



Original article

Examining anxiety and stress regarding virtual learning in colleges of health sciences: A cross-sectional study in the era of the COVID-19 pandemic in Saudi Arabia



Tahani Alshammari^{a,*}, Sarah Alseraye^a, Rawabi Alqasim^a, Aleksandra Rogowska^b, Nouf Alrasheed^a, Musaad Alshammari^a

^a Department of Pharmacology and Toxicology, College of Pharmacy, King Saud University, Saudi Arabia

^b Institute of Psychology, University of Opole, Opole, Poland

ARTICLE INFO

Article history:

Received 23 September 2021

Accepted 12 January 2022

Available online 25 January 2022

Keywords:

Anxiety

Virtual learning

COVID-19

Pharmacy education

Medical education

ABSTRACT

Background: Stress and anxiety are relatively common, particularly in females and college students. Stress can impact students' overall performance and their physical and mental health. The COVID-19 pandemic has affected all aspects of life and is associated with high levels of psychological distress. It has considerably affected the education sector, not only locally but worldwide, forcing a shift in the education system from on-site to virtual learning. This cross-sectional study was undertaken to evaluate the prevalence of anxiety and stress regarding virtual learning among health sciences college students in the Kingdom of Saudi Arabia (KSA) after introducing blended virtual classes and exams and in-person laboratory training. The study was carried six months after the COVID-19 outbreak.

Methodology: Participants were recruited by convenient sampling and snowballing strategies. Our study was conducted between November 18 and December 6, 2020. Questionnaires were employed; they included the General Anxiety Disorder-7 (GAD-7) scale and focused on the participants' attitudes toward virtual learning. The present research was validated by a pilot study, followed by implementing some amendments.

Results: A total of 418 health sciences college students, aged 18–27 ($M = 20.88$, $SD = 1.97$), participated in the study. Our analysis indicated that more than half the sample (51.44%) reported a risk of moderate to severe GAD. Anxiety was recognized more frequently in women (72.09%) than in men (27.91%). Interestingly, our X^2 analysis revealed an association between marital status and anxiety, with a higher risk of GAD found in single people (compared with married). In addition, we found that the risk of anxiety increased in junior students (1st–3rd year) compared to senior students (4th–6th year).

Conclusion: Our study highlights the need to establish gender-based tailored mental health support systems that provide preventive measures. The study findings also recommend that institutions develop programs and platforms that safely support students to interact and seek guidance, particularly those at higher risk of stress, such as females and first-year students. Overall, our study underlines the need to pursue an understanding of the complicated nature of anxiety disorders..

© 2022 The Authors. Published by Elsevier B.V. on behalf of King Saud University. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

* Corresponding author at: Pharmacology and Toxicology, College of Pharmacy/ King Saud University, P.O. Box 2475, Riyadh 11451, Saudi Arabia.

E-mail address: talshammari@ksu.edu.sa (T. Alshammari).

Peer review under responsibility of King Saud University.



1. Introduction

According to the World Health Organization, Coronavirus (COVID-19) outbreak poses a severe public health threat worldwide (WHO Europe, 2020). In response to this pandemic, most governments across the globe have introduced instructions and policies to prevent the spread of the disease – by imposing lockdowns, social distancing, and home quarantine, as well as shifting the entire education system to online (Loades et al., 2020; Rose, 2020). Most colleges of health sciences reported restricted access

to academic buildings and thus planned to provide, or indeed were already providing, online education to replace face-to-face learning (Machado et al., 2020). In addition, clinical skills sessions and examinations were shifted to a virtual format, which resulted in a different learning environment, isolation, and struggling to establish boundaries between work and home; these changes, in turn, affected the psychological status of the student population (Rose, 2020).

In the COVID-19 era, multiple studies have been conducted to assess different aspects that affect human health. Numerous systematic review studies were undertaken to investigate the direct and indirect impact of the pandemic on mental health as well as factors that increase the risk of psychological distress. These studies revealed that the general public, including healthcare workers, have higher levels of anxiety, depression, insomnia, and lower psychological well-being, compared with who they were before COVID-19 (Nearchou et al., 2020; Pappa et al., 2020; Al Mamun et al., 2021; Li et al., 2021). Different risk factors were also identified that increased the risk of psychological symptoms, such as female gender, poor self-rated health, relatives with COVID-19, and frontline healthcare workers (Basu et al., 2021; Tasnim et al., 2021). Anxiety and depression were the most common indicators of psychological impact reported across the studies, with prevalence rates of 33% and 28%, respectively (Luo et al., 2020). Additionally, studies found that quarantine negatively impacts the general population, resulting in confusion, anger, and post-traumatic distress (Loades et al., 2020).

The American Psychological Association defines anxiety as an emotion characterized by feelings of tension, worried thoughts, and physical changes such as increased blood pressure (The American Psychological Association n.d.). Anxiety is also characterized by stress and uncertainty and worry about insignificant life situations and unlikely future events (Francis et al., 2012). Mostly, these feelings are associated with an overestimation of unfavorable circumstances (Dugas et al., 1997). Anxiety is a common and widespread mental health issue (Hendriks et al., 2014). It is a highly prevalent disorder among healthcare providers and college students, and females during the COVID-19 pandemic (Bahhawi et al., 2018; AlAteeq et al., 2020; Naser et al., 2020). A recent systematic review found that the prevalence of anxiety among college and school students in Saudi Arabia had ranged from 34.9% to 65% before the COVID-19 pandemic (AlAteeq et al., 2020). Evidence in the literature suggests that when anxiety increases, the academic performance of students – both genders – declines (Ren et al., 2021). Furthermore, anxiety affects students' physical health, learning efficiency, and lifestyle and leads to social isolation and misbehavior (Ahmad, 2019; Liu et al., 2019). Numerous studies have assessed the psychological impact of the pandemic on college students and found that anxiety is higher in this population (Son et al., 2020; Wang et al., 2020; Browning et al., 2021; Hakami et al., 2021). Students who live alone or have relatives infected with COVID-19 were even more severely anxious (Tuncay and Uzunboylu, 2010).

Although undergraduates are not at especially higher risk of contracting COVID-19, their daily activities were dramatically affected by the pandemic. Among undergraduate students, females and first-year students were more vulnerable to stress (Aristovnik et al., 2020). The system of delivering education and knowledge online has evolved enormously. Globally, the number of closed schools reached 1.3 billion in almost one hundred fifty countries in April 2020 – which dropped to one hundred million in about twenty country-wide closures in September 2021 (UNESCO, 2020 – 2021). The transition from a face-to-face to a virtual learning environment could cause students to feel anxious about their ability to succeed in what can be described as an unfamiliar learning environment (Abdous, 2019). Other variables played a crucial role

in mediating stress, such as closed libraries (Ogunbodede and Wiche, 2021), online office hours (Columbia Center for Teaching and Learning n.d.), and change assessment tools (Santamarina, 2021). A study undertaken to investigate the impact of stress and anxiety on college students' performance in relation to online learning during the pandemic found that online learning enabled students to shift their attention away from the pandemic (Hoxha, 2020), and that it helped them to be motivated (OECD, 2020). However, online learning increases anxiety that interferes with specific learning skills, such as time management, concentration, learning methods, and motivation to study (Hoxha, 2020). Another study, conducted at the beginning of the COVID-19 pandemic in KSA to assess stress levels in virtual classrooms among school and college students, observed a moderate to a high level of stress among students due to academic, financial, and social difficulties (AlAteeq et al., 2020).

It is assumed that during disease outbreaks, individuals experience extremely stressful situations, resulting in a higher risk of developing anxiety and that students' mental health may deteriorate over prolonged periods of physical distancing and virtual learning. To the best of our knowledge, no study has been undertaken in KSA to examine the impact of anxiety on health sciences students' performance while living the blended virtual educational experience. In the present research, we also examined the stress experienced by the participants regarding virtual learning during this pandemic. This study thus aims to identify the anxiety levels among health sciences college students and its impact on their performance with respect to online learning during the distance learning forced by the COVID-19 pandemic in KSA. It is essential to identify factors related to virtual and blended learning that impact students learning, providing input to make adaptations to the education programs to support students, facilitate their learning, and improve the education in KSA.

2. Methods

2.1. Participants

Male and female students at health sciences colleges at King Saud University – including the colleges of medicine, pharmacy, nursing, dentistry, and applied medical science – who tried virtual learning during the pandemic were eligible for the online survey. A total of 418 students from medical universities in KSA participated in the study. The mean age of the participants was 21 years ($M = 20.93$, $SD = 1.71$, ranging from 18 to 27 years). Most of the participants were female, from a large family, studying pharmacy, and first-year students. Table 1 presents the demographic characteristics of the sample.

2.2. Measurement

2.2.1. Anxiety

The 7-item Generalized Anxiety Disorder (GAD-7) scale is an easily and widely used validated tool for anxiety screening; it measures worry and anxiety symptoms and is increasingly utilized for general purposes and research (Johnson et al., 2019). The GAD-7 consists of seven items, each of which is scored on a four-point Likert scale from 0 (not at all) to 3 (every day) with total scores ranging from 0 to 21; higher scores reflect greater anxiety severity (Johnson et al., 2019). Scores of 5, 10, and 15 are taken as the cut-off points for mild, moderate, and severe anxiety, respectively (Spitzer et al., 2006). For logistic regression, the total sample was divided into two groups based on anxiety level, coded as 0 = Low risk of anxiety (GAD-7 scores < 9) and 1 = High risk of anxiety

Table 1
Demographic characteristics of the sample.

Demographic variable	n	%
Gender		
Female	252	60.29
Male	166	39.71
Marital status		
Married	14	3.35
Single	404	96.65
Number of family members		
0–3	30	7.18
4	22	5.26
5	69	16.51
6	79	18.90
7	87	20.81
8	66	15.79
9	34	8.13
10 or more	31	7.52
Study major		
Pharmacy	93	22.25
Medicine	86	20.57
Applied medical sciences	78	18.66
Dentistry	86	20.57
Nursing	75	17.94
Study year		
Internship	29	6.94
1st year	92	22.01
2nd year	64	15.31
3rd year	81	19.38
4th year	69	16.51
5th year	50	11.96
6th year	33	7.89
Exposure to COVID-19		
No	313	74.88
Yes	105	25.12
Virtual classes-related stress and anxiety		
Better (less anxious)	139	33.25
Same	99	23.68
Worse (more anxious)	180	43.06
Reason for virtual classes-related stress		
Forgot attending classes because of sleeping	197	47.13
Loud or noisy sounds or disturbance while speaking	112	26.79
Poor internet connection	109	26.08

(GAD-7 scores > 10). The Cronbach's α reliability coefficient in this study was 0.90 for the GAD-7.

2.2.2. Virtual learning-related stress (VLRS)

In order to assess virtual learning-related stress (VLRS), we devised some questions based on our belief that these questions would reflect the prevalence of stress toward virtual learning in colleges of health sciences that are mainly characterized by their practical and team-based approaches. In terms of the first item, VLRS1 was created to examine the general stress toward virtual learning that students experienced during the COVID-19 pandemic. The rest of the items addressed specific aspects of the blended online educational experience during the COVID-19 pandemic (“Virtual classes make me more stressed and anxious”) VLRS2 was developed to investigate higher cognitive tasks (“In virtual classes, it is more challenging to focus and understand the topics”). This part of the questionnaire covers the participants' ability to concentrate and focus during online classes. Most of the health sciences colleges implemented a blended experience (virtual classes and in-person laboratory sessions with social distancing precautions taken). A significant number of didactic courses have laboratory and practical sessions; we thus developed VLRS3 – a question that addresses students' feelings while attending practical sessions (“In practical laboratory session, I experience more anxiety”). “VLRS4: Select the second choice; 1 = agree, 0 = disagree” As the survey was self-reported by participants, we aimed – through this question – to reduce fake responses during participa-

tion (“Select the second choice”) VLRS5 was developed to establish whether students had encountered technical or communication difficulties with the instructors during online exams (“Online exams make me more anxious than in-class exams”). This tool was developed to identify students' stress toward online exams. Given that the curriculum of the college of pharmacy and that of most colleges at King Saudi University have a research cycle, graduation project courses, and internship training, we addressed whether physical attending and performing experiments would stress them in VLRS 6 (“Training at the hospital or practical laboratories makes me more anxious”). Participants answered each VLRS question selecting one of the two options: *Agree, Disagree*.

2.2.3. Strategies during exam sessions

Two questions about learning strategies used by students during exam sessions were derived from the Student Skills Assessment Questionnaire (SSAQ), developed in the Counseling Centre of Houston University (Services, 2021). The SSAQ has been used in numerous studies (Ezeala and Siyanga, 2015; Hoxha, 2020; Kamel et al., 2020). The two questions were adapted in the study from the Domain IV “Test strategies/Test anxiety” (TSTA): “I feel confident about my exam preparations” (TSTA 1), and “During exam sessions, I follow directions carefully” (TSTA 2). The responses were provided on a four-point Likert scale, ranging from 1 = *Never*, 2 = *Sometimes*, 3 = *usually*, to 4 = *Always*. (Services, 2021). Higher scores in the SSAQ as well as in the TSTA mean better student skills. For the logistic analysis, the scores were converted into 0 = usually and Always, and 1 = Never and Sometimes.

2.2.4. Demographics

The online survey also contained the socio-demographic characteristics of the participants, including age, gender, and marital status, the number of family members at home, study major, and year of study. Exposure to COVID-19 was tested using one question about the subject's or their family member's experience of contracting Coronavirus (“Have you or anyone from your family members been diagnosed with COVID 19?”), with yes/no answer.

2.3. Study design

A cross-sectional study using an online survey was conducted in KSA six months after the outbreak of the COVID-19 pandemic, between September 2020 to February 2021. At that point in time, most of our classes were virtual, and only practical sessions and exams were attended in person, with social distancing and other precautions observed in compliance with the Saudi Ministry of Health guidelines. The survey was distributed from November 18 to December 6, 2020.

The sample size was calculated using Raosoft software (Raosoft, 2004). The required sample size was estimated at the 95% confidence level with a projected 50% response distribution and a margin of error of 5%. The recommended minimum sample size was 377. By using convenient sampling and snowballing strategies, participants were invited to take part in this study through social media (WhatsApp and Twitter). Google Forms was used to create a link for the survey, and each participant was invited using the specific survey link; all participants voluntarily took part in the study.

The study survey was validated by conducting a pilot study involving 30 participants similar to the main research subjects to complete the survey and express their views on making the survey simpler, shorter, and user-friendly. Necessary amendments were implemented into the finalized questionnaire. The online survey included a clearly explained message describing the purpose of the study and stressing voluntary participation, confidentiality, and the right not to participate. The consent was obtained by

asking participants to confirm that they agree to complete the questionnaire by marking a “yes, I agree to participate” tick box. Ethical approval was obtained from the Institutional Review Board at King Saud University in Riyadh, Saudi Arabia (KSU-HE-20-488).

2.4. Statistical analysis

A frequency of people at risk of General Anxiety Disorder (GAD) was compared with frequencies of reply to questions about test strategies (TSTA) and virtual learning-related stress (VLRS), as well as the demographic characteristics of the sample of university students. The Pearson’s X² test of independence was used for testing associations between these variables. The effect size for was assessed using ϕ coefficient, while *p*-value <0.05 was considered a significant outcome. Additionally, a logistic regression was performed to find predictors of GAD risk among university students. All variables were coded 0 or 1 for the X² test and logistic regression, including age (0 = Older age > 21, 1 = Younger age < 20), gender (0 = Male, 1 = Female), relationships status (0 = Married, 1 = Single), number of family members (0 = Less or equal 6, 1 = More or equal 7), department of study (0 = Other than pharmacy, 1 = Pharmacy), year of the study (0 = 4th-6th; 1 = 1th-3rd with Internship), exposure to the Coronavirus (0 = No, 1 = Yes), TSTA 1 – 2 (0 = Better skills, 1 = Worst skills), and VLRS 1 – 6 (0 = Disagree, 1 = Agree). All statistical analyses were conducted using SPSS ver. 26.

3. Results

3.1. Prevalence of anxiety in university students

The demographic characteristics of the sample are shown in Table 1. Among university students, 88 (21.05%) did not experience anxiety, 115 (27.51%) exhibited a mild GAD risk, 118 (28.23%) demonstrated moderate anxiety, while 97 (23.21%) presented a risk of severe anxiety disorder. Overall, more than half the sample (51.44%) reported a risk of moderate to severe GAD.

3.2. Association between test strategies and virtual learning-related stress

The relationships between test strategies (TSTA) and virtual learning-related stress (VLRS) were examined using Pearson’s X² test. Contingency tables and the results of the statistical analysis are presented in Table 2. A statistically significant association was found between TSTA 1 and questions 1, 2, 3, and 6 of the VLRS,

but the effect size was small. The TSTA 2 was significantly related to questions 3 – 5 of the VLRS, but again, the effect size was small.

3.3. The relationship between anxiety and demographics, test strategies, and virtual learning-related stress

Several associations between anxiety and demographic variables, as well as TSTA and VLRS, were found using Pearson’s X² test. These are presented in Table 3.

A higher risk of GAD was found in women, single people, students in the 1st-3rd year of study, and those on an internship (compared with those in the 4th-6th year of study). The TSTA was not related to anxiety. A significant relationship was found between high GAD risk and students who experience more stress and anxiety in practical laboratory sessions (VLRS 3) and during hospital training or practical laboratories in colleges (VLRS 6). However, the effect size for all significant associations was small.

3.4. Predictors of anxiety among university students

Logistic regression was conducted to identify predictors of anxiety among all the other variables (Table 4). Female students were almost four times more likely to be at high risk of anxiety than men. A high risk of anxiety was half as common among pharmacy students as their peers from other KSA colleges. Among university students, high GAD risk was two times more frequent among those on an internship and in lower levels of study (between 1st and 3rd year) than in those in higher levels of study (between 4th and 6th year). The TSTA was not related to anxiety risk. People with high levels of virtual learning-related stress (VLRS 1) were more likely to experience high anxiety than those who were not stressed. . In addition, students who experienced a lot of stress and anxiety during virtual exams (VLRS 5) were half more likely to show a higher risk of GAD than students who were less stressed with online testing during the exam session.

4. Discussion

The current study investigated a sample of students from health sciences colleges at King Saud University six months after the COVID-19 outbreak. We found that most health sciences students displayed anxiety, which was exhibited in a gender-based manner. At the same time, female students exhibited more anxiety than males.. We also found that the risk of anxiety increased in 1st-3rd year students, compared with 4th-6th year participants.

Table 2 Associations between test strategies and virtual learning-related stress.

	TSTA 1				X ² (1)	p	ϕ	TSTA 2				X ² (1)	p	ϕ
	Better skills		Worst skills					Better skills		Worst skills				
	n	%	n	%				n	%	n	%			
VLRS 1					10.9	0.001	0.16					3.60	0.074	0.09
	Disagree	103	45.8	122	54.2			184	81.8	41	18.2			
	Agree	58	30.1	135	69.9			143	74.1	50	25.9			
VLRS 2					7.33	0.007	0.13					0.02	0.900	0.01
	Disagree	65	47.8	71	52.2			107	78.7	39	21.3			
	Agree	96	34.0	186	66.0			220	78.0	62	22.0			
VLRS 3					11.69	0.001	0.17					5.89	0.017	0.12
	Disagree	104	46.0	122	54.0			187	82.7	39	17.3			
	Agree	57	29.7	135	70.3			140	72.9	52	27.1			
VLRS 5					0.05	0.841	-0.01					4.68	0.033	0.11
	Disagree	84	38.0	137	62.0			182	82.4	39	17.6			
	Agree	77	39.1	120	60.9			145	73.6	52	26.4			
VLRS 6					7.47	0.006	0.13					4.74	0.035	0.11
	Disagree	117	43.3	153	56.7			220	81.5	50	18.5			
	Agree	44	29.7	104	70.3			107	72.3	41	27.7			

Note: TSTA = Test Strategies/Test Anxiety subscale of the Student Skills Assessment Questionnaire (SSAQ); VLRS = Virtual Learning-Related Stress.

Table 3
Association between anxiety and other variables (N = 418).

Variable	Anxiety				X ² (1)	p	φ
	Low risk		High Risk				
	n	%	n	%			
Age					1.43	0.235	0.06
	Older (>21)	125	51.0	120	49.0		
	Younger (<20)	78	45.1	95	54.9		
Gender					25.77	< 0.001	0.25
	Male	106	63.9	60	36.1		
	Female	97	38.5	155	61.5		
Relationships status					5.22	0.022	0.11
	Married	11	78.6	3	21.4		
	Single	192	47.5	212	52.5		
Family number					1.32	0.028 _a	0.06
	Less or equal to 6	103	51.5	97	48.5		
	More or equal to 7	100	45.9	118	51.1		
Department of study					0.19	0.724	-0.02
	Other than pharmacy	156	48.0	169	52.0		
	Pharmacy	47	50.5	46	49.5		
Year of study					4.29	0.042	0.10
	Between 4th and 6th	84	55.3	68	44.7		
	Between 1st and 3rd with Internship	119	44.7	147	55.3		
Exposure to the Coronavirus					0.05	0.823	-0.01
	No	151	48.2	162	51.8		
	Yes	52	49.5	53	50.5		
TSTA 1					0.01	0.970	-0.01
	Better skills	78	48.4	83	51.6		
	Worst skills	125	48.6	132	51.4		
TSTA 2					0.44	0.554	-0.03
	Better skills	156	47.7	171	52.3		
	Worst skills	47	51.6	44	48.4		
VLRS 1					0.86	0.378	0.05
	Disagree	114	50.7	111	49.3		
	Agree	89	46.1	104	53.9		
VLRS 2					0.04	0.917	0.01
	Disagree	67	49.3	69	50.7		
	Agree	136	48.2	146	51.8		
VLRS 3					5.33	0.024	-0.11
	Disagree	98	43.4	128	56.6		
	Agree	105	54.7	87	45.3		
VLRS 5					1.09	0.327	-0.05
	Disagree	102	46.2	119	53.8		
	Agree	101	51.3	96	48.7		
VLRS 6					6.16	0.014	-0.12
	Disagree	119	44.1	151	55.9		
	Agree	84	56.8	64	43.2		

Note: TSTA = Test Strategies/Test Anxiety subscale of the Student Skills Assessment Questionnaire (SSAQ); VLRS = Virtual Learning-Related Stress; a = the Fisher exact test statistic value was used due to the small sample size among married students.

Table 4
Predictors of anxiety in the sample of university students (N = 418).

Variable	b	SE b	AOR	95% CI		Wald's χ ² (1)	p
				LL	UL		
Constant	-1.57	0.77	0.21			4.12	0.042
Age	-0.40	0.27	0.67	0.395	1.135	2.22	0.136
Gender	1.37	0.24	3.94	2.455	6.309	32.39	0.000
Relationship status	1.09	0.71	2.99	0.737	12.116	2.35	0.125
Family number	0.27	0.22	1.30	0.850	2.001	1.48	0.224
Department of study	-0.53	0.26	0.59	0.352	0.984	4.09	0.043
Year of study	0.77	0.27	2.15	1.263	3.669	7.95	0.005
Exposure to the Coronavirus	-0.22	0.25	0.80	0.491	1.309	0.78	0.377
TSTA 1	-0.16	0.24	0.85	0.532	1.361	0.46	0.500
TSTA 2	0.00	0.27	1.00	0.586	1.709	0.00	0.997
VLRS 1	0.50	0.25	1.65	1.020	2.678	4.16	0.041
VLRS 2	-0.15	0.25	0.86	0.529	1.395	0.38	0.539
VLRS 3	-0.31	0.25	0.74	0.450	1.204	1.49	0.222
VLRS 5	-0.68	0.24	0.51	0.315	0.815	7.86	0.005
VLRS 6	-0.33	0.26	0.72	0.432	1.204	1.56	0.211

Note: TSTA = Test Strategies/Test Anxiety subscale of the Student Skills Assessment Questionnaire (SSAQ); VLRS = Virtual Learning-Related Stress. AOR = Adjusted Odds Ratio; CI = confidence interval, LL = lower limit; UL = upper limit.

We detected an association between high GAD risk and students who experience more stress and anxiety in practical laboratory sessions (VLRS 3) and during hospital training or practical laboratories in colleges (VLRS 6).

4.1. Anxiety in health science students during the COVID-19 pandemic

Our results indicated that the majority of the participants exhibited anxiety, which is consistent with previous local (AlAteeq et al., 2020) and global reports (Rogowska et al., 2020; Basheti et al., 2021; Cleofas and Rocha, 2021; Seaborn et al., 2021). In Saudi populations during the pandemic, one report examined overall mental health by analyzing both depression and anxiety among healthcare practitioners (AlAteeq et al., 2020), while another report addressed the perceived stress felt toward virtual classrooms at multiple educational levels (AlAteeq et al., 2020). To the best of our knowledge, the current report is the first to investigate stress and anxiety in colleges of health sciences during the blended educational experience. Our results indicated that more than half the sample exhibited a moderate to severe risk of GAD. Malaysian undergraduates and medical students reported similar findings with higher percentages (Yusoff et al., 2013). Usually, academic pressures lead to motivation and stimulate learning. However, they can also lead to the development of stress and anxiety, which are associated with health and academic adverse events (Ali et al., 2015). Further studies are needed to analyze other predisposing and risk factors (Fauzi et al., 2021).

4.2. Anxiety association with other variables

With regard to the association between TSTA and VLRS, our analysis revealed that students with high stress toward virtual classes (VLRS1) are those with worse skills in both TSTA1 and 2. Similarly, our analysis detected a strong association between difficulties in focusing during the virtual classes and worse test strategies in TSTA1 and 2. This indicates that students with poor test strategies, such as being confident to prepare and follow exam instruction preparations, exhibited a higher level of virtual learning stress. Overall, VLRS1, VLRS 2, VLRS 3, and VLRS 6 are highly associated with TSTA 1 and 2. In line with this, previous research indicated a strong association between anxiety and students' academic performance (Mahmood, 2010).

In line with our findings, previous studies have reported that stress in medical students is strongly associated with poor problem solving and a reduced ability to focus (Saipanish, 2003). This indicates that a higher level of anxiety and lower coping strategies are key factors in modulating student academic preparations and performance. Additionally, a high level of stress affects the academic performance of medical students (Saipanish, 2003). It has therefore been proposed that stress-coping strategies need to be incorporated into the curriculum of medical schools (James et al., 2017).

However, our analyses also suggested that individuals with better TSTA exhibited an almost equal (non-significant) distribution with respect to virtual learning stress. This pattern in the association between TSTA1 and 2 and VLRS was extremely frequent. Previous reports have examined the stress felt towards virtual learning (AlAteeq et al., 2020; Khalil et al., 2020) and the impact of COVID-19 on medical education in KSA (Alsoufi et al., 2020). Other reports have examined anxiety among undergraduate students (Khoshaim et al., 2020). However, this is the first study to analyze anxiety and its association with stress towards online learning as part of blended educational experience. Future studies could usefully discuss metacognitive processing, especially during the virtual learning experience.

At the end of the 1970s, the term metacognition was introduced and defined by Flavell (Flavell, 1979) as “higher-order thinking to

actively control the cognitive processes engaged in thinking and acquiring knowledge.” This concept includes knowledge, attitude, and an active regulatory behavioral process (Jackson, 2004; Colthorpe et al., 2018). These aspects have been utilized to assess the stress felt towards learning and academic performance (Entwistle and Peterson, 2004; Credé and Kuncel, 2008; Puziffero, 2008; Liaw and Huang, 2013). Thus, finding the best strategic interventions requires a complete understanding of the academic-related factors contributing to stress and anxiety.

4.3. Predictors of anxiety in a logistic regression analysis

According to the research findings, females are about four times more likely to develop anxiety, indicating that gender is a strong predictor of the latter. The experience of managing social isolation during this pandemic has had a profound impact on family members, especially females (Francesca Lagomarsino, 2020). It is widely acknowledged that undergraduate students bear a substantial burden of stress and anxiety (Batra et al., 2021). The risk of developing anxiety is reported to be higher in younger adults (Hawes et al., 2021). These mental health issues are also observed to be more frequent in females than males (Gao et al., 2020; Guo et al., 2021). In addition, a previous report indicated that the pandemic educational experience highlighted several learning barriers, including higher levels of anxiety and workspace distractions. These barriers were more impactful on first-generation college students and females (Gillis and Krull, 2020). Consistent with this evidence, our analyses indicated that the level of anxiety in students at colleges of health sciences was higher among females. Our report underscores the unmet need to establish supportive programs and cultivate proper interventions. Recently, the need to develop and implement Saudi guidelines for the management of patients with mental issues has been highlighted (Alshammari and Alshammari, 2021). However, particular emphasis is placed on developing and implementing policies to provide service-led supporting programs addressing these gender differences.

Notably, our logistic regression s indicated that being single predicts a three-fold higher risk of developing anxiety, but these associations were not statistically significant. In contrast, the Pearson's χ^2 independency test showed that single status is related to higher anxiety ($p < 0.05$). Furthermore, previous reports suggested that an elevated level of stress is associated with being single (Coombs and Fawzy, 1982; Ta et al., 2017). Unfortunately, the only 14 students were married in the present study, so the small sample size was too small and insufficient to state a strong conclusion. More research is necessary in the future, with a larger sample representing married population, to resolve this issue. Another study.

Additionally, we found that pharmacy students are at lower risk of developing anxiety in comparison with students from the colleges of medicine, dentistry, applied medical science and nursing. In support of our results, the prevalence of anxiety was reported to be lower in Malaysian pharmacy students than in other disciplines examined in previous reports (Rajiah and Saravanan, 2014). Previous research suggested that medical students exhibit a high level of stress (James et al., 2017; Naseem and Munaf, 2017; Zvauya et al., 2017; Pitanupong, 2020), even higher than undergraduate engineering students (Saxena et al., 2019). Similarly, the risk of mood disorders, including anxiety and depression, was reported to be significant in dental students in King Saud University (Basudan et al., 2017). Another study conducted in Florida identified an elevated level of stress severity in medical students (Hill et al., 2018).

This psychological issue appears to be more frequent in colleges of health sciences worldwide (Ahmad et al., 2011; Divaris et al., 2013; Jowkar and Mahmoodian, 2020). This accumulating evidence indicates that students enrolled in medical schools are more prone to stress and mood disorders due to the nature of skills acquired,

full-time commitment, and these students' expectations compared to other schools (Dyrbye et al., 2005; Mocny-Pachonńska et al., 2020).

Our logistic regression analyses also indicated that year of study is associated with the risk of being stressed. For instance, we found that 1st-3rd year students are at twice the risk compared with those on an internship. It has been reported that first-year medical students exhibit significant and persistent mental health issues (Duffy et al., 2020). A recent longitudinal study indicated that the level of anxiety four months before COVID-19 among first-year undergraduates was significant and increased following the pandemic (Fruehwirth et al., 2021). In a study that examined depression among students in the first year and fourth year of dentistry college, it was found that the prevalence was 12% and 4 %, respectively (Jaworska et al., 2014). A previous study reported that the majority of first-year medical students in northwestern India are stressed and burned out. Most of reported a moderate level of stress. Additionally, these students performed active coping strategies (Nebhinani and Kuppili, 2021), indicating the profound effect of stress on students at the beginning of their college life (Owczarek et al., 2020). This issue seems to be extremely serious, and preventive measures are urgently needed. A previous successful experience implemented Dismiss Your School Anxieties (DYSA). This program is based on cognitive restructuring capacities, mainly through small-group training, optimizing self-organization, and holistic approaches. Two decades ago, the University of Manchester implemented DYSA. In their experience, the program can be further modified and implemented in colleges successfully. Their study suggested that its impact on students' mental health and academic performance would be enhanced if implemented in the first weeks of transitioning from schools to universities (Brown and Ralph, 1999). At present, adapted and modulated training programs can help prevent reduction in health and academic levels.

Additionally, our results indicated that VLR1 is associated with anxiety. The adjusted odds ratio was almost 1.5. Conversely, our logistic regression suggested that VLR5 is associated negatively with GAD. This indicates that more anxious students were less stressed about online exams, meaning that online exams are not a contributor to the development of anxiety. This is evidenced in the weak association between exam-mediated stress and anxiety and depression. In line with this interpretation, a German report indicated the lack of association between acute test anxiety and depression in medical students (Hahn et al., 2017). Another explanation for this is that the hallmarks of anxiety are the continuous worry and a lack of tolerance towards ambiguous future events (Dugas et al., 1997), as exam arrangements during COVID-19 were less stressful compared with previous years. These arrangements in King Saud University were: 1) total grades per final exam were reduced and 2) more continuous quizzing and an assignment-based grading system were implemented. It is evident from a previous study that the implementation of frequent consequential examination improves student performance by 50%. The frequent grading system enhanced students' self-regulatory skills (Pennebaker et al., 2013), such as taking notes, attending classes, and so on (Schunk and Zimmerman, 1997). Additionally, repeated testing helped them meet course goals (Pennebaker et al., 2013). During the virtual educational experience, students' self-regulatory competence and academic self-regulatory skills were highlighted. This provides insights into new tools that could be implemented frequently in the education system in health science colleges (Schunk and Zimmerman, 1997; Zheng and Zhang, 2020; Pelikan et al., 2021).

5. Study limitations

Although the output of this study is significant, several limitations need to be addressed. First, although these scales have been

validated previously, this study involved a self-reported questionnaire. Second, the research was conducted in one university. Other institutes and demographical variability may have affected the results and the interpretation of the data. While our study consists of a large sample size, our results were utilized through preventive measures convenient sampling.

6. Conclusion

In conclusion, our study highlights the need to establish gender-based tailored mental health support systems that provide preventive measures. This study also indicates the need to seek an understanding of the complicated nature of mood disorders. Additionally, it will help communicate science with our local communities and highlight the massive impact of our funding agencies on the role of research in shaping our youths' health and safety. The findings also lead us to recommending that institutions should develop programs and platforms that safely encourage students to interact and seek guidance, particularly those at higher risk of stress such as females and first-year students.

The overwhelming mental health burden should be extensively examined to provide further insights into establishing supportive programs and assist policymakers, health system personnel, and educators identify the best management systems. Most importantly, this will help to reach parity in managing brain disorders and reduce the global mental health burden across the health and economic sectors.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

The authors extend their appreciation to the College of Pharmacy Research Center, Deanship of Scientific Research, King Saud University.

Author Contributions

TKA designed the current study and contributed to the acquisition, analysis, and interpretation of data. SA & RA contributed to the study design, sample collection, and drafting the manuscript. AR contributed to the study design, data analysis, and writing the manuscript. NMA, MAA provided intellectual support and contributed to the study design. All authors read and approved the final manuscript.

References

- Abdous, M.H., dous 2019. Influence of satisfaction and preparedness on online students' feelings of anxiety. *Internet Higher Educ.* <https://doi.org/10.1016/j.iheduc.2019.01.001>.
- Ahmad, S., Ajmal, M., 2019. Exploration of Anxiety Factors among Students of Distance Learning: A Case Study of Allama Iqbal Open University. *Bull. Educ. Res.*
- Ahmad, M.S., Md Yusoff, M.M., Abdul Razak, I., 2011. Stress and its relief among undergraduate dental students in Malaysia. *Southeast Asian J. Trop. Med. Public Health.*
- Al Mamun, F., Hosen, I., Misti, J.M., et al., 2021. Mental Disorders of Bangladeshi Students During the COVID-19 Pandemic: A Systematic Review. *Psychol. Res. Behav. Manag.* <https://doi.org/10.2147/PRBM.S315961>.
- AlAteeq, D.A., Aljhani, S., AlEesa, D., 2020a. Perceived stress among students in virtual classrooms during the COVID-19 outbreak in KSA. *J. Taibah Univ. Med. Sci.* 15 (5), 398–403. <https://doi.org/10.1016/j.jtumed.2020.07.004>.

- AlAteeq, D.A., Aljhani, S., Althiyabi, I., Majzoub, S., 2020b. Mental health among healthcare providers during coronavirus disease (COVID-19) outbreak in Saudi Arabia. *J. Infect. Public Health* 13 (10), 1432–1437. <https://doi.org/10.1016/j.jiph.2020.08.013>.
- Ali, M., Asim, H., Edhi, A.I., Hashmi, M.D., Khan, M.S., Naz, F., Qaiser, K.N., Qureshi, S. M., Zahid, M.F., Jehan, I., 2015. Does academic assessment system type affect levels of academic stress in medical students? *Medical Educ. Online* 20 (1), 27706. <https://doi.org/10.3402/meo.v20.27706>.
- Alshammari, M.A., Alshammari, T.K., 2021. COVID-19: A new challenge for mental health and policymaking recommendations. *J. Infect. Public Health* 14 (8), 1065–1068. <https://doi.org/10.1016/j.jiph.2021.05.020>.
- Alsoufi, A., Alsuayihili, A., Msherghi, A., et al., 2020. Impact of the COVID-19 pandemic on medical education: Medical students' knowledge, attitudes, and practices regarding electronic learning. *PLoS One*. <https://doi.org/10.1371/journal.pone.0242905>.
- Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., Umek, L., 2020. Impacts of the COVID-19 Pandemic on Life of Higher Education Students: A Global Perspective. *Sustainability* 12 (20), 8438. <https://doi.org/10.3390/su12208438>.
- Association, T. A. P. n.d. Anxiety. *Psychology Topics*, from <https://www.apa.org/topics/anxiety>.
- Bahhawi, T.A., Albasheer, O.B., Makeen, A.M., et al., 2018. Depression, anxiety, and stress and their association with khat use: a cross-sectional study among Jazan University students, Saudi Arabia. *Neuropsychiatr. Dis. Treat.* <https://doi.org/10.2147/ndt.S182744>.
- Basheti, I.A., Mhaidat, Q.N., Mhaidat, H.N., Saqr, M., 2021. Prevalence of anxiety and depression during COVID-19 pandemic among healthcare students in Jordan and its effect on their learning process: A national survey. *PLoS ONE* 16 (4), e0249716. <https://doi.org/10.1371/journal.pone.0249716>.
- Basu, A., Kim, H.H., Basaldua, R., Choi, K.W., Charron, L., Kelsall, N., Hernandez-Diaz, S., Wyszynski, D.F., Koenen, K.C., Kamperman, A.M., 2021. A cross-national study of factors associated with women's perinatal mental health and wellbeing during the COVID-19 pandemic. *PLoS ONE* 16 (4), e0249780. <https://doi.org/10.1371/journal.pone.0249780>.
- Basudan, S., Binanzan, N., Alhassan, A., 2017. Depression, anxiety and stress in dental students. *Int. J. Med. Educ.* 8, 179–186. <https://doi.org/10.5116/ijme.5910.b961>.
- Batra, K., Sharma, M., Batra, R., Singh, T.P., Schvaneveldt, N., 2021. Assessing the Psychological Impact of COVID-19 among College Students: An Evidence of 15 Countries. *Healthcare (Basel)* 9 (2), 222. <https://doi.org/10.3390/healthcare9020222>.
- Brown, M., Ralph, S., 1999. Using the DYSA Programme to Reduce Stress and Anxiety in First-year University Students. *Pastoral Care Educ.* 17 (3), 8–13. <https://doi.org/10.1111/1468-0122.00130>.
- Browning, M.H.E.M., Larson, L.R., Sharaievska, I., et al., 2021. Psychological impacts from COVID-19 among university students: Risk factors across seven states in the United States. *PLoS ONE*. <https://doi.org/10.1371/journal.pone.0245327>.
- Cleofas, J.V., Rocha, I.C.N., 2021. Demographic, gadget and internet profiles as determinants of disease and consequence related COVID-19 anxiety among Filipino college students. *Educ. Informat. Technol.* 26 (6), 6771–6786. <https://doi.org/10.1007/s10639-021-10529-9>.
- Colthorpe, K., Sharifrad, T., Ainscough, L., Anderson, S., Zimbardi, K., 2018. Prompting undergraduate students' metacognition of learning: implementing 'meta-learning' assessment tasks in the biomedical sciences. *Assessm. Eval. Higher Educ.* 43 (2), 272–285. <https://doi.org/10.1080/02602938.2017.1334872>.
- Coombs, R.H., Fawzy, F.I., 1982. The effect of marital status on stress in medical school. *Am. J. Psychiatry*. <https://doi.org/10.1176/ajp.139.11.1490>.
- Credé, M., Kuncel, N.R., 2008. Study Habits, Skills, and Attitudes: The Third Pillar Supporting Collegiate Academic Performance. *Perspect. Psychol. Sci.* 3 (6), 425–453. <https://doi.org/10.1111/j.1745-6924.2008.00089.x>.
- Divaris, K., Mafla, A.C., Villa-Torres, L., Sánchez-Molina, M., Gallego-Gómez, C.L., Vélez-Jaramillo, L.F., Tamayo-Cardona, J.A., Pérez-Cepeda, D., Vergara-Mercado, M.L., Simancas-Pallares, M.Á., Polychronopoulou, A., 2013. Psychological distress and its correlates among dental students: a survey of 17 Colombian dental schools. *BMC Med. Educ.* 13 (1). <https://doi.org/10.1186/1472-6920-13-91>.
- Duffy, A., Keown-Stoneman, C., Goodday, S., Horrocks, J., Lowe, M., King, N., Pickett, W., McNevin, S.H., Cunningham, S., Rivera, D., Bisdounis, L., Bowie, C.R., Harkness, K., Saunders, K.E.A., 2020. Predictors of mental health and academic outcomes in first-year university students: Identifying prevention and early-intervention targets. *BJPsych Open* 6 (3). <https://doi.org/10.1192/bjo.2020.24>.
- Dugas, M.J., Freeston, M.H., Ladouceur, R., 1997. Intolerance of Uncertainty and Problem Orientation in Worry. *Cognitive Therapy Res.* <https://doi.org/10.1023/A:1021890322153>.
- Dyrbye, L.N., Thomas, M.R., Shanafelt, T.D., 2005. Medical Student Distress: Causes, Consequences, and Proposed Solutions. *Mayo Clin. Proc.* 80 (12), 1613–1622. <https://doi.org/10.4065/80.12.1613>.
- Entwistle, N.J., Peterson, E.R., 2004. Conceptions of learning and knowledge in higher education: Relationships with study behaviour and influences of learning environments. *Int. J. Educ. Res.* 41 (6), 407–428. <https://doi.org/10.1016/j.ijer.2005.08.009>.
- Europe, W. R. O. f. 2020. 2019-nCoV outbreak is an emergency of international concern. Health emergencies from <https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/news/news/2020/01/2019-ncov-outbreak-is-an-emergency-of-international-concern>.
- Ezeala, C.C., Siyanga, N., 2015. Analysis of the study skills of undergraduate pharmacy students of the University of Zambia School of Medicine. *J. Educ. Eval. Health Prof.* 12, 46. <https://doi.org/10.3352/jeehp.2015.12.46>.
- Fauzi, M.F., Anuar, T.S., Teh, L.K., et al., 2021. Stress, Anxiety and Depression among a Cohort of Health Sciences Undergraduate Students: The Prevalence and Risk Factors. *Int. J. Environ. Res. Public Health*. <https://doi.org/10.3390/ijerph18063269>.
- Flavell, J.H., 1979. Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *Am. Psychol.* 34 (10), 906–911. <https://doi.org/10.1037/0003-066X.34.10.906>.
- Francesca Lagomarsino, I.C., Parisi, R., Rania, N., 2020. Care Tasks and New Routines for Italian Families during the COVID-19 Pandemic: Perspectives from Women. *Italian Sociol. Rev.* <https://doi.org/10.13136/isr.v10i3S.401>.
- Francis, J.L., Moitra, E., Dyck, I., Keller, M.B., 2012. The impact of stressful life events on relapse of generalized anxiety disorder. *Depression Anxiety* 29 (5), 386–391.
- Fruehwirth, J.C., Biswas, S., Perreira, K.M., Lin, C.-Y., 2021. The Covid-19 pandemic and mental health of first-year college students: Examining the effect of Covid-19 stressors using longitudinal data. *PLoS ONE* 16 (3), e0247999. <https://doi.org/10.1371/journal.pone.0247999>.
- Gao, W., Ping, S., Liu, X., 2020. Gender differences in depression, anxiety, and stress among college students: A longitudinal study from China. *J. Affect. Disord.* 263, 292–300.
- Gillis, A., Krull, L.M., 2020. COVID-19 Remote Learning Transition in Spring 2020: Class Structures, Student Perceptions, and Inequality in College Courses. *Teaching Sociol.* 48 (4), 283–299. <https://doi.org/10.1177/0092055X20954263>.
- Guo, K., Zhang, X., Bai, S., Minhat, H.S., Nazan, A.I.N.M., Feng, J., Li, X., Luo, G., Zhang, X., Feng, J., Li, Y., Si, M., Qiao, Y., Ouyang, J., Saliluddin, S., West, J.C., 2021. Assessing social support impact on depression, anxiety, and stress among undergraduate students in Shaanxi province during the COVID-19 pandemic of China. *PLoS ONE* 16 (7), e0253891. <https://doi.org/10.1371/journal.pone.0253891>.
- Hahn, H., Kropp, P., Kirschstein, T., Rucker, G., Müller-Hilke, B., Manalo, E., 2017. Test anxiety in medical school is unrelated to academic performance but correlates with an effort/reward imbalance. *PLoS ONE* 12 (2), e0171220. <https://doi.org/10.1371/journal.pone.0171220>.
- Hakami, Z., Khanagar, S.B., Vishwanathaiah, S., Hakami, A., Bokhari, A.M., Jabali, A.H., Alasmari, D., Aldrees, A.M., 2021. Psychological impact of the coronavirus disease 2019 (COVID-19) pandemic on dental students: A nationwide study. *J. Dent. Educ.* 85 (4), 494–503.
- Hawes, M.T., Szenczy, A.K., Klein, D.N., et al., 2021. Increases in depression and anxiety symptoms in adolescents and young adults during the COVID-19 pandemic. *Psychol. Med.* <https://doi.org/10.1017/S0033291720005358>.
- Hendriks, S.M., Spijker, J., Licht, C.M.M., Beekman, A.T.F., Hardeveld, F., de Graaf, R., Batelaan, N.M., Penninx, B.W.J.H., 2014. Disability in anxiety disorders. *J. Affect. Disord.* 166, 227–233. <https://doi.org/10.1016/j.jad.2014.05.006>.
- Hill, M.R., Goicochea, S., Merlo, L.J., 2018. In their own words: stressors facing medical students in the millennial generation. *Med. Educ. Online* 23 (1), 1530558. <https://doi.org/10.1080/10872981.2018.1530558>.
- Hoxha, Z.H.D.A.L., 2020. The impact of COVID-19 on higher education: A study of interaction among Kosovar students' mental health, attitudes toward online learning, study skills, and lifestyle changes Impact of the COVID-19 Pandemic on Education and Wellbeing: Implications for Practice and Lessons for the Future. P. D. M. M. a. P. A. D. L. Jemini-Gashi, University of Prishtina " Hasan Prishtina" Faculty of Philosophy, Department of Psychology.
- Jackson, N., 2004. Developing the concept of metalearning. *Innovat. Educ. Teaching Int.* <https://doi.org/10.1080/1470329042000276995>.
- James, B.O., Thomas, I.F., Omoaregba, J.O., Okogbenin, E.O., Okonoda, K.M., Ibrahim, A.W., Salihu, A.S., Oshodi, Y.O., Orowigho, A., Odinka, P.C., Eze, G.O., Onyebueke, G.C., Aweh, B.E., 2017. Psychosocial correlates of perceived stress among undergraduate medical students in Nigeria. *Int. J. Med. Educ.* 8, 382–388. <https://doi.org/10.5116/ijme.59c6.3075>.
- Jaworska, L., Morawska, N., Morga, P., Szczepańska-Gieracha, J., 2014. Analiza Częstości Występowania Objawów Depresyjnych Wśród Studentów Wydziału Fizjoterapii Akademii Wychowania Fizycznego We Wrocławiu w Kontekście Planów Zawodowych. *Fizjoterapia*.
- Johnson, S.U., Ulvenes, P.G., Øktedalen, T., Hoffart, A., 2019. Psychometric Properties of the General Anxiety Disorder 7-Item (GAD-7) Scale in a Heterogeneous Psychiatric Sample. *Front. Psychol.* 10. <https://doi.org/10.3389/fpsyg.2019.01713>.
- Jowkar, Z., Masoumi, M., Mahmoodian, H., 2020. Psychological Stress and Stressors Among Clinical Dental Students at Shiraz School of Dentistry, Iran. *Adv. Med. Educ. Practice*. <https://doi.org/10.2147/AMEP.S236758>.
- Kamel, A., Behery, F., Kenawy, G., et al., 2020. Exploring study skills among university students in Riyadh, Saudi Arabia. *Saudi J. Oral Sci.* <https://doi.org/10.4103/sjos.SJOralSci.87.19>.
- Khalil, R., Mansour, A.E., Fadda, W.A., Almisnid, K., Aldamegh, M., Al-Nafeesah, A., Alkhalifah, A., Al-Wutayd, O., 2020. The sudden transition to synchronized online learning during the COVID-19 pandemic in Saudi Arabia: a qualitative study exploring medical students' perspectives. *BMC Med. Educ.* 20 (1). <https://doi.org/10.1186/s12909-020-02208-z>.
- Khoshaem, H.B., Al-Sukayt, A., Chinn, K., Nurunnabi, M., Sundarasan, S., Kamaludin, K., Baloch, G.M., Hossain, S.F.A., 2020. Anxiety Level of University Students During COVID-19 in Saudi Arabia. *Front. Psychiatry* 11. <https://doi.org/10.3389/fpsyg.2020.579750>.

- Learning, C. C. f. t. a. n.d. Virtual Office Hours. Teaching in All Modalities, from <https://ctl.columbia.edu/resources-and-technology/teaching-with-technology/teaching-online/office-hours/>.
- Li, Y., Wang, A., Wu, Y., et al., 2021. Impact of the COVID-19 Pandemic on the Mental Health of College Students: A Systematic Review and Meta-Analysis. *Front. Psychol.* <https://doi.org/10.3389/fpsyg.2021.669119>.
- Liaw, S.-S., Huang, H.-M., 2013. Perceived satisfaction, perceived usefulness and interactive learning environments as predictors to self-regulation in e-learning environments. *Comput. Educ.* 60 (1), 14–24. <https://doi.org/10.1016/j.compedu.2012.07.015>.
- Liu, X., Ping, S., Gao, W., 2019. Changes in Undergraduate Students' Psychological Well-Being as They Experience University Life. *Int. J. Environ. Res. Public Health* 16 (16), 2864. <https://doi.org/10.3390/ijerph16162864>.
- Loades, M.E., Chatburn, E., Higson-Sweeney, N., Reynolds, S., Shafran, R., Brigden, A., Linney, C., McManus, M.N., Borwick, C., Crawley, E., 2020. Rapid Systematic Review: The Impact of Social Isolation and Loneliness on the Mental Health of Children and Adolescents in the Context of COVID-19. *J. Am. Acad. Child Adolesc. Psychiatry* 59 (11), 1218–1239.e3. <https://doi.org/10.1016/j.jaac.2020.05.009>.
- Luo, M., Guo, L., Yu, M., Jiang, W., Wang, H., 2020. The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public – A systematic review and meta-analysis. *Psychiatry Res.* 291, 113190. <https://doi.org/10.1016/j.psychres.2020.113190>.
- Machado, R.A., Bonan, P.R.F., Perez, D.E.d.C., Martelli Júnior, H., 2020. COVID-19 pandemic and the impact on dental education: discussing current and future perspectives. *Braz Oral. Res.* 34. <https://doi.org/10.1590/1807-3107bor-2020.vol34.0083>.
- Mahmood, R.R.N., 2010. The Relationship between Test Anxiety and Academic Achievement. *Bull. Educ. Res.*
- Mocny-Pachońska, K., Doniec, R., Trzcionka, A., et al., 2020. Evaluating the stress-response of dental students to the dental school environment. *PeerJ.* <https://doi.org/10.7717/peerj.8981>.
- Naseem, S., Munaf, S., 2017. Suicidal Ideation, Depression, Anxiety, Stress, And Life Satisfaction Of Medical, Engineering, And Social Sciences Students. *J. Ayub. Med. Coll. Abbottabad*.
- Naser, A.Y., Dahmash, E.Z., Al-Rousan, R., Alwafi, H., Alrawashdeh, H.M., Ghoul, I., Abidine, A., Bokhary, M.A., Al-Hadithi, H.T., Ali, D., Abuthawabeh, R., Abdelwahab, G.M., Alhartani, Y.J., Al Muhaisen, H., Dagash, A., Alyami, H.S., 2020. Mental health status of the general population, healthcare professionals, and university students during 2019 coronavirus disease outbreak in Jordan: A cross-sectional study. *Brain. Behav.* 10 (8). <https://doi.org/10.1002/brb3.v10.810.1002/brb3.1730>.
- Nearchou, F., Flinn, C., Niland, R., Subramaniam, S.S., Hennessy, E., 2020. Exploring the Impact of COVID-19 on Mental Health Outcomes in Children and Adolescents: A Systematic Review. *Int. J. Environ. Res. Public Health* 17 (22), 8479. <https://doi.org/10.3390/ijerph17228479>.
- Nebhinani, N., Kuppili, P.P., 2021. Stress, Burnout, and Coping among First-Year Medical Undergraduates. *J. Neurosci. Rural Pract.* 12 (03), 483–489. <https://doi.org/10.1055/s-0041-1727576>.
- OECD. 2020. Strengthening online learning when schools are closed: The role of families and teachers in supporting students during the COVID-19 crisis. OECD Policy Responses to Coronavirus (COVID-19).
- Ogunbode, K.F., Wiche, H.I., 2021. Nexus of Nigerian Academic Libraries and Online Education in the Pandemic Era. *Int. Informat. Library Rev.* <https://doi.org/10.1080/10572317.2021.1973310>.
- Owczarek, J.E., Lion, K.M., Radwan-Oczko, M., 2020. The impact of stress, anxiety and depression on stomatognathic system of physiotherapy and dentistry first-year students. *Brain Behavior.* 10 (10). <https://doi.org/10.1002/brb3.1797>.
- Pappa, S., Ntella, V., Giannakas, T., Giannakoulis, V.G., Papoutsis, E., Katsaounou, P., 2020. Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. *Brain Behav. Immun.* 88, 901–907. <https://doi.org/10.1016/j.bbi.2020.05.026>.
- Pelikan, E.R., Lüftenecker, M., Holzer, J., Korlat, S., Spiel, C., Schober, B., 2021. Learning during COVID-19: the role of self-regulated learning, motivation, and procrastination for perceived competenceLernen während COVID-19: Die Relevanz von selbstreguliertem Lernen, intrinsischer Motivation und passiver Prokrastination für die wahrgenommene Kompetenz. *Zeitschrift für Erziehungswissenschaft* 24 (2), 393–418. <https://doi.org/10.1007/s11618-021-01002-x>.
- Pennebaker, J.W., Gosling, S.D., Ferrell, J.D., Costa, M.J., 2013. Daily Online Testing in Large Classes: Boosting College Performance while Reducing Achievement Gaps. *PLoS ONE* 8 (11), e79774. <https://doi.org/10.1371/journal.pone.0079774>.
- Pitanupong, J., 2020. Stress and Coping Strategies among Thai Medical Students in a Southern Medical School. *Siriraj Med. J.* 72 (3), 238–244. <https://doi.org/10.33192/Smj.2020.32>.
- Puzziferro, M., 2008. Online Technologies Self-Efficacy and Self-Regulated Learning as Predictors of Final Grade and Satisfaction in College-Level Online Courses. *Am. J. Distance Educ.* 22 (2), 72–89. <https://doi.org/10.1080/08923640802039024>.
- Rajiah, K., Saravanan, C., 2014. The effectiveness of psychoeducation and systematic desensitization to reduce test anxiety among first-year pharmacy students. *Am. J. Pharm. Educ.* 78 (9), 163. <https://doi.org/10.5688/ajpe789163>.
- Raosoft, I., 2004. Raosoft, I. Sample size calculator.
- Ren, Z., Xin, Y., Ge, J., Zhao, Z., Liu, D., Ho, R.C.M., Ho, C.S.H., 2021. Psychological Impact of COVID-19 on College Students After School Reopening: A Cross-Sectional Study Based on Machine Learning. *Front. Psychol.* 12. <https://doi.org/10.3389/fpsyg.2021.641806>.
- Rogowska, A.M., Kuśnierz, C., Bokszczanin, A., 2020. Examining Anxiety, Life Satisfaction, General Health, Stress and Coping Styles During COVID-19 Pandemic in Polish Sample of University Students. *Psychol. Res. Behav. Manag.* <https://doi.org/10.2147/prbm.S266511>.
- Rose, S., 2020. Medical Student Education in the Time of COVID-19. *JAMA* 323 (21), 2131. <https://doi.org/10.1001/jama.2020.5227>.
- Saipanish, R., 2003. Stress among medical students in a Thai medical school. *Med. Teach.* 25 (5), 502–506. <https://doi.org/10.1080/0142159031000136716>.
- Santamarina, G.A.J.C., 2021. Academia During the COVID-19 Pandemic: A Study within the Geo-Science and Engineering Field. *Int. J. Innovat. Educ. Res.* <https://doi.org/10.31686/ijer.vol9.iss1.2906>.
- Saxena, S.K., Mani, R.N., Dwivedi, A.K., et al., 2019. Association of educational stress with depression, anxiety, and substance use among medical and engineering undergraduates in India. *Ind. Psychiatry J.* https://doi.org/10.4103/ijp.ijp_3_20.
- Schunk, D.H., Zimmerman, B.J., 1997. Social origins of self-regulatory competence. *Educ. Psychol.* 32 (4), 195–208. https://doi.org/10.1207/s15326985ep3204_1.
- Seaborn, K., Chignell, M., Gwizdka, J., 2021. Psychological resilience during COVID-19: a meta-review protocol. *BMJ Open* 11 (6), e051417. <https://doi.org/10.1136/bmjopen-2021-051417>.
- Services, U. o. H.-C. L. C. 2021. Study Skills Assessment Questionnaire. from <https://uhcl.edu/counseling-services/resources/study-skills-questionnaire>.
- Son, C., Hegde, S., Smith, A., Wang, X., Sasangohar, F., 2020. Effects of COVID-19 on College Students' Mental Health in the United States: Interview Survey Study. *J. Med. Internet Res.* 22 (9), e21279. <https://doi.org/10.2196/21279>.
- Spitzer, R.L., Kroenke, K., Williams, J.B.W., Löwe, B., 2006. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch. Intern. Med.* 166 (10), 1092. <https://doi.org/10.1001/archinte.166.10.1092>.
- Ta, V.P., Gesselman, A.N., Perry, B.L., Fisher, H.E., Garcia, J.R., 2017. Stress of Singlehood: Marital Status, Domain-Specific Stress, and Anxiety in a National U. S. Sample. *J. Social Clin. Psychol.* 36 (6), 461–485. <https://doi.org/10.1521/jscp.2017.36.6.461>.
- Tasnim, R., Suján, M.S.H., Islam, M.S., Ritu, A.H., Siddique, M.A.B., Toma, T.Y., Nowshin, R., Hasan, A., Hossain, S., Nahar, S., Islam, S., Islam, M.S., Potenza, M.N., van Os, J., 2021. Prevalence and correlates of anxiety and depression in frontline healthcare workers treating people with COVID-19 in Bangladesh. *BMC Psychiatry* 21 (1). <https://doi.org/10.1186/s12888-021-03243-w>.
- Tuncay, N., Uzunboylu, H., 2010. Anxiety and Resistance in Distance Learning. *Cypriot J. Educ. Sci.*
- UNESCO, 2020 - 2021. Covid-19 Impact on Education. Education: From disruption to recovery, UNESCO: Global monitoring of school closures.
- Wang, X., Hegde, S., Son, C., Keller, B., Smith, A., Sasangohar, F., 2020. Investigating Mental Health of US College Students During the COVID-19 Pandemic: Cross-Sectional Survey Study. *J. Med. Internet Res.* 22 (9), e22817. <https://doi.org/10.2196/22817>.
- Yusoff, M.S.B., Abdul Rahim, A.F., Baba, A.A., Ismail, S.B., Mat Pa, M.N., Esa, A.R., 2013. Prevalence and associated factors of stress, anxiety and depression among prospective medical students. *Asian J. Psychiatr.* 6 (2), 128–133. <https://doi.org/10.1016/j.ajp.2012.09.012>.
- Zheng, B., Zhang, Y., 2020. Self-regulated learning: the effect on medical student learning outcomes in a flipped classroom environment. *BMC Med. Educ.* 20 (1). <https://doi.org/10.1186/s12909-020-02023-6>.
- Zvauya, R., Oyebo, F., Day, E.J., Thomas, C.P., Jones, L.A., 2017. A comparison of stress levels, coping styles and psychological morbidity between graduate-entry and traditional undergraduate medical students during the first 2 years at a UK medical school. *BMC Res. Notes* 10 (1). <https://doi.org/10.1186/s13104-017-2395-1>.