students self-reported increased levels of loneliness and nervousness, respectively. While significantly more males (39.5%) than females reported increased level of loneliness (p=0.006), more females (45.9%) than males (26.9%) self-reported increased nervousness levels (p<0.001).

On the other hand, self-reported anxiety and worry were not significantly different between students in the pre-clinical *vs* clinical years while depression and panic, respectively, were significantly higher among students in pre-clinical years (25.9% and 26.8%) compared with their counterparts in the clinical years (19.0% and 16.4%) (p=0.003 and <0.001). Similarly, self-reported loneliness and nervousness, respectively, were significantly more common among students in the pre-clinical years (37.6% and 42.5%) compared to their counterparts in the clinical years (31.7% and 31.3%) (p=0.026 and <0.001).

About 13% of students self-reported experiencing increased insomnia, shallow sleep, nightmares, or insufficient sleep. In general, females self-reported experiencing significantly more sleeping problems than males. Likewise, students in the pre-clinical years experienced sleep problems (insomnia, shallow sleep, and insufficient sleep) significantly more frequently than those in their clinical years.

While about one-quarter of participants (26.7%) self-reported increased level of arguing with others, 5.1% self-reported increasing physical fight. However significant differences in aggression variables were not detected by gender, students in the pre-clinical years self-reported higher levels of both arguing with others (26.9%), compared with their counterparts in the clinical years (22.0%) (p=0.001), and physical fights (7.0%), compared with clinical years students (2.1%) (p<0.001).

Approximately half of the participants self-reported a decrease in their level of positive emotions, namely happiness (44.8%), joy (47.8%), and excitement (45.1%). Self-reported decrease in the levels of joy and excitement, respectively, were statistically more prevalent among females (50.2% and 49.9%) compared with males (43.1% and 38.0%) (p=0.009 and <0.001). Significant differences in each of the three positive emotions by academic levels were not statistically significant.

Overall, 37.9% of study participants reported never using social media as a source of information for COVID-19, while almost half (45.6%) reported using it "most/all the times" (Table 3). Statistically significant relationships were detected between social media as a source for COVID-19 information and anxiety (p=0.002), worry (0.016), panic (<0.001), loneliness (0.003), and nervousness (0.004). Among those who reported to use social media most/all the times as a source of information about COVID-19, the prevalence estimates of self-reported anxiety, worry, panic, loneliness, and nervousness, respectively, were less than that among their counterparts who never used it (47.3% *vs* 55.6%, 70.9% *vs* 77.8%, 20.3% *vs* 28.9%, 31.7% *vs* 41.5%, and 36.1% *vs* 44.2%). Changes in sleep disorder and aggression variables, on the other hand, were not significantly different by social media.

Discussion

The current descriptive study assessed the self-reported emotional changes following the COVID-19 pandemic among medical students in Jordan. Participants were found to have increased levels of almost all self-reported negative emotions and decreased levels of almost all positive emotions. These changes were more prevalently the case with females and preclinical students. Utilizing social media as a main source of COVID-19 information should be further investigated as having a potential "buffering effect" against emotional changes under investigation.

Our results suggest that medical students may not be immune against COVID-19 emotional distress and increased psychological challenges. This could potentially usher a period of adjustment and may produce significant mental health issues. Addressing and mitigating the negative effects of public health emergencies on the mental health of medical students seem to be critical.

Overall, preclinical level students seemed to have a greater increase in almost all negative emotions compared with clinical students. The reason why preclinical students might have had a greater increase in negative emotions could be attributed to their lesser experience in the clinical field and lesser understanding of the pandemic in general. However, it is interesting to note that the two negative emotions that showed no significant difference between preclinical and clinical students were worry and anxiety. When considering that medical students are already exposed to high levels of anxiety

Table 3. Distribution of study participants by social media use as a main source of COVID-19 information and by items under investigation

				Use of social media as a main source of COVID-19 Information						
Item				**Never (N=532)**		**Rarely/sometimes (N=232)**		**Most/All the times (N=640)**		***P-value***
				Number	***Percent***	**Number**	***Percent***	**Number**	***Percent***	
	Overall			**532**	***37.9%***	**232**	***16.5%***	**640**	***45.6%***	
Negative emotion	Anxiety	No		241	*46.1%*	135	*58.2%*	337	*52.7%*	*0.002*
		Yes Increased		291	*55.6%*	97	*41.8%*	303	*47.3%*	
	Worry	No		125	*23.9%*	76	*32.8%*	186	*29.1%*	*0.016*
		Yes Increased		407	*77.8%*	156	*67.2%*	454	*70.9%*	
	Depression	No		405	*77.4%*	181	*78.0%*	493	*77.0%*	*0.841*
		Yes Increased		127	*24.3%*	51	*22.0%*	147	*23.0%*	
	Panic	No		381	*72.8%*	196	*84.5%*	510	*79.7%*	*0.000*
		Yes Increased		151	*28.9%*	36	*15.5%*	130	*20.3%*	
	Loneliness	No		315	*60.2%*	157	*67.7%*	437	*68.3%*	*0.003*
		Yes Increased		217	*41.5%*	75	*32.3%*	203	*31.7%*	
	Nervousness	No		301	*57.6%*	158	*68.1%*	409	*63.9%*	*0.004*
		Yes Increased		231	*44.2%*	74	*31.9%*	231	*36.1%*	
Sleep disorders	Insomnia	No		456	*87.2%*	207	*89.2%*	568	*88.8%*	*0.213*
		Yes Increased		76	*14.5%*	25	*10.8%*	72	*11.3%*	
	Shallow sleep	No		454	*86.8%*	211	*90.9%*	557	*87.0%*	*0.105*
		Yes Increased		78	*14.9%*	21	*9.1%*	83	*13.0%*	
	Nightmares	No		469	*89.7%*	207	*89.2%*	580	*90.6%*	*0.388*
		Yes Increased		63	*12.0%*	25	*10.8%*	60	*9.4%*	
	Insufficient sleep	No		466	*89.1%*	200	*86.2%*	564	*88.1%*	*0.749*
		Yes Increased		66	*12.6%*	32	*13.8%*	76	*11.9%*	
Aggression	Argue with others	No		388	*74.2%*	173	*74.6%*	468	*73.1%*	*0.888*
		Yes Increased		144	*27.5%*	59	*25.4%*	172	*26.9%*	
	Physical fight	No		500	*95.6%*	225	*97.0%*	608	*95.0%*	*0.220*
		Yes Increased		32	*6.1%*	7	*3.0%*	32	*5.0%*	
Positive emotion	Happiness	No		298	*57.0%*	128	*55.2%*	349	*54.5%*	*0.879*
		Yes Decreased		234	*44.7%*	104	*44.8%*	291	*45.5%*	
	Joy	No		272	*52.0%*	124	*53.4%*	344	*53.8%*	*0.650*
		Yes Decreased		260	*49.7%*	108	*46.6%*	296	*46.3%*	
	Feeling excitement	No		277	*53.0%*	138	*59.5%*	356	*55.6%*	*0.148*
		Yes Decreased		255	*48.8%*	94	*40.5%*	284	*44.4%*	

disorders (Quek *et al.*, 2019), higher levels of anxiety are than expected. Exacerbation of a pre-existing emotional distress among medical students due to COVID-19 were previously suggested (Ullah & Amin, 2020).

Gender differences observed in the current study suggest vulnerability of female medical students to emotional distress more than male students. Females are generally more susceptible to emotional changes due to the hormonal fluctuations that are part of their physiology. It can be expected, thus, that several chemical mediators have a potential of elevating emotional distress in females. Beyond biological considerations, the conservative gender roles present different expectations of behaviours based on gender. Previous research have emphasized the gender roles and traits (masculinity in particular) and explained part of the gender differences in emotional distress and coping mechanisms (Mayor, 2015). On the other hand, gender differences in emotional intelligence, test stress, coping and academic stress were also suggested to contribute to similar observations (Alzahem *et al.*, 2011; Babar *et al.*, 2015; Elsalem *et al.*, 2020). Our findings that female medical students self-reported higher rates of depression, anxiety, worry, nervousness, and panic, while male students reported higher rates of loneliness, are in line with the literature addressing such gender roles.

In Jordan, about 7% of medical students reported that they became obsessed with precautionary measures related to COVID-19 (Khasawneh *et al.*, 2020), while about half self-reported distance education as a main source of worry and stress. Such negative emotions were attributed to the learning and assessment models used during the pandemic as students were not familiar with distance learning (Elsalem *et al.*, 2020). The difference in prevalence estimates of distress in different studies may be attributed to several factors among which are the length of quarantine period, environment, contact with COVID-19 patients, and different coping styles of individuals.

Medical students who self-reported utilizing social media as a source of COVID-19 information more frequently reported lower levels of emotional distress compared to those who never utilized it for such. The role that social media can play in risk perception and dissemination of reliable information during pandemics could be critical (Albarrak *et al.*, 2019). While the information available about the pandemic may be a concern for COVID-19 infodemic among the general public, medical students seem to have utilized social media as a mitigation source to better understand the disease dynamics. This could have been reflected on the lower level of emotional distress reported among students who used social media more often. Medical students, therefore, by accessing social media, may be better equipped to avoid misinformation and to distinguish rumours from reality (Karasneh *et al.*, 2020). Still, our results contradict reports where young people tend to obtain a large amount of information from social media which can easily be a trigger for stress and anxiety (Qiu *et al.*, 2020). Assessment of the role of social media on medical students' emotional distress should be further investigated using both qualitative and quantitative methods.

It is important to note that, in the current study, all estimates were self-reported and that we did not use standardized tools. This could have called out for over-estimation of the prevalence rates and over presentation of reported emotional changes. The cross-sectional nature of the study limits temporality. It will be imperative for other research groups to include longitudinal aspects in their study design and to use standardized screening tools as well as clinical assessment among this vulnerable group.

Conclusion

Our results support the notion to screen for mental health problems among medical students and to invest in mental health infrastructures. Psychoeducation, and psychosocial support should be seriously considered within health education programs at medical schools and should be fine-tuned by gender. The role of social media within the context of a classical medical educational system should be further investigated and utilized as a mediating factor towards better mental health and psychosocial support.

Acknowledgements

The authors would like to express their gratitude to all medical students who helped in the conduct of this study and all personnel at the medical schools for their support.

Underlying data

In compliance with IRB guidelines specified for this research activity, data will be shared by the corresponding author following official request for research with clear objectives that is initially approved by the corresponding author.

Consent

Written informed consent for publication of the participants' details was obtained from the participants.

References

Al-Rabiaah A, Temsah MH, Al-Eyadhy AA, *et al.*: **Middle East Respiratory Syndrome-Corona Virus (MERS-CoV) associated stress among medical students at a university teaching hospital in Saudi Arabia.** *J Infect Public Health.* 2020; **13**(5): 687–691.
PubMed Abstract | Publisher Full Text | Free Full Text

Albarrak AI, Mohammed R, Al Elayan A, *et al.*: **Middle East Respiratory Syndrome (MERS): Comparing the knowledge, attitude and practices of different health care workers.** *J Infect Public Health.* 2019.
PubMed Abstract | Publisher Full Text | Free Full Text

Alzahem AM, Van Der Molen HT, Alaujan AH, *et al.*: **Stress amongst dental students: A systematic review.** *Eur J Dent Educ.* 2011; **15**(1): 8–18.
PubMed Abstract | Publisher Full Text

Babar MG, Hasan SS, Ooi YJ, *et al.*: **Perceived sources of stress among Malaysian dental students.** *Int J Med Educ.* 2015; **6**(126): 56–61.
PubMed Abstract | Publisher Full Text | Free Full Text

Chandratre S: **Medical Students and COVID-19: Challenges and Supportive Strategies.** *J Med Educ Curric Dev.* 2020; **7**: 238212052093505.
PubMed Abstract | Publisher Full Text | Free Full Text

Elsalem L, Al-Azzam N, Jumʾah AA, *et al.*: **Stress and behavioral changes with remote E-exams during the Covid-19 pandemic: A cross-sectional study among undergraduates of medical sciences.** *Ann Med Surg.* 2020; **60**: 271–279.
PubMed Abstract | Publisher Full Text | Free Full Text

Greenberg N: **Mental health of health-care workers in the COVID-19 era.** *Nat Rev Nephrol.* 2020; **16**(8): 425–426. Nature Research.
PubMed Abstract | Publisher Full Text | Free Full Text

Karasneh R, Al-Azzam S, Muflih S, *et al.*: **Media's effect on shaping knowledge, awareness risk perceptions and communication practices of pandemic COVID-19 among pharmacists.** *Res Social Adm Pharm.* 2020;
PubMed Abstract | Publisher Full Text | Free Full Text

Khasawneh AI, Humeidan AA, Alsulaiman JW, *et al.*: **Medical Students and COVID-19: Knowledge, Attitudes, and Precautionary Measures. A Descriptive Study From Jordan.** *Front Public Health.* 2020; **8**, 253.
PubMed Abstract | Publisher Full Text | Free Full Text

Kheirallah KA, Alsinglawi B, Alzoubi A, *et al.*: **The effect of strict state measures on the epidemiologic curve of covid-19 infection in the context of a developing country: A simulation from Jordan.** *Int J Environ Res Public Health.* 2020; **17**(18): 1–11.
PubMed Abstract | Publisher Full Text | Free Full Text

Kinder F, Harvey A: **Covid-19: The medical students responding to the pandemic.** *BMJ.* 2020; **369**: 1–2.
PubMed Abstract | Publisher Full Text

Lasheras I, Gracia-García P, Lipnicki DM, *et al.*: **Prevalence of anxiety in medical students during the covid-19 pandemic: A rapid systematic review with meta-analysis.** *Int J Environ Res Public Health.* 2020; **17**(18): 1–12. MDPI AG.
PubMed Abstract | Publisher Full Text | Free Full Text

Loch C, Kuan IBJ, Elsalem L, *et al.*: **COVID-19 and dental clinical practice: Students and clinical staff perceptions of health risks and educational impact.** *J Dent Educ.* 2020.
PubMed Abstract | Publisher Full Text

Mayor E: **Gender roles and traits in stress and health.** *Front Psychol.* 2015; **6**(JUN).
PubMed Abstract | Publisher Full Text | Free Full Text

O'Byrne L, Gavin B, McNicholas F: **Medical students and COVID-19: The need for pandemic preparedness.** *J Med Ethics.* 2020; **46**(9): 623–626.
PubMed Abstract | Publisher Full Text | Free Full Text

Pfefferbaum B, North CS: **Mental Health and the Covid-19 Pandemic.** *N Engl J Med.* 2020; **383**(6): 510–512.
PubMed Abstract | Publisher Full Text

Qiu J, Shen B, Zhao M, *et al.*: **A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: Implications and policy recommendations.** *Gen Psychiatr.* 2020; **33**(2): 100213. BMJ Publishing Group.
PubMed Abstract | Publisher Full Text | Free Full Text

Quek TTC, Tam WWS, Tran BX, *et al.*: **The global prevalence of anxiety among medical students: A meta-analysis.** *Int J Environ Res Public Health.* 2019; **16**(15). MDPI AG.
PubMed Abstract | Publisher Full Text | Free Full Text

Samrah SM, Al-Mistarehi AH, Aleshawi AJ, *et al.*: **Depression and coping among covid-19-infected individuals after 10 days of mandatory in-hospital quarantine, irbid, jordan.** *Psychol Res Behav Manag.* 2020; **13**: 823–830.
PubMed Abstract | Publisher Full Text | Free Full Text

Samrah SM, Al-Mistarehi AHW, Ibnian AM, *et al.*: **COVID-19 outbreak in Jordan: Epidemiological features, clinical characteristics, and laboratory findings.** *Ann Med Surg.* 2020; **57**: 103–108.
PubMed Abstract | Publisher Full Text | Free Full Text

Sindiani AM, Obeidat N, Alshdaifat E, *et al.*: **Distance education during the COVID-19 outbreak: A cross-sectional study among medical students in North of Jordan.** *Ann Med Surg .* 2020; **59**: 186–194.
PubMed Abstract | Publisher Full Text | Free Full Text

Talevi D, Socci V, Carai M, *et al.*: **Mental health outcomes of the covid-19 pandemic.** *Riv Psichiatr.* 2020; **55**3).
PubMed Abstract | Publisher Full Text

Ullah R, Amin S: **The psychological impact of COVID-19 on medical students [Letter].** *Psychiatry Res.* 2020; **288**(2): p. 113020. Elsevier Ireland Ltd.
PubMed Abstract | Publisher Full Text | Free Full Text

Vindegaard N, Eriksen Benros M: **COVID-19 pandemic and mental health consequences: Systematic review of the current evidence.** *Brain Behav Immun.* 2020.
PubMed Abstract | Publisher Full Text | Free Full Text

Wolf TM: **Stress, coping and health: enhancing well-being during medical school.** *Med Educ.* 1994; **28**(1): 8–17.
PubMed Abstract | Publisher Full Text

Open Peer Review

Current Peer Review Status: ✔ ✔ ✔

Version 2

Reviewer Report 15 June 2021

https://doi.org/10.5256/f1000research.56594.r85935

✔ **Tariq Kewan**
[1] Department of Internal Medicine, Cleveland Clinic Fairview Hospital, Cleveland, OH, USA
[2] Translational Hematology and Oncology, Cleveland Clinic, Cleveland, OH, USA

No further comments.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Oncology, COVID-19 treatment, Coagulopathy, Acute leukemia, blood disorders, critical care

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 01 June 2021

https://doi.org/10.5256/f1000research.56594.r85933

✔ **Nedal Alnawaiseh**
Department of Public Health, School of Medicine, University of Mutah, Al-Karak, Jordan

I approve this version.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Epidemiologist, Biostatician, Public health and research expertise.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 07 May 2021

https://doi.org/10.5256/f1000research.55277.r83592

Walid Alali
Department of Epidemiology and Biostatistics, Faculty of Public Health, Kuwait University, Safat, Kuwait

The manuscript present descriptive findings from a cross-sectional study conducted via a questionnaire tool to assess emotional distress during COVID-19 pandemic on medical students in Jordan. There were reports of significant increase in negative emotional mental health issues. The findings add to the scientific literature on mental health issues related to COVID-19 pandemic restrictions in a specific group of people.

My minor comments:

1. The probability sampling plan is not clear as authors mentioned "students were selected randomly". Needs explanation.

2. The questionnaire tool should be included as an appendix.

3. Please add a statistical/data analysis statement.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Epidemiology; Infectious Diseases; Public Health; Antimicrobial Resistance.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 29 April 2021

https://doi.org/10.5256/f1000research.55277.r83591

?

Tariq Kewan
[1] Department of Internal Medicine, Cleveland Clinic Fairview Hospital, Cleveland, OH, USA
[2] Translational Hematology and Oncology, Cleveland Clinic, Cleveland, OH, USA

In this article Kheirallah and colleagues studied the impact of COVID-19 pandemic on the medical student emotional distress using a self reported questionnaire. In addition Authors analyzed the impacts of social media utilization as a source of information on the the emotional factors, below are some comments to consider:

1. The authors used a self reported cross sectional design to analyze the outcomes, however targeted population size and response rates were not reported. It is also worth to mention the response rate by each different university.

2. Can the authors explain why they considered response rate of 20% to be sufficient, please cite a paper.

3. How the authors guaranteed that each participant will respond one time only?

4. Can you provide the time period of the study?

5. Authors need to provide the questionnaire used in the study to be published as a supplementary with the article.

6. The definition of different symptoms reported was not specified. For example what is the difference between anxiety and panic or worry and anxiety? This also will raise the question regarding participant understanding of the questions. Did the authors provide explanations for the participant to ensure understanding. Can the authors provide specific definition for each symptoms / disorder they reported, for example what is the dentition of insomnia?

7. Results are conflicting. In table 2 , 72.2% of all participant reported worry but at the same time 44.8% reported increased happiness. This will raise the concern of appropriate understanding of the participants.

8. Authors concluded that social media use may have a buffering effect on emotional distress which is wrong. This conclusion cant be made based on the study design provided. Authors just described the differences in the prevalence of different symptoms / diseases between three different groups based on the use of social media as a source of information. Other variables / confounders were not taken into consideration and this conclusion is not appropriate.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
No

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Oncology, COVID-19 treatment, Coagulopathy, Acute leukemia, blood disorders, critical care

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 29 Apr 2021

khalid kheirallah, Medical School of Jordan University of Science and Technology, Irbid, Jordan

We appreciate your opinion and feedback. Kindly note our response in line with the provided comments.
In this article Kheirallah and colleagues studied the impact of COVID-19 pandemic on the

medical student emotional distress using a self reported questionnaire. In addition Authors analyzed the impacts of social media utilization as a source of information on the the emotional factors, below are some comments to consider:

1. The authors used a self reported cross sectional design to analyze the outcomes, however targeted population size and response rates were not reported. It is also worth to mention the response rate by each different university.
   - **Thank you for this comment. We have updated the manuscript to state that the total population of medical students is 10,000. Out of the sample selected for this survey, a total of 3,000 as already stated, the response rate was added to the results section (46.8%).**

1. Can the authors explain why they considered response rate of 20% to be sufficient, please cite a paper.
   - **Thank you for this comment. We have a previous experience with this population and a response rate was less than 30%. Being conservative, we have decided that a 20% is suitable. A reference is already inserted for which we had a 20% response rate.**
1. How the authors guaranteed that each participant will respond one time only?
   - **Thank you for this valuable note. We have no guarantee that each student will fill the questionnaire only once. But we have no reason to believe that medical students will fill more than one time.**
1. Can you provide the time period of the study?
   - **Thank you for this comment. The study stated, under methods, that this survey was conducted between March 17 and 20, 2020.**
1. Authors need to provide the questionnaire used in the study to be published as a supplementary with the article.
   - **Thank you for this note. We have now updated the supplementary materials to include the questionnaire.**
1. The definition of different symptoms reported was not specified. For example what is the difference between anxiety and panic or worry and anxiety? This also will raise the question regarding participant understanding of the questions. Did the authors provide explanations for the participant to ensure understanding. Can the authors provide specific definition for each symptoms / disorder they reported, for example what is the dentition of insomnia?
   - **Thank you for this note. We have defined each term as self-reported. It was meant to screen and prioritize potential mental health issues using self-reported responses. This was stated as part of the limitations.**
1. Results are conflicting. In table 2 , 72.2% of all participant reported worry but at the same time 44.8% reported increased happiness. This will raise the concern of appropriate understanding of the participants.
   - **Thank you for this note. The potential overlap is possible given the way the study was conducted. It may be true that students are worried about their educational process at the early stages of the pandemic, still feel happy being able to spend more time with their families. This issue needs further investigation using qualitative study design as positive and negative emotions are possible given the circumstances of uncertainties.**

- **Qualitative investigations of the study results was suggested and recommended as part of the study's future directions in multiple locations.**

1. Authors concluded that social media use may have a buffering effect on emotional distress which is wrong. This conclusion cant be made based on the study design provided. Authors just described the differences in the prevalence of different symptoms / diseases between three different groups based on the use of social media as a source of information. Other variables / confounders were not taken into consideration and this conclusion is not appropriate.

- **Thank you for this note. Social media utilization has been suggested to "moderate" the relationship between multiple variables and mental health issues. As such, our results of potential differences in mental health variables by social media utilization *may* suggest a buffering effect. Future studies, including follow-up designs are then needed to investigate this relationship. This is what was suggested in the conclusion of the study. As such, the effect of social media utilization may, or may not, be a factor in the buffering suggested. The conclusion, as such, has been worded to reflect this. Edits were made.**

Competing Interests: None.

Reviewer Report 22 April 2021

https://doi.org/10.5256/f1000research.55277.r83589

Nedal Alnawaiseh
Department of Public Health, School of Medicine, University of Mutah, Al-Karak, Jordan

This study addressed a critical point, mental health, which is considered a taboo within conservative societies. The authors addressed this issue and clearly clarified its limitation in the manuscript.

I found it really interesting to cover a spectrum of indicators that assess, or screen, for potential mental health problems among medical students. The question is, then, how could this reflect on the population? Any suggestions?

Also, medical students are more likely to seek mental health problems if they have access to a clinic. But this is not the norm in conservative societies like Jordan. It may be considered a limitation if the authors did not assess access to mental health professional services. On the same point, how will the screening tools for the positive and negative domains investigated reflect the true problem given that self-reported mental health depression, for example, may be overestimating the actual values. Any thoughts on what the authors expect the true need for

mental health advising and counseling among this population?

The mental health status of medical students is biased by multiple factors that were not addressed in the study. How will the authors direct future research considering such biases? For example, academic achievement and substance use.

On the same page of future research, will next research question encounters worry? Depression? Anxiety? Or what domain?

It seems that gender is playing a major role in defining mental health of medical students. Why didn't the authors do a regression analysis to identify the role of gender? This may be due to the fact that the tools used limit further statistical tests? Any other thoughts?

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Epidemiologist, Biostatician, Public health and research expertise.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 29 Apr 2021

khalid kheirallah, Medical School of Jordan University of Science and Technology, Irbid, Jordan

The authors much appreciate your valuable feedback and thank you for the approval of this manuscript to be considered for publication at F1000Research. Below please note our response in line with your feedback.

This study addressed a critical point, mental health, which is considered a taboo within conservative societies. The authors addressed this issue and clearly clarified its limitation in the manuscript.

- **Thank you for this positive feedback and added value of the paper.**

I found it really interesting to cover a spectrum of indicators that assess, or screen, for potential mental health problems among medical students. The question is, then, how could this reflect on the population? Any suggestions?

- **This study addressed such spectrum in order to fine-tune needs of this valuable population. As indicated in our submission, one can simply identify the major mental ill-health concerns as being self-identified among participants by gender and by year level. Top problems could be further explored using future research as indicated in the study. We never aimed to diagnose mental ill-health but rather point to the potential problem among this group. If 10% of self-reported issues are considered high-risk, then this could further identify where interventions could be considered and where the research focus should be.**
- **As for the population, the results reflect an image that reflects on the general population. Our focus then should also consider the general public and other subpopulations.**

Also, medical students are more likely to seek mental health problems if they have access to a clinic. But this is not the norm in conservative societies like Jordan. It may be considered a limitation if the authors did not assess access to mental health professional services. On the same point, how will the screening tools for the positive and negative domains investigated reflect the true problem given that self-reported mental health depression, for example, may be overestimating the actual values. Any thoughts on what the authors expect the true need for mental health advising and counseling among this population?

- **It is a major limitation that we did not consider seeking medical help. But this is an issue that was suggested by reviewers of the questionnaire to exclude as it will not be an accurate measure for this taboo-related issue.**
- **As stated earlier, we expect that our screening self-reported results address provide 10% of self-reported issues be an actual estimate then we have an idea about the impact of mental health issues among medical students.**

The mental health status of medical students is biased by multiple factors that were not addressed in the study. How will the authors direct future research considering such biases? For example, academic achievement and substance use.

- **The top 5 mental health issues identified in the manuscript could be further investigated and explored using fine-tuned questionnaires that consider other potential confounders. This is not added to the manuscript and will be part of the recommendations.**

On the same page of future research, will next research question encounters worry? Depression? Anxiety? Or what domain?

- **Apparently this research pointed to the top 5 mental health issues (for each gender and year level). These could further be explored using follow-up studies.**

This was indicated in the study.

It seems that gender is playing a major role in defining mental health of medical students. Why didn't the authors do a regression analysis to identify the role of gender? This may be due to the fact that the tools used limit further statistical tests? Any other thoughts?

- **While a regression is a good fit for this paper, we wanted to only shed the light on the major mental health issues and point out to the policy makers of the major ones to be considered in the medical curriculum and medical services provided to students. We did not feel that adding a regression model for a self-reported mental health issue is a good fit as it may not reflect validity of self-reported depression, for example. Future research utilizing standardized screening tools may use advanced statistical analyses and have more variables relevant to mental health.**

Competing Interests: None.