



Awareness regarding COVID-19 and its effects on mental health among pre-professional health sciences students at King Saud bin Abdulaziz University for health sciences in Riyadh and Jeddah, Saudi Arabia

Zackary Alghamdy¹ · Ashwaq Alshahrani¹ · Ismail Memon² · Aslam Khan³ · Muhammad Anwar Khan¹ · Yazeed Alrayani⁴ · Fulwah Alfawzan⁵ · Syed Faisal Zaidi^{1,6}

Received: 10 November 2021 / Accepted: 14 May 2022 / Published online: 27 May 2022

© The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature 2022, corrected publication 2022

Abstract

In light of the outbreak caused by the COVID-19 and its impact on the physical and mental wellbeing, we explored the consequences of this pandemic on the mental health among pre-professional health sciences students and their awareness regarding the virus. A descriptive observational cross-sectional study was conducted at King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) in Jeddah and Riyadh campuses. Data was collected from 770 participants using an online questionnaire, and statistical analysis was performed using SPSS. The majority of the participants (87.5%) considered governmental authorities as their main source of information, and therefore, they were up to date on the general information regarding COVID-19. For findings on mental health, it was found that 61.9% were exhibiting variant degrees of depression, as well as 50% expressing signs of extremely severe anxiety. However, 50.9% of the participants expressed no signs of stress during this pandemic. An association was found between gender and mental health showing females to have higher tendencies to express signs of extremely severe depression, anxiety, and stress. An association was also found between parents' marital status and anxiety. Analysis revealed that participants with separated parents were the least among the participants to show no signs of anxiety, as well as reporting the highest numbers in the "extremely severe" anxiety category. With the increased awareness and higher than normal levels of the investigated mental illnesses, we advise that proper action should be considered to address this issue.

Keywords COVID-19 · Coronavirus · Mental health · Depression · Anxiety · Stress · Quarantine · Pandemic · Health science students

Responsible Editor: Lotfi Aleya

✉ Syed Faisal Zaidi
sfaisalhz@gmail.com

¹ College of Medicine, King Saud Bin Abdulaziz University for Health Sciences, Jeddah, Saudi Arabia

² College of Science and Health Professions, King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia

³ Riphah Institute of Pharmaceutical Sciences, Riphah International University, 13KM Raiwind Road, Lahore, Pakistan

⁴ College of Medicine, King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia

⁵ College of Dentistry, King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia

⁶ Faculty of Eastern Medicine, Hamdard University, Madinat al-Hikmah, Hakim Mohammad Said Road, Karachi 74600, Pakistan

Introduction

The emergence and re-emergence of pathogens is a major and constant global threat to the public's physical and psychological health (Gao 2018). The recent emergence of the novel coronavirus COVID-19 poses a similar threat, putting the entire world's general health on the line. In late December 2019, several cases of pneumonia of unknown etiology were reported in Wuhan, the capital of Hubei province, Central China. The initial clinical presentations were greatly resembling viral pneumonia, and several cases were found to possibly be epidemiologically linked to the Huanan seafood and wet animal market in Wuhan using a surveillance mechanism designed for "pneumonia of unknown etiology" that was established in the wake of the 2003 SARS-CoV outbreak in order to allow timely identification of such novel pathogens (Li et al. 2020; Rothan and Byrareddy 2020). On January 3, 2020, with the use of next-generation sequencing of bronchoalveolar lavage fluid samples, a novel coronavirus was confirmed by the Chinese Center for Disease Control and Prevention (CDC) to be the cause of this disease. On January 7, 2020, the World Health Organization (WHO) gave it the provisional name 2019 novel coronavirus (2019-nCoV) until the International Committee on Taxonomy of Viruses (ICTV) termed it the SARS-CoV-2. The illness associated with the SARS-CoV-2 was then given the name 2019 novel coronavirus disease (COVID-19) by WHO (Huang et al. 2020; Lu et al. 2020; Gorbalenya et al. 2020).

Coronaviruses have caused global disturbances over the past decades and jeopardized the general health of our world populations. Coronaviruses are enveloped RNA viruses that can cause respiratory, enteric, hepatic, and neurologic diseases. They are widely distributed in humans, other mammals, and birds. Six coronavirus species are known to cause human disease, 4 of which — 229E, NL63, OC43, and HKU1 — are prevalent and typically cause common cold symptoms in immunocompetent individuals (Zhu et al. 2020). The other two strains — severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) — have been associated with severe and fatal illnesses. SARS-CoV is the agent that caused an outbreak of severe respiratory disease during the period 2002–2003 in China, whereas MERS-CoV is responsible for an ongoing outbreak of severe respiratory distress in the Middle East since 2012. Considering the high prevalence of the coronaviruses, the large genetic diversity and frequent genome recombinations, as well as the increasing human-animal interface activities, novel coronaviruses that are transmissible to humans from their

mammalian hosts are likely to emerge periodically due to cross-species spillover infections (Su et al. 2016; Li et al. 2020).

The emergence of COVID-19 has attracted global attention as being a serious threat to public health since it resulted in a worldwide outbreak that led WHO to declare on January 30, 2020 COVID-19 to be a public health emergency of international concern (PHEIC) on. By March 11, 2020, as a result of the rapid increase in the number of cases across continents, WHO declared COVID-19 a pandemic, and it has been recognized to be very contagious and highly spreadable (Dong et al. 2020; World Health Organization (WHO) 2021). Compared to other coronaviruses outbreaks that burdened the world in recent decades — SARS in 2003 and MERS-CoV in 2012 — none of them hit the globe on such a large scale and resulted in the same number of cases and fatalities (Casella et al. 2022). As of July 28, 2020, 7 months after the first reported case, more than 16.3 million cases of COVID-19 were reported worldwide, with roughly 650,000 confirmed deaths (mortality rate \approx 3.98%) (WHO 2020b). Given the magnitude and severity of the ongoing COVID-19 pandemic, governments around the world have utilized drastic measures to slow down the rapid spread of the disease. The world population was demanded to abide by these measures in order to overcome this adversity. These measures included issuing new nationwide guidelines including isolation of suspected cases, curfews, lockdowns, and social distancing.

Evidently, sudden widespread outbreaks of infectious diseases are usually associated with psychological distress and symptoms of mental illness. In the early phase of SARS outbreak, a range of psychiatric morbidities, including persistent depression, anxiety, panic attacks, psychomotor excitement, psychotic symptoms, delirium, and even suicidality, was reported (Xiang et al. 2020). The measures taken and enforced by the governments worldwide to stop the rapid spread of COVID-19, along with the current pandemic state, are guaranteed to cause psychological distress and negatively impact the mental health of the general population around the world (Bao et al. 2020). Therefore, a rise in rates of anxiety, depression, obsessive-compulsive disorder, and other psychological disorders is expected to happen among the general population, especially in those with preexisting mental conditions. In fact, the public has begun showing anxiety-related behaviors through the recent hoarding and stockpiling of resources, and the panic purchasing of masks, sterilization products, and other personal protective equipment (PPE), which led to a significant shortage in the above-mentioned supplies (WHO 2020a; Shigemura et al. 2020).

The increase in psychological symptoms during the COVID-19 pandemic could be attributed to several causative factors. For instance, the seriousness of the situation and

the fear of death through contracting the virus to oneself or loved ones are critical factors. Also, the unpredictability and uncertainty the future holds can heighten concern and stress among masses. Furthermore, people who are quarantined are expected to experience feelings of boredom, loneliness, anger, and stress due to the disruption of traditional social interventions and loss of face-to-face connections (Zandifar and Badrfam 2020). Furthermore, the magnitude of the current COVID-19 pandemic predicts a major worldwide economic decline, already seen in parts of the world (Madhav et al. 2017). This will, unquestionably, have its weight on the mental health and wellbeing of the world's population as it can result in income instability and unemployment for individuals. As revealed by Chang et al. who looked into multiple studies done on past economic crises in multiple countries, it was evident that there was an increased prevalence of depression, anxiety, and suicide during these times (Chang et al. 2013).

The psychological consequences of a pandemic and the measures taken in response have become evident to us through previous outbreaks and pandemics. It has been pointed out that the magnitude and widespread of COVID-19 could lead to a true mental health crisis, especially in countries with high numbers of cases (Rajkumar 2020). Therefore, it is of necessity that we take into consideration the appropriate measures to assess and assist the mental health of the general population, especially endangered groups. This includes mental health patients, low-income citizens, and even students. As shown in a report conducted by The Association for University and College Counseling Center Directors (AUCCCD) annual survey, college students are at greater risk of developing psychological disorders as compared to the general population. The prevalence of anxiety among college students was stated to be as great as 41.6% followed by depression at 36.4% (Mistler et al. 2012). Additionally, according to a study that investigated levels of stress, anxiety, and depression in the initial stage of COVID-19 outbreak in north Spain, college students (aged 18–25) showed higher mean levels than any other age groups, which was suggested to be due to the stress students experienced in the sudden move from face to face classes to virtual classes and the urge to cope rapidly with the online learning environment (Ozamiz-Etxebarria et al. 2020). Moreover, a study in China that explored anxiety levels among Chinese university students during COVID-19 outbreak showed that medical students compared to other college students experienced higher rates of anxiety (Wang and Zhao 2020). In addition to that, according to a study conducted on medical students in China in 2020, it was revealed that 24.9% of medical students experienced some form of anxiety ranging from mild to severe due to the ongoing COVID-19 pandemic (Cao et al. 2020). Considering the above-mentioned risk factors, health

students are considered as a high-risk group making them more susceptible to mental stress during the current worldwide pandemic.

Therefore, the aim of this study is to understand the effects of COVID-19 pandemic and its consequences on the mental health of pre-professional health sciences students, in order to assist the university in providing the appropriate mental care for its students.

Methodology

Study design and sampling

This was a descriptive observational cross-sectional study, where a multiple-choice questionnaire was used to target pre-professional health sciences students in College of Science and Health Professions (COSHP) at KSAU-HS in Jeddah and Riyadh campuses, Saudi Arabia. COSHP is composed of 2 years studying basic science and health subjects; therefore, the student sample is divided into first year students and second year students both male and female, except for nursing students who are all female.

Development of the questionnaire

The questionnaire was written in English then translated to Arabic as it is the national language in Saudi Arabia. Then, it was distributed among students through social networks as a link in Google forms. The survey was divided into three parts: the first part contained questions regarding the general background of the participants, the second part was questions regarding the awareness of COVID-19, the third part was questions to assess depression, anxiety, and stress levels obtained through the Depression Anxiety Stress Scales (DASS-21).

Estimated sample size

The total number of COSHP students at the time of conducting the research was approximately about 2838, where 1723 (60.7%) students were enrolled in Riyadh campus and 1115 (39.3%) students were enrolled in Jeddah campus. Convenience sampling technique was used, and COSHP students enrolled in both Jeddah and Riyadh campus received the link to the online questionnaire. The required minimum sample size was determined to be 601, with 315 students in Riyadh campus and 286 students in Jeddah campus which was estimated at the 95% confidence level with an estimated 50% response distribution and a margin of error of $\pm 5\%$. Sample size was calculated by Raosoft® website (<http://www.raosoft.com/samplesize.html>).

Statistical analysis

Data analysis was performed by using SPSS version 20.0 after entering them into the Microsoft Excel program. Frequency, percentage, and bar graph were conducted for qualitative variable presentation, and quantitative variables were presented as mean and standard deviation. Chi-square tests were used to present data comparison. The dependent variables are level of awareness of COVID-19 and level of anxiety and depression. The independent variables are gender and campuses. p -value of < 0.05 was considered as significant. Awareness was measured by using a point-based system where each question was allocated 1 point for correct answers and zero points for incorrect answer. The percentage of correct answers was calculated, and Blooms cut off points were used to determine the level of awareness. A score of 80–100% corresponded to

high level of awareness, 60–80% denoted moderate level of awareness, and those that scored 59% and below were considered as having a low level of awareness.

Results

Basic information

The basic information of the participants is summarized in Table 1. The total number of participants in the study was 770 students. Riyadh campus students constituted 57.01% while Jeddah campus students constituted 42.99%. About half of the participants (51.17%) have just finished their first year in COSHP, while the other half (48.83%) have just finished their second year. The collected sample consisted of 47.14% male participants and 52.86% female participants.

Table 1 Mean and standard deviations (SD) of participants' demographics

Age	<i>N</i>	Mean	Std. Dev
	770	19.35	1.025
		<i>n</i>	%
At which KSAU-HS campus do you currently study?	Riyadh campus	439	57.01
	Jeddah campus	331	42.99
Which year have you just finished?	Just finished 1st year in COSHP	394	51.17
	Just finished 1st year in COSHP	376	48.83
Gender	Male	363	47.14
	Female	407	52.86
Marital status of parents	Married	655	85.06
	Divorced	42	5.45
	Separated	38	4.94
	Widowed	35	4.55
Is any family member's occupation related to health care?	Yes	289	37.53
	No	481	62.47
	Total	770	100
What is your major?	Medicine	309	40.18
	AMS (Not specialized yet)	159	20.68
	Nursing	91	11.83
	Dentistry	55	7.15
	Pharmacy	55	7.15
	Health Informatics	20	2.60
	Emergency Medical services	17	2.21
	Respiratory Therapy	15	1.95
	Occupational Therapy	15	1.95
	Anesthesia Technology	9	1.17
	Cardiovascular Technology: ECVT	7	0.91
	Radiology	6	0.78
	Cardiovascular Technology: ICVT	5	0.65
	Clinical Laboratory Sciences	4	0.52
	Clinical Nutrition	2	0.26
	Total	769	100

Regarding marital status of participants' parents, 85.06% were found to be primarily married, followed by 5.45% being divorced, followed by 4.94% of separated parents then 4.55% of widowed parents. Moreover, only 37.53% of participants' family members were found to have an occupation related to healthcare. The majority of the participants (40.18%) were found to be majoring in medicine, followed by 20.68% in applied medical sciences (not specialized yet), and 11.83% in nursing. The remaining third of the participants' majors varied between dentistry, pharmacy, emergency medical services, and other specialties.

Awareness regarding COVID-19

The sources from which the participants obtained their information about COVID-19 are illustrated in Fig. 1. As shown in the table, 87.5% of the participants considered governmental authorities to be their source of information regarding the COVID-19 pandemic. However, a considerable proportion (63.9%) also chose social media as another source of information. Only 9.1% of the participants were not keeping up with the current situation.

Awareness regarding the novel coronavirus is demonstrated in Table 2. According to the collected data, the majority of the participants considered COVID-19 to be highly infectious. In regard to the mortality of COVID-19 virus among infectious diseases, the participants showed uncertainty in regard to the mortality of the disease with answers varying from agreeing to disagreeing with the statement. The majority of the participants agreed on physical contact to be the main mode of transmission of COVID-19.

Moreover, the participants reported different perceptions regarding the need of hospitalizations for the majority of COVID-19 patients; however, the majority agreed that severe cases of COVID-19 are in need for mechanical ventilation. The majority of participants reported a neutral opinion to the possibility of a COVID-19 vaccine being available within the next couple of months. A similar attitude was reported regarding the effectiveness of hydroxychloroquine and remdesivir, as 68.2% and 69.4% reported neutral opinion about the effectiveness of hydroxychloroquine and remdesivir respectively.

Awareness regarding the effective measures against COVID-19 is summarized in Fig. 2. The majority of the participants agreed that all the following preventative measures including social distancing (97.7%), hand hygiene (97%), avoiding handshakes (89.9%), the use of personal protective equipment (86.5), and the application of quarantine, curfew, and travel ban laws are effective measures against the novel coronavirus.

Awareness regarding the common symptoms of COVID-19 infection is summarized in Fig. 3. The majority of the participants seemed to agree that shortness of breath (96.1%), fever (89.7%), and cough (80.6%) are common symptoms of COVID-19.

As explained in Fig. 4 regarding the predictors of complicated cases of COVID-19, the majority of the participants (92.7%) believed that existing respiratory conditions such as asthma or chronic obstructive pulmonary disease (COPD) could possibly complicate COVID-19 infection. Moreover, 76.9% of the participants believed that immunodeficiency has the potential to complicate COVID-19 cases. Age was also a leading factor with 70.1% of the participants choosing age being above 65 to be a risk factor for

Fig. 1 Participants' sources of information on COVID-19 (%)

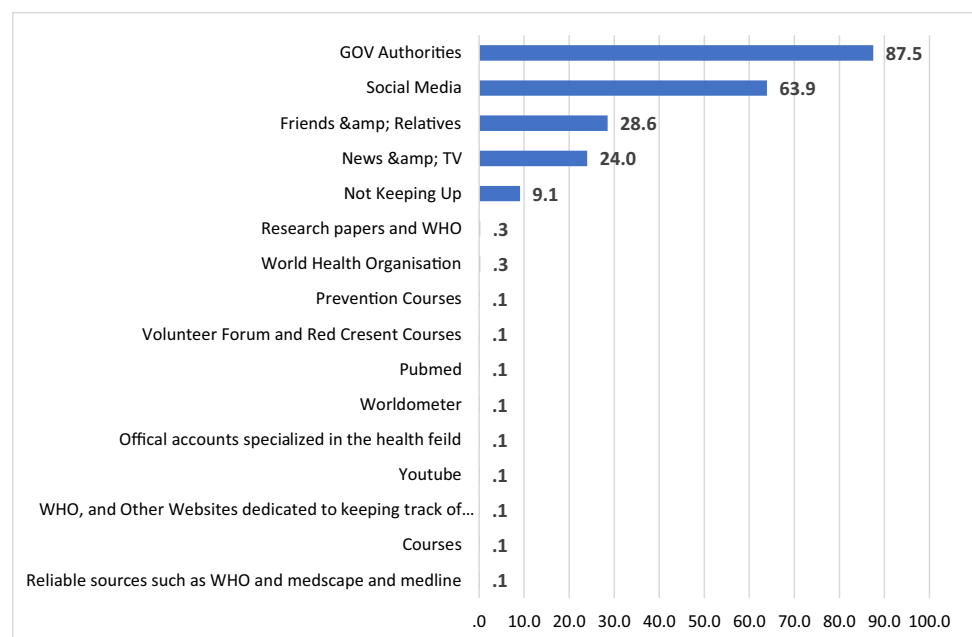


Table 2 Five-point Likert scale assessing participants' awareness on COVID-19

		<i>n</i>	%
COVID-19 is highly infectious	Strongly agree	559	72.6
	Agree	179	23.2
	Neutral	19	2.5
	Disagree	12	1.6
	Strongly disagree	1	.1
COVID-19, in terms of infectious diseases, has a high mortality rate	Strongly agree	79	10.3
	Agree	139	18.1
	Neutral	169	21.9
	Disagree	243	31.6
	Strongly disagree	140	18.2
Most common method of transmission for COVID-19 is physical contact	Strongly agree	345	44.8
	Agree	240	31.2
	Neutral	85	11.0
	Disagree	70	9.1
	Strongly disagree	30	3.9
Majority of COVID-19 patients need hospitalization	Strongly agree	95	12.3
	Agree	137	17.8
	Neutral	192	24.9
	Disagree	242	31.4
	Strongly disagree	104	13.5
Severe COVID-19 patients need ventilation	Strongly agree	309	40.1
	Agree	242	31.4
	Neutral	153	19.9
	Disagree	34	4.4
	Strongly disagree	32	4.2
A COVID-19 vaccination will be readily available in the next couple of months	Strongly agree	58	7.5
	Agree	174	22.6
	Neutral	350	45.5
	Disagree	124	16.1
	Strongly disagree	64	8.3
Hydroxychloroquine is an effective treatment against COVID-19	Strongly agree	17	2.2
	Agree	65	8.4
	Neutral	525	68.2
	Disagree	107	13.9
	Strongly disagree	56	7.3
Remdesivir is an effective treatment against COVID-19	Strongly agree	27	3.5
	Agree	89	11.6
	Neutral	534	69.4
	Disagree	85	11.0
	Strongly disagree	35	4.5
	Total	770	100.0

further complication of the disease. About a third of the participants chose diabetes and hypertension as contributing factors. Other factors such as heart disease and vitamin D deficiency were listed at lower percentages.

Overall awareness level and its association with mental health

The overall awareness regarding COVID-19 was measured and allocated according to Blooms cut off points. Table 3 shows 23.4% of the participants having low levels of

Fig. 2 Participants' responses on the effectiveness of preventative measures against COVID-19

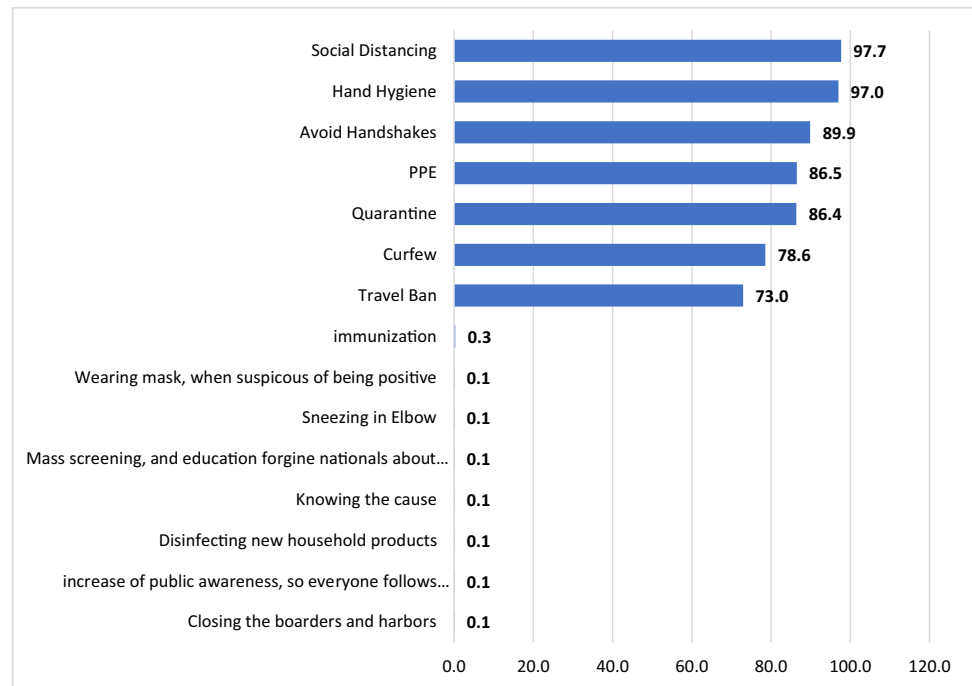
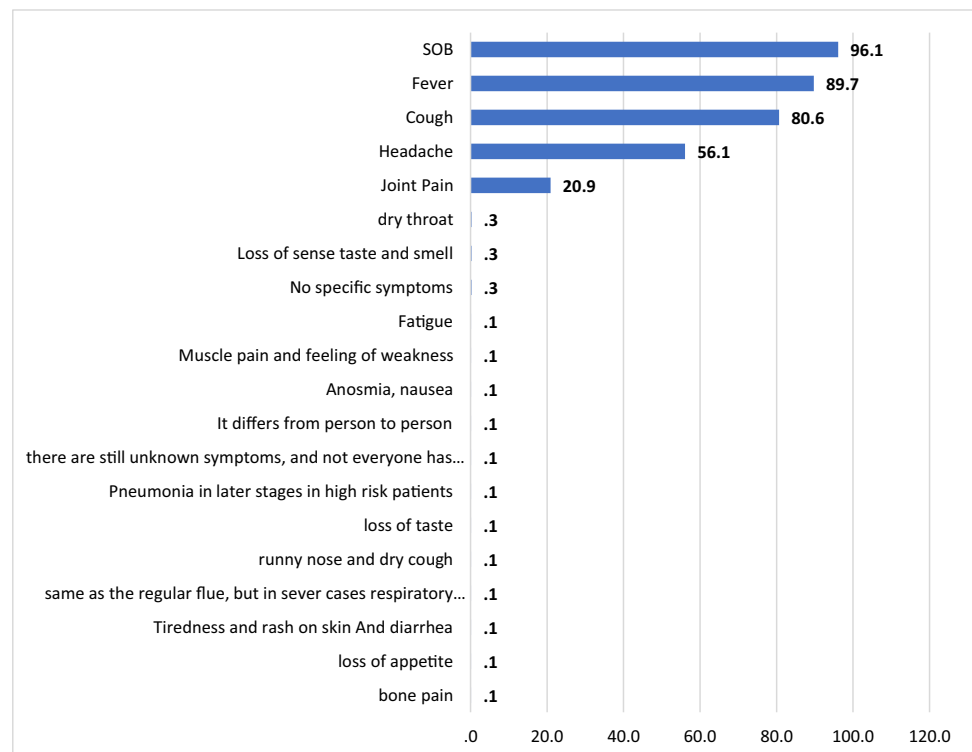


Fig. 3 Participants' awareness on common COVID-19 symptoms



awareness, 64.5% moderate levels of awareness, and 12.1% with high levels of awareness. Table 4 suggests no significant association between level of awareness and mental illness.

COVID-19 impact on mental health

Tables 5 and 6 explain in detail the prevalence of depression, anxiety, and stress among pre-professional health students according to the DASS-21 criteria. As seen in Table 6, only

Fig. 4 Participants’ responses on predictors for complicated COVID-19 cases

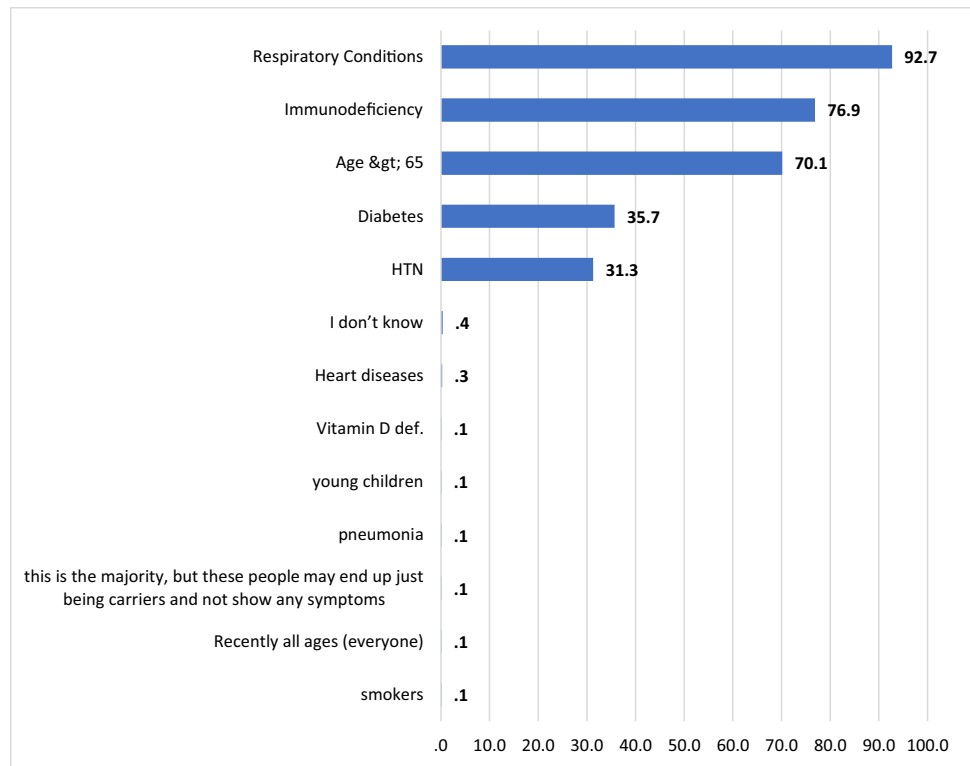


Table 3 Level of awareness regarding COVID-19

	Frequency	Percent
Low	180	23.4
Moderate	497	64.5
High	93	12.1

38.1% of the participants declared no signs of depression. The remaining participants showed variable degrees of depression with about a third of the sample size (27.4%) showing signs of extremely severe depression. The data also detected a substantial rate of extremely severe anxiety accounting for half the sample size (50.0%), while only 24.7% expressed no signs of anxiety. Moreover, half the participants (50.9%) stated they have no signs of stress during

Table 4 Levels of depression, anxiety, and stress analyzed across awareness levels using chi-square test

		Normal		Mild		Moderate		Severe		Extremely severe		p
		n = 293	%	n = 79	%	n = 126	%	n = 61	%	n = 211	%	
Depression	Awareness											0.326*
	Low	71	39.4	20	11.1	29	16.1	14	7.8	46	25.6	
	Moderate	192	38.6	54	10.9	84	16.9	38	7.6	129	26.0	
	High	30	32.3	5	5.4	13	14.0	9	9.7	36	38.7	
Anxiety	Awareness											0.110*
	Low	47	26.1	13	7.2	23	12.8	11	6.1	86	47.8	
	Moderate	126	25.4	50	10.1	32	6.4	41	8.2	248	49.9	
	High	17	18.3	12	12.9	5	5.4	8	8.6	51	54.8	
Stress	Awareness											0.372*
	Low	92	51.1	18	10.0	20	11.1	14	7.8	36	20.0	
	Moderate	257	51.7	45	9.1	51	10.3	56	11.3	88	17.7	
	High	43	46.2	6	6.5	6	6.5	14	15.1	24	25.8	

*Chi-square

Table 5 Participants' responses on the DASS-21 questionnaire, which is used to assess levels of depression, anxiety and stress

Impact on mental health of COVID-19	0	1	2	3
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
I found it hard to wind down	328 (42.6)	229 (29.7)	119 (15.5)	94 (12.2)
I was aware of dryness of my mouth	539 (70)	137 (17.8)	60 (7.8)	34 (4.4)
I couldn't seem to experience any positive feeling at all	349 (45.3)	241 (31.1)	99 (12.9)	81 (10.5)
I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion)	639 (83)	92 (11.9)	22 (2.9)	17 (2.2)
I found it difficult to work up the initiative to do things	359 (46.6)	207 (26.9)	116 (15.1)	88 (11.4)
I tended to over-react to situations	449 (58.3)	196 (25.5)	73 (9.5)	52 (6.8)
I experienced trembling (e.g., in the hands)	629 (81.7)	84 (10.9)	40 (5.2)	17 (2.2)
I felt that I was using a lot of nervous energy	397 (51.2)	158 (20.5)	121 (15.7)	94 (12.2)
I was worried about situations in which I might panic and make a fool of myself	457 (59.4)	152 (19.7)	84 (10.9)	77 (10)
I felt that I had nothing to look forward to	385 (50)	162 (21)	120 (15.6)	103 (13.4)
I found myself getting agitated	289 (37.5)	215 (27.9)	148 (19.2)	118 (15.3)
I found it difficult to relax	367 (47.7)	199 (25.8)	104 (13.5)	100 (13)
I felt down-hearted and blue	264 (34.3)	247 (32.1)	119 (15.5)	140 (18.2)
I was intolerant of anything that kept me from getting on with what I was doing	406 (52.7)	200 (26)	92 (11.9)	72 (9.4)
I felt I was close to panic	547 (71)	121 (15.7)	48 (6.2)	54 (7)
I was unable to become enthusiastic about anything	354 (46)	202 (26.2)	108 (14)	106 (13.8)
I felt I wasn't worth much as a person	509 (66.1)	121 (15.7)	71 (9.2)	69 (9)
I felt that I was rather touchy	451 (58.6)	166 (21.6)	89 (11.6)	64 (8.3)
I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat)	529 (68.7)	144 (18.7)	51 (6.6)	46 (6)
I felt scared without any good reason	507 (65.8)	149 (19.4)	58 (7.5)	56 (7.3)
I felt that life was meaningless	462 (60)	134 (17.4)	79 (10.3)	95 (12.3)

0 Did not apply to me at all, 1 Applied to me to some degree, or some of the time, 2 Applied to me to a considerable degree, or a good part of time, 3 Applied to me very much, or most of the time

Table 6 Prevalence of depression, anxiety, and stress based on severity levels

DASS 21 (<i>n</i> = 770)	Depression		Anxiety		Stress	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Normal	293	38.1	190	24.7	392	50.9
Mild	79	10.3	75	9.7	69	9.0
Moderate	126	16.4	60	7.8	77	10.0
Severe	61	7.9	60	7.8	84	10.9
Extremely Severe	211	27.4	385	50.0	148	19.2

this pandemic, while the others gave variable signs of mild, moderate, severe, and extremely severe stress.

The association between gender and mental illness

Table 7 summarizes the results of the chi-square test of independence between students' gender and mental illness. Looking at all three categories of the DASS-21 survey — depression, anxiety, and stress — a significant difference is found between genders. As demonstrated, in the depression category (p -value = 0.008), the biggest difference is

noted in the “extremely severe” category of depression with $n = 79$ (21.8%) being males and $n = 132$ (32.4%) being females. Likewise, in terms of anxiety (p -value = 0.006), more females $n = 220$ (54%) appeared to be showing signs of extremely severe anxiety than males $n = 165$ (45.5%). Although, there was also a notable difference in the category “severe” in anxiety with males $n = 38$ (10.5%) being more severely anxious than females $n = 22$ (5.4%). Lastly, the number of females in the stress category extremely severe was almost twice that of males with $n = 93$ (22.2%) and $n = 55$ (15.2%) respectively.

Table 7 Levels of depression, anxiety and stress analyzed across genders using chi-square

		Normal		Mild		Moderate		Severe		Extremely severe		<i>p</i> -value
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Depression category	Male	153	42.1%	37	10.2%	68	18.7%	26	7.2%	79	21.8%	0.008
	Female	140	34.4%	42	10.3%	58	14.3%	35	8.6%	132	32.4%	
	Total	293	38.1%	79	10.3%	126	16.4%	61	7.9%	211	27.4%	
Anxiety category	Male	102	28.1%	35	9.6%	23	6.3%	38	10.5%	165	45.5%	0.006
	Female	88	21.6%	40	9.8%	37	9.1%	22	5.4%	220	54.1%	
	Total	190	24.7%	75	9.7%	60	7.8%	60	7.8%	385	50.0%	
Stress category	Male	200	55.1%	30	8.3%	33	9.1%	45	12.4%	55	15.2%	0.031
	Female	192	47.2%	39	9.6%	44	10.8%	39	9.6%	93	22.9%	
	Total	392	50.9%	69	9.0%	77	10.0%	84	10.9%	148	19.2%	

Chi-square test

Table 8 Levels of depression, anxiety, and stress analyzed across parents’ marital status using Fisher’s exact test

		Normal		Mild		Moderate		Severe		Extremely severe		<i>p</i> -value
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Depression category	Married	252	38.5%	69	10.5%	108	16.5%	51	7.8%	175	26.7%	0.178
	Divorced	16	38.1%	3	7.1%	4	9.5%	1	2.4%	18	42.9%	
	Separated	10	26.3%	4	10.5%	6	15.8%	4	10.5%	14	36.8%	
	Widowed	15	42.9%	3	8.6%	8	22.9%	5	14.3%	4	11.4%	
	Total	293	38.1%	79	10.3%	126	16.4%	61	7.9%	211	27.4%	
Anxiety category	Married	167	25.5%	62	9.5%	55	8.4%	46	7.0%	325	49.6%	0.024
	Divorced	11	26.2%	3	7.1%	1	2.4%	7	16.7%	20	47.6%	
	Separated	4	10.5%	3	7.9%	2	5.3%	7	18.4%	22	57.9%	
	Widowed	8	22.9%	7	20.0%	2	5.7%	0	0	18	51.4%	
	Total	190	24.7%	75	9.7%	60	7.8%	60	7.8%	385	50.0%	
Stress category	Married	333	50.8%	63	9.6%	67	10.2%	68	10.4%	124	18.9%	0.188
	Divorced	21	50.0%	3	7.1%	2	4.8%	3	7.1%	13	31.0%	
	Separated	16	42.1%	1	2.6%	6	15.8%	8	21.1%	7	18.4%	
	Widowed	22	62.9%	2	5.7%	2	5.7%	5	14.3%	4	11.4%	
	Total	392	50.9%	69	9.0%	77	10.0%	84	10.9%	148	19.2%	

Fisher’s exact test

The association between parent’s marital status and mental illness

Table 8 suggests no significant association between parents’ marital status and mental illness except for anxiety (*p*-value = 0.024). Participants with separated parents seemed to report the lowest numbers *n* = 4 (10.5%) in the “normal” category as well as the highest numbers *n* = 22

(57.9%) in the extremely severe category on the anxiety scale.

Other associated factors

Supplemental Tables 1–3 denote the insignificance found between prevalence of mental illnesses and difference in campuses or school year. A significance was found

between students' majors and prevalence of depression (p -value < 0.001), anxiety (p -value < 0.001), and stress (p -value < 0.001); however, it is difficult to distinguish the significant data due to the high number of variables that are included.

Discussion

Previous studies have suggested the association between major epidemics and/or pandemics and the increased levels of anxiety, stress, and depression, especially for those working in the health care field (Stuijzand et al. 2020; Jalloh; Tucci et al. 2017). Moreover, more recent studies have shown the impact of the novel coronavirus (COVID-19) pandemic on the psychological and mental health of the general population (Wang and Zhao 2020; Zhang et al. 2020; Huang et al. 2020). Consequently, this study aimed to evaluate the impact of COVID-19 on the general mental status of pre-professional health students in KSAU-HS in Jeddah and Riyadh.

The study's findings revealed that anxiety had the major impact on mental health of the participating students as 50% of the participants expressed signs of extremely severe anxiety, 25% of the participants expressed other varying degrees of anxiety — mild, moderate, and severe — and only 24.7% of the participants expressed no signs of anxiety. Moreover, depression rates showed only 38.1% of the participants reporting no signs of depression, while 27.4% showed signs of extremely severe depression. Furthermore, 49.1% of the participants exhibited some form of stress with 19.2% of those expressing signs of extremely severe stress.

Findings of this study showed significance in relation to gender and depression, anxiety, and stress. Generally, the prevalence of mental disorders is predominating more in females than males (Albert 2015; Cox et al. 2000), which is also evident from our study, where females showed higher levels of depression than males, particularly in the extremely severe depression category. Similarly, higher levels of varying degrees of anxiety were higher in females than males, with the exception of the category severe in anxiety, as it was noted that males are more prevalent in that category. Moreover, varying degrees of stress were manifested more in females than males with the exception of the category severe in stress as more males expressed signs of severe stress than females. However, the number of females in the extremely severe stress category was double that of males.

Other studies have demonstrated the effects of the pandemics and the precautionary measures taken, such as lockdowns, on the mental health of the general population (Zheng et al. 2020; Vindegaard and Benros 2020; Solomou and Constantinidou 2020). These studies explored the risk

factors associated with higher risk of psychiatric disorders including depression, anxiety, and stress. Falling in line with this study's findings, these studies indicated that female gender among other risk factor is associated with developing of such psychiatric issues or worsening of current ones.

Moreover, when analyzing the marital status of the participating students' parents, an association was found between the marital status and the increased levels of anxiety. Participating students with separated parents reported the highest numbers in the extremely severe anxiety category during the pandemic, as well as the lowest numbers of showing no signs of anxiety. Furthermore, no significance was found when comparing the results of students with relatives whose occupation is related to health care with students who have no family members working in the health sector.

Furthermore, other studies have explored the familial situation and its association with increased susceptibility of developing mental illness during the pandemic and lockdown. For example, Smyth BM et al. investigated the effects of the pandemic on separated families (2020). Similarly, to this study's findings, Smyth BM et al. stated that separated families experienced relatively more stress and challenges during lockdown than other intact families. This could be attributed to the difficulties of shared parenting for separated partners to be managed properly under governmental lockdown. Different geographical locations of separated parents can be another stress factor for their sons and daughters, as lockdown's regulations restricted traveling by all means of transportation. Another aspect that should be considered is parents who have decided to separate prior to the emergence of the pandemic but have not finalized their separation were forced to separate in their own homes due to the lockdown. This could have created a stressful living situation that could contribute to the worsening of the mental health of the family members.

The overall awareness levels of participants were prominent, with those having moderate to high awareness levels comprising 88% of the participants. This high level of awareness can be contributed to the country's strong efforts in combating the spread of the virus with awareness campaigns through all social media outlets, news broadcasting, and public campaigns. The participants of this study did not have any association between levels of awareness and depression, anxiety, or stress. Other studies, however, pointed out an association between levels of awareness and severity of mental disorders. One study that was done among Thai health professional students found that COVID-19 awareness was negatively associated with anxiety symptoms. However, a positive association was found between COVID-19 awareness and mood, social well-being, and quality of life (Tiaprapong et al. 2021). Another study that

was done across 8079 Chinese junior and senior high school students showed significance between level of awareness and depressive symptoms. The study showed that students with depressive symptoms had lower levels of COVID-19 knowledge and its prevention and control in comparison with those without depressive symptoms (Zhou et al. 2020). The lack of significance of awareness levels and mental illness in the present study's findings could be attributed to the limited variability in the targeted population.

The present study's findings could help further understand the psychological impact of the ongoing and previous pandemics and epidemics. This in return could be beneficial to improving the provided mental healthcare by the responsible entities. The findings indicate relatively high prevalence of mental health disorders during the COVID-19 pandemic on the participating population. The necessary attention should be directed towards alleviating such stressors arising from the current pandemic.

Limitations and recommendations

There were certain limitations faced while conducting this study. One limitation was the study's design in accordance to the subject investigated. This study is a cross-sectional study, so it essentially captures the participant views in a specific time and place. This does not allow for further investigation to understand the specifics of the ramifications analyzed in this study and their precise relation to the lockdown, quarantine, and curfews. To further improve this study, a longitudinal study can be done to explore the effects of pandemics over a longer period of time to possibly help understand the progression of mental illness associated with such circumstances. Additionally, other factors linked to the worsening of mental health during pandemics were not investigated in this study. For example, pandemics are associated with economic decline and higher rates of unemployment. Assessing parent income and/or job loss rates and its influence on mental health could further help in understanding the psychological stress experienced during pandemics.

Furthermore, the survey distributed to obtain this study's data was given at a rather conflicting time, as a governmental announcement was made prior to collection of surveys announcing lifting of the lockdown in the upcoming weeks. This could have promoted higher spirit and enhanced the general mental status of those affected from lockdown and consequently influenced the results of the taken surveys. In addition to that, another factor that could have lifted the spirits of the general population is that the survey was distributed a few days prior to the nationally celebrated Islamic holiday of Eid Alfitr.

Conclusion

In conclusion, the findings of the study indicated higher than normal rates of depression (62%), anxiety (75%), and stress (49%) in pre-professional students in KSAU-HS campuses. These results were gathered upon governmental announcement of ending pandemic lockdown and restrictions, which could have masked a higher incidence rate. College students and especially those of healthcare-related majors already express more susceptibility of experiencing mental illness in comparison to the general population. Considering the known and previously studied effects of pandemics on mental health, college students living under the stress of a global pandemic could experience a substantially higher rate of developing some form of mental illness. In light of the results obtained by this study, it is recommended that a form of collaboration between the government and universities is put into practice to address and support the general psychological health of the health science students.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11356-022-20934-3>.

Acknowledgements The authors are thankful to King Abdullah Medical Research Center (KAIMRC) for the approval of research proposal, King Saud bin Abdulaziz University for Health Sciences administration for allowing investigators to collect data, and the health science students for their cooperation.

Author contribution AA and ZA conceptualized study idea, designed the study and survey, collected the data, as well as wrote and edited the manuscript. YA assisted in survey design, data collection, and writing the introduction part in the manuscript. FA helped in data collection and writing methodology. MAK statistically analyzed the data and critically revised the manuscript. IM facilitated the data collection in Riyadh and critically revised the manuscript. AK facilitated the data collection in Jeddah and critically revised the manuscript. SFZ supervised the whole study, assisted in the study idea and design, facilitated data collection, and critically revised the manuscript.

Data availability Data can be obtained upon request from the corresponding author.

Declarations

Ethics approval and consent to participate This study was accepted by the Research Committee and approved by Institutional Review Board (IRB), King Abdullah Medical Research Center (KAIMRC), Ministry of National Guard-Health Affairs (MNG-HA), with study number SP20/132/J and Memo. Ref. no. IRBC/0743/20. Electronic consent was obtained from each participant at the time of completing the survey.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

References

- Albert PR (2015) Why is depression more prevalent in women? *J Psychiatry Neurosci*: JPN 40(4):219
- Bao Y, Sun Y, Meng S, Shi J, Lu L (2020) 2019-nCoV epidemic: address mental health care to empower society. *The Lancet* 395(10224):e37–e38. [https://doi.org/10.1016/S0140-6736\(20\)30309-3](https://doi.org/10.1016/S0140-6736(20)30309-3)
- Cao W, Fang Z, Hou G, Han M, Xu X, Dong J, Zheng J (2020) The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res* 287:112934. <https://doi.org/10.1016/j.psychres.2020.112934>
- Cascella M, Rajnik M, Aleem A, Dulebohn S, Di Napoli R (2022) Features, evaluation, and treatment of coronavirus (COVID-19). *StatPearls*
- Chang SS, Stuckler D, Yip P, Gunnell D (2013) Impact of 2008 global economic crisis on suicide: time trend study in 54 countries. *BMJ* 347. <https://doi.org/10.1136/bmj.f5239>
- Coronaviridae Study Group of the International Committee on Taxonomy of Viruses. The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. *Nat Microbiol* 5:536–544. <https://doi.org/10.1038/s41564-020-0695-z>
- Coronavirus N (2019) situation reports [Internet]. *Who. int.* 2020 [cited 2 April 2020].
- Cox DL, Stabb SD, Hulgus JF (2000) Anger and depression in girls and boys: a study of gender differences. *Psychol Women Q* 24(1):110–112
- Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z, Tong S (2020) Epidemiology of COVID-19 among children in China. *Pediatrics* 145(6). <https://doi.org/10.1542/peds.2020-0702>
- Food, U.S. (2020) Drug Administration (FDA): coronavirus (COVID-19) Update: FDA Issues Emergency Use Authorization for Potential COVID-19 Treatment. FDA News release. 2020.
- Gao GF (2018) From “A” IV to “Z” IKV: attacks from emerging and re-emerging pathogens. *Cell* 172(6):1157–1159. <https://doi.org/10.1016/j.cell.2018.02.025>
- Gorbalenya AE, Baker SC, Baric RS, De Groot RJ, Drosten C, Gulyaeva AA, Haagmans BL, Lauber C, Leontovich AM, Neuman BW, Penzar D (2020) The species severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. *Nat Microbiol* 5:536–544. <https://doi.org/10.1038/s41564-020-0695-z>
- Huang Y, Zhao N (2020) Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res* 288:112954. <https://doi.org/10.1016/j.psychres.2020.112954>
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z (2020) Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 395(10223):497–506. [https://doi.org/10.1016/S0140-6736\(20\)30183-5](https://doi.org/10.1016/S0140-6736(20)30183-5)
- Jalloh MF, Li W, Bunnell RE, Ethier KA, O’Leary A, Hageman KM, Sengeh P, Jalloh MB, Morgan O, Hersey S, Marston BJ (2018) Impact of Ebola experiences and risk perceptions on mental health in Sierra Leone, July 2015. *BMJ Glob Health* 3(2):e000471. <https://doi.org/10.1136/bmjgh-2017-000471>
- Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, Ren R, Leung KS, Lau EH, Wong JY, Xing X (2020) Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med*. <https://doi.org/10.1056/NEJMoa2001316>
- Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, Wang W, Song H, Huang B, Zhu N, Bi Y (2020) Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet* 395(10224):565–574. [https://doi.org/10.1016/S0140-6736\(20\)30251-8](https://doi.org/10.1016/S0140-6736(20)30251-8)
- Madhav N (2017) Oppenheim, B., Gallivan, M., Mulembakani, P., Rubin, E. and Wolfe, N. Pandemics: risks, impacts, and mitigation.
- Mistler BJ, Reetz DR, Krylowicz B, Barr V (2012) The association for university and college counseling center directors annual survey. Retrieved from Association for University and College Counseling Center Directors website: http://files.cmcglobal.com/Monograph_2012_AUCCCD_Public.pdf
- Ozamiz-Etxebarria N, Dosal-Santamaria M, Picaza-Gorrochategui M, Idoiaga-Mondragon N (2020) Stress, anxiety, and depression levels in the initial stage of the COVID-19 outbreak in a population sample in the northern Spain. *Cad Saude Publica* 36. <https://doi.org/10.1590/0102-311X00054020>
- Rajkumar RP (2020) COVID-19 and mental health: a review of the existing literature. *Asian J Psychiatr* 52:102066. <https://doi.org/10.1016/j.ajp.2020.102066>
- Rothan HA, Byrareddy SN (2020) The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *J Autoimmun* 109:102433. <https://doi.org/10.1016/j.jaut.2020.102433>
- Shigemura J, Ursano RJ, Morganstein JC, Kurosawa M, Benedek DM (2020) Public responses to the novel 2019 coronavirus (2019-nCoV) in Japan: mental health consequences and target populations. *Psychiatry Clin Neurosci* 74(4):281. <https://doi.org/10.1111/pcn.12988>
- Smyth BM, Moloney LJ, Brady JM, Harman JJ, Esler M (2020) COVID-19 in Australia: impacts on separated families, family law professionals, and family courts. *Fam Court Rev* 58(4):1022–1039. <https://doi.org/10.1111/fcre.12533>
- Solomou I, Constantinidou F (2020) Prevalence and predictors of anxiety and depression symptoms during the COVID-19 pandemic and compliance with precautionary measures: age and sex matter. *Int J Environ Res Public Health* 17(14):4924. <https://doi.org/10.3390/ijerph17144924>
- Stuijzand S, Deforges C, Sandoz V, Sajin CT, Jaques C, Elmers J, Horsch A (2020) Psychological impact of an epidemic/pandemic on the mental health of healthcare professionals: a rapid review. *BMC Public Health* 20(1):1–18. <https://doi.org/10.1186/s12889-020-09322-z>
- Su S, Wong G, Shi W, Liu J, Lai AC, Zhou J, Liu W, Bi Y, Gao GF (2016) Epidemiology, genetic recombination, and pathogenesis of coronaviruses. *Trends Microbiol* 24(6):490–502. <https://doi.org/10.1016/j.tim.2016.03.003>
- Tiaprapong K, Sirikul A, Krajangmek C, Duangthongkul N, Pandam N, Piya-Amornphan N (2021) Awareness of COVID-19 influences on the wellness of Thai health professional students: an ambulatory assessment during the early “new normal” informing policy. *PLoS ONE* 16(6):e0252681. <https://doi.org/10.1371/journal.pone.0252681>
- Tucci V, Moukaddam N, Meadows J, Shah S, Galwankar SC, Kapur GB (2017) The forgotten plague: psychiatric manifestations of Ebola, Zika, and emerging infectious diseases. *J Glob Infect Dis* 9(4):151. https://doi.org/10.4103/jgid.jgid_66_17
- Vindegaard N, Benros ME (2020) COVID-19 pandemic and mental health consequences: Systematic review of the current evidence. *Brain Behav Immun* 1(89):531–542. <https://doi.org/10.1016/j.bbi.2020.05.048>
- Wang C, Zhao H (2020) The impact of COVID-19 on anxiety in Chinese university students. *Front Psychol* 11:1168. <https://doi.org/10.3389/fpsyg.2020.01168>
- World Health Organization (2020a) Shortage of personal protective equipment endangering health workers worldwide. <https://www.who.int/news/item/03-03-2020-shortage-of-personal-protective-equipment-endangering-health-workers-worldwide>. Accessed 22 May 2022
- World Health Organization (2020b) WHO Coronavirus (COVID-19) Dashboard. <https://covid19.who.int>. Accessed 28 July 2020

- World Health Organization (2021) Archived: WHO Timeline-COVID-19. 2020. URL <https://www.who.int/news/item/27-04-2020-who-timeline---covid-19> [accessed 2021–10–31]
- Xiang YT, Yang Y, Li W, Zhang L, Zhang Q, Cheung T, Ng CH (2020) Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. *Lancet Psychiat* 7(3):228–229. [https://doi.org/10.1016/S2215-0366\(20\)30046-8](https://doi.org/10.1016/S2215-0366(20)30046-8)
- Zandifar A, Badrfam R (2020) Iranian mental health during the COVID-19 epidemic. *Asian J Psychiatr* 51. <https://doi.org/10.1016/j.ajp.2020.101990>
- Zhang C, Ye M, Fu Y, Yang M, Luo F, Yuan J, Tao Q (2020) The psychological impact of the COVID-19 pandemic on teenagers in China. *J Adolesc Health* 67(6):747–755. <https://doi.org/10.1016/j.jadohealth.2020.08.026>
- Zheng L, Miao M, Lim J, Li M, Nie S, Zhang X (2020) Is lockdown bad for social anxiety in COVID-19 regions?: a national study in the SOR perspective. *Int J Environ Res Public Health* 17(12):4561. <https://doi.org/10.3390/ijerph17124561>
- Zhou SJ, Zhang LG, Wang LL, Guo ZC, Wang JQ, Chen JC, Liu M, Chen X, Chen JX (2020) Prevalence and socio-demographic correlates of psychological health problems in Chinese adolescents during the outbreak of COVID-19. *Eur Child Adolesc Psychiatry* 29(6):749–758. <https://doi.org/10.1007/s00787-020-01541-4>
- Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R, Niu P (2020) A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med*. <https://doi.org/10.1056/NEJMoa2001017>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.