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Middle East Respiratory Syndrome-Corona Virus (MERS-CoV) associated stress among medical students at a university teaching hospital in Saudi Arabia

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ABSTRACT

Background and objectives: Middle East Respiratory Syndrome Corona Virus (MERS-CoV) outbreak in 2014 was associated with high public anxiety in the affected countries. Media speculations may have increased this psychological distress. The healthcare community was the most distressed because they were at the highest risk of infection. This study is the first to explore MERS-CoV epidemic impact on medical students' perception and determinants of their psychological distress during this outbreak.

Methods: We randomly selected and surveyed 200 students from the College of Medicine at King Saud University, Riyadh, Saudi Arabia. A predesigned questionnaire was answered by participants, and the collected data were statistically analyzed.

Results: One hundred and seventy-four (87%) responded. Female students had a significantly higher mean stress level than males ($P < 0.001$). Participants had a mean GAD score of 2.7 ± 3.1 and a median of 2. Perceived sufficiency of information score was the highest mean and median (17.4 ± 4.2 and 18 respectively). College and hospital announcements were the most common source of information (25.4%). One hundred and thirty-four (77%) reported minimal anxiety, thirty-two (18.4%) reported mild anxiety, 8 (4.6%) reported moderate anxiety, and none of them reported severe anxiety (score > 14). The stress level (as reported on 1–10 scale) shows significant correlation with Generalized Anxiety Disorder (GAD-7) score. We found in this study that significant predictors in our model, in terms of more significant to the least, were: an increased self-report on hygienic habits, self-reported social avoidance, the generalized anxiety score and finally being female gender while other variables including numbers of resources access, agreeing with public fear and knowledge score on MERS-CoV all were found to be non-significant. However, the number of accessed resources, as per students, has borderline significant correlation with higher self-reported anxiety from MERS-CoV.

Conclusions: Medical students' psychological needs during the MERS-CoV outbreak should be addressed appropriately. Our results highlight the need to establish psychological support programs for medical students during an infectious disease outbreak.

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Introduction

The Middle East Respiratory Syndrome Coronavirus (MERS-CoV) was first isolated in September 2012 [1], and as of September 2019, it has caused 851 deaths out of 2468 who encountered this viral infection according to the World Health Organization (WHO) [2]. Saudi Arabia has had the vast majority of cases, with decreasing mortality over the years starting from 45% in 2014 to 41% in 2015, while in a recent study in 2017–2018, the mortality rate was 30.5% [3]. Neighboring countries had most of the remaining cases, with small clusters in remote countries in North Africa, East Asia, Europe, and the United States. The cases ranged from being diagnosed by screening asymptomatic contacts to manifestations of severe pulmonary infection and multi-organ failure with substantial consequences.

Outbreaks can put significant psychological stress that may lead to unfavorable effects on learning and the overall psychological health of students. Many other studies investigate stress in the aftermath, which may not reflect the actual stress subjects felt during the actual event. Many publications addressed similar issues among hospital workers and residents; however, only a few studies investigate the psychological stress of university health college students during the MERS-CoV outbreak [4,5].

We aim in this study to explore and evaluate the degree of stress and possible risk factors that might interact individually or jointly with worry levels that medical students experienced during the MERS-CoV 2014 epidemic in Saudi Arabia.

Methods

Study design and subjects' selection

We randomly selected and surveyed 200 students from the College of Medicine at King Saud University, Riyadh, Saudi Arabia (17% of the total registered number of medical students in the College of Medicine, King Saud University). Sampling was done by sending the electronic surveys to a random sample of 40 medical students in each academic year through dedicated five peer representatives. Out of them, 174 (87%) students completed the survey, 13 (6.5%) did not complete the survey, and another 13 (6.5%) did not respond. The Institutional Review Board of King Saud University Medical City (KSUMC) approved the study, and the objectives of the study were explained to subjects before enrollment. Their voluntary participation was documented with their written consent on the first page of the questionnaire.

Data was compiled over two weeks during the outbreak of MERS-CoV that occurred in King Khalid University Hospital (KKUH) in Saudi Arabia in July 2014. The surveyed sample included undergraduate medical students from different years of education at the College of Medicine, King Saud University, Riyadh, Saudi Arabia. For the analysis purpose, junior students were those in their first three years, and seniors were those in their fourth and fifth years.

The sample size of 200 was determined since the focus of the study was exploring the relationship between co-variables and the stress level with 95% confidence and power of detecting multiple R^2 as low as 8% in 80% of the time. The desired sample was determined to be 200 since the tentative focus was on 10–Major-variables as a priori assumption, a ratio of 20 observations to each variable of interest were determined ahead of the time, so the decision was taken to include at least 200 subjects.

Data collection and processing

The questionnaire used was partially adapted from a previously published study in Greece after obtaining the authors' permission [6].

After obtaining students' consent to participate, the first part of the survey addressed the students' perceived level of change in their personal hygiene and social habits with five responses (do not know, did not change, changed a little, moderately, or very much). This part discussed hand washing, buying more sanitizers, compliance with universal precautions, avoiding contact with people with flu symptoms, avoiding social gatherings, handshaking, and public utilities. We also administered a basic knowledge test on MERS-CoV consisting of seven true or false questions. Questions were tailored, and answers were specified based on the literature review about the MERS-CoV, modes of transmission, clinical presentation, and treatment.

The next part of the survey dealt with the students' feelings about the sufficiency of information they have received about MERS-CoV during the outbreak, each aspect at a time, symptoms, signs, prognosis, treatment, mode of transmission, and prevention. In addition, we asked about various sources of this information; MOH official statements, MOH website, Hospital or College announcements, WHO website, social media, or others. Then we administered the General Anxiety Disorder 7-item (GAD-7) scale, each item is coded from zero to three, per the frequency of different anxiety symptoms, and the total score is computed by summing the responses. Categorizations of the GAD-7 scores were as per the original scale (i.e.: 0–4 = minimal anxiety, 5–9 = mild anxiety, 10–14 = moderate anxiety, and >14 = severe anxiety). A score of 10 and above is diagnostic of GAD with a sensitivity of 89% and a specificity of 82% [7].

Next, we asked four questions about approval to public fear of the outbreak. Answers were on a Likert-like scale ranging from 1 to 5, from strongly agree to strongly disagree. Finally, we asked subjects to rate their worries on a scale from one to ten regarding contracting the infection or transmitting it to a friend or a family member.

Data was collected from the students and further entered a secure Excel™ sheet initially. All information was treated with strict confidentiality, maintaining the anonymity of respondents throughout the study.

Statistical analysis

Missing Data Analysis was carried out, and only 13 records out of the 200 contained missing information on more than 50% of the questionnaire; therefore, they were eliminated from the study. Five more records were signed with a refusal to complete the survey, and seven were returned late. Therefore, only 175 properly completed records were included in the analysis.

Descriptive statistics with mean, median, and Standard Deviation (SD) were carried out on continuous variables, and percentages were utilized for dichotomous variables. Multiple Response Dichotomy Analysis was utilized for multiple response items and correlations (Pearson's r product correlation) for relationships/dependency. Moreover, the summative scale estimation relied on at least 0.6 Cronbach's alpha between scale items to compute the total scores of existing constructs. A Linear regression model with the criterion of stress level (1–10 score) to test the relationship between the outcome variable of stress and the

Table 1
Demographic characteristics and stress-level of respondents.

Characteristic	Number of respondents = 174	Stress levels Mean \pm SD
Male: N (%)	105 (60.3%)	4.56 \pm 1.63
Female: N (%)	69 (39.7%)	5.61 \pm 1.65
Age (years): Mean \pm SD	21.6 (1.4)	2.7 \pm 3.1
Senior student: N (%)	98 (56.3%)	4.75 \pm 1.70
Junior student: N (%)	76 (43.7%)	5.14 \pm 1.72

Table 2
Descriptive statistics of surveyed variables among participants.

	Mean \pm SD	Median
GAD score	2.7 \pm 3.1	2
Perceived change hygienic score	7.8 \pm 2.3	8
Perceived social avoidance score	4.4 \pm 1.7	4
Perceived sufficiency of information score	17.4 \pm 4.2	18
Attitude to public fear score	14.2 \pm 2.4	14
Knowledge score	5.2 \pm 1.3	5
Number of information resources accessed	2.5 \pm 1.1	3

variant which included main composite-summed-scores of GAD, knowledge score, self-reported hygienic habits improvement score, perceived sufficiency of information, the total number of accessed resources and social avoidance. Predictors also included the gender of the student and their seniority level. Alpha significance level was set to 0.05.

The summated scores for both social avoidance and change in hygienic habits were made from items that were found internally consistent after doing reliability testing for their grouped items; the same was applied to GAD score. For hygienic habits score, it had an alpha Cronbach of 0.74, and it included three variables (Increased compliance with hand hygiene, increased buying of sanitizers, and overall increased compliance with universal precautions). For the social avoidance summated score, it had alpha Cronbach's of 0.72, and it included two variables only (social visits limitations and avoiding handshaking). Regarding the GAD-7 score, it had alpha Cronbach of 0.811. The sufficiency of information also has an overall alpha Cronbach's of 0.77, and it included all the questions. However, the agreeability on public fear score had an overall weak Cronbach's alpha of 0.53 with the four items included, one item was dropped, and the Cronbach's alpha Improved to 0.58. Statistical tests for normality, homogeneity of variance, and visual depiction of covariates and the dependent variable were evaluated, only the GAD required square root transformation when fitted into the linear regression model.

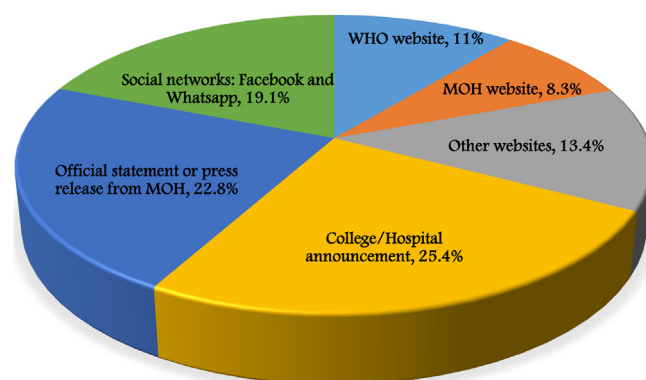
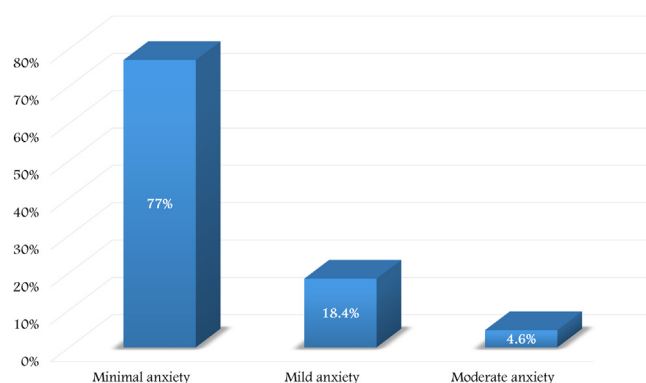
Results

Demographic characteristics of participants

Table 1 shows the demographic characteristics of participants. Out of the 174 respondents, 105 (60.3%) were males. Female students had an overall higher mean stress level than males (Mean \pm SD was 5.61 \pm 1.65 and 4.56 \pm 1.63 respectively), and the difference was found significant in a Mann-Whitney U non-parametric test ($U = 4847.7$, $P < 0.001$). Ninety-eight out of 174 (56.3%) were senior students, and junior students 76 (43.7%) reported more stress than seniors; however, the difference was non-significant ($U = 3283$, $P = 0.176$).

Anxiety levels of participants and associated factors

Table 2 shows the descriptive statistics of the questioned variables. Participant students had mean GAD score of 2.7 \pm 3.1 and a median of 2. Perceived sufficiency of information score was the

**Fig. 1.** Information accessed resources.**Fig. 2.** GAD-7 anxiety level category.

highest mean and median (17.4 \pm 4.2 and 18 respectively), while the number of resources accessed had the lowest mean and median (2.5 \pm 1.1 and 3 respectively).

Fig. 1 shows the percentages of different information resources among participants. College and hospital announcements were the most common source of information (25.4%), followed by official statements or press releases from MOH (22.8%), and the third most common were social networks, mainly Facebook and WhatsApp (19.1%). Other resources for information were: other web resources (13.4%), WHO website (11%), and MOH website (8.3%).

Fig. 2 shows the percentages of the GAD-7 anxiety levels category among surveyed students. Out of the 174 respondents, 134 (77%) reported minimal anxiety, 32 (18.4%) reported mild anxiety, 8 (4.6%) reported moderate anxiety, and none of them reported severe anxiety (score >14).

Table 3 shows the correlation between stress level and continuous predictors included in the model. The stress level (as reported on 1–10 scale) shows a significant correlation with GAD-7 score and moderate correlation with both social avoidance and hygienic habit change ($r = 0.41$ and $r = 0.471$, respectively), and both were statistically significant. Independently, both social avoidance scores and personal hygienic habits show a significant correlation to each other.

Table 4 shows the linear regression model predicting stress level of students as measured on 1–10 points. The model showed that 61.7% of the variations in the students reported anxiety levels from contacting MERS-CoV (Multiple $R = -0.617$), which is equivalent to an adjusted R squared of 38.1%. The model suggested that at least one or more of the predictors had a significant relationship with the student's levels of anxiety [$F(8|165) = 12.71$, <0.001]. The student's improvised hygienic habits score correlated significantly with the student's reported level. Also, the students reported social avoidance score converged significantly with the students reported

Table 3
Correlation between stress level and continuous predictors included in the model.

	Stress level	MERS-CoV Knowledge Score	GAD-7 Score	Number of accessed information resources	Perceived social avoidance score	Perceived change hygienic habits score	Attitude to public fear	Sufficiency of information score
Stress level								
MERS-CoV Knowledge score	0.107							
GAD-7 Score	0.335 ^b	−0.079						
Number of accessed information resources	0.130	−0.168 ^a	0.059					
Perceived social avoidance score	0.411 ^b	−0.086	0.229 ^b	0.037				
Perceived change hygienic habits score	0.417 ^b	0.159 ^a	0.192 ^a	−0.032	0.395 ^b			
Attitude to public fear	0.190 ^a	0.137	0.058	0.070	0.067	0.201 ^b		
Sufficiency of information score	0.107	0.208 ^b	0.129	0.303 ^b	0.118	0.061	0.129	

^a Correlation is significant at the 0.05 level (2-tailed).

^b Correlation is significant at the 0.01 level (2-tailed).

Table 4
Linear regression model predicting stress level of students as measured on 1–10 points.

Predictors/Co-variates	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations		Co-linearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Partial correlation	Part correlation	Tolerance	VIF
(Constant)	−.317	.807		−.393	.695	−1.910	1.276				
Square Root (GAD)	.297	.108	.189	2.760	.006	.085	.510	.210	.169	.799	1.251
Gender (Female)	.646	.232	.185	2.788	.006	.188	1.103	.212	.171	.852	1.174
Student Level (Senior)	.209	.240	.061	.871	.385	−.265	.684	.068	.053	.770	1.299
Knowledge score (out of 7)	.099	.086	.075	1.151	.252	−.071	.269	.089	.070	.894	1.118
Agreeability on Public Fear	.061	.045	.085	1.343	.181	−.028	.150	.104	.082	.944	1.060
Perceived Social Avoidance Score	.246	.073	.238	3.362	.001	.102	.391	.253	.206	.747	1.340
Improved hygienic habits	.208	.053	.282	3.910	.000	.103	.313	.291	.239	.724	1.382
No. Resources accessed	.182	.101	.113	1.793	.075	−.018	.382	.138	.110	.949	1.054

anxiety score when considering all other variables jointly. Those were followed by the GAD score, which shows significant correlation with the student's reported anxiety from the MERS-CoV when all the other variables were controlled.

Discussion

The MERS-CoV outbreak in Saudi Arabia is probably one of the most challenging threats to national and international public health in the last few decades. The epidemic had a significant impact on healthcare communities. Initially, the healthcare workers were placed in a stressful condition due to the uncertainty about the mode of transmission of the disease, tremendous fear, and implementation of rigorous infection control protocols.

Similarly, medical students were exposed to similar stressors during the outbreak, but usually, this group is often overlooked, despite having possibly adverse effects on their academic achievements. While distressing their overall psychological health, this situation can adversely affect learning, by the increased avoidance of learning activities and reducing their psychomotor concentration.

The MERS-CoV Outbreak in 2014 was associated with tremendous public anxiety in the affected countries. Media speculations and rumors may have increased this psychological distress. The healthcare community was probably distressed the most because previously published data had shown that this group was at the highest risk for infection. It had been found that 30% of confirmed cases were healthcare workers (HCW), and majority of infections were hospital-acquired [8,9].

The general state of panic usually accompanies such outbreaks, especially when details of transmissibility and infectivity are vague,

which is usually the case in emergent diseases. Psychological effects of outbreaks require thorough studying for the possible negative effects on the psychological health and productivity to mitigate these effects actively in any unfortunate future events, especially if such psychological distress may affect HCWs, who will be in high demand and shortage during outbreaks.

During the Severe Acute Respiratory Syndrome (SARS) epidemic in 2003 and the influenza A/H1N1 pandemic in 2009, researchers evaluated psychological stress on HCWs using different modalities, and stress was found constantly high. Other emotional stressors that were found to be highly prevalent among HCWs were the exceeded worries about one's own or family's health, fear, feeling of stigmatization by working in a hospital, with some of these concerns associated with younger ages [6,10,11]. Comparing different groups, doctors reported fewer worries than other HCW [12].

Students are also expected to have stress during such outbreaks, especially for those in the medical field. Research had shown a high grade of psychological stress during an outbreak, and it was notable that junior medical students were more anxious than their senior colleagues, despite having less contact with patients [13]. Furthermore, while the overall estimated stress level was high, medical students were less stressed than nursing and non-health university students [14,15].

GAD-7 is constructed to be an efficient screening tool for GAD; subjects scoring >10 in this seven-item scale were found to have GAD with high levels of sensitivity and specificity. We included this scale to control for baseline anxiety disorders our sample might have, i.e., removing the effect of any underlying pathological distress. However, we hypothesized that it would also correlate with the reported stress level on 1–10 scale, which is what we found with statistical significance.

Comparing our findings with those in the literature, we found that female students reported more anxiety regarding the disease. Female students of health and non-health majors were reported to have more anxiety, while no gender difference was found in another study of medical students, with both studies describing undergraduate students during or after the SARS epidemic [15,16]. In another study about MERS-CoV outbreak perceptions of risk and stress evaluation in nurses, females were also found to have significantly more fear of contracting the virus compared to males [17]. In our study, the stress score was 5.14 ± 1.72 of junior medical students were more worried, but it was not statistically significant. However, in one study, junior students reported more worries and exaggerated responses in terms of personal protection and social avoidance during SARS crisis [14].

Our sample revealed that college or hospital announcements were the most common source of information, followed by official health authority statements. This is similar to the sources that were used by the healthcare workers about MERS-CoV from the same hospital [18]. These findings are reassuring because such sources are official, and these sources can be tailored to guide the HCWs about the outbreak extent and what is needed from them at each stage. Perceived availability of resources of information was not found to affect knowledge, however, the number of accessed resources correlated with knowledge, denoting that the higher the numbers of resources a respondent have accessed, the higher their knowledge tended to be which is similar to another study which reported that students who use internet more than other media were more informed about SARS [16]. Moreover, another study found that the more the disease is mentioned in media, the more its seriousness was overestimated by students, and vice versa [19].

In conclusion. We found in this study that major predictors in our model, in terms of more significant to the least, were: an increased self-report on hygienic habits, self-reported social avoidance, the generalized anxiety score and finally being female gender. It provides us with a perception of the amount and determinants of students' psychological stress during this outbreak. We recommend colleges and health authorities to address medical students' psychological needs more often in the future, especially during a crisis. These results highlight the need to establish psychological support programs for medical students during an infectious disease outbreak.

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Conflict of interest

All authors of this study declare hereby that they have not received any support from any external organization for the submitted work. No contractual agreement for receiving financial support has been concluded with any organization that might have an interest in the submitted work. It is hereby declared that authors of this manuscript have no significant competing financial, professional or personal interests that may influence the performance or the presentation of the work described herein.

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