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MENTAL HEALTH DISORDERS AMONG HEALTH CARE WORKERS DURING THE COVID-19 PANDEMIC: A CROSS-SECTIONAL SURVEY FROM THREE MAJOR HOSPITALS IN KENYA.

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MENTAL HEALTH DISORDERS AMONG HEALTH CARE WORKERS DURING THE COVID-19 PANDEMIC: A CROSS-SECTIONAL SURVEY FROM THREE MAJOR HOSPITALS IN KENYA.

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ABSTRACT

Background:

COVID-19 is an international global health emergency and has posed a great challenge to mental well-being and resilience. Little is known about the mental health impact of COVID-19 among HCWs in sub-Saharan Africa or other low-resource settings.

Methods:

We conducted a cross-sectional study between August and November 2020 among HCWs recruited from three major hospitals in Kenya. The survey questionnaire consisted of six components- demographic and work title characteristics, information regarding care of COVID-19 patients, symptoms of depression, anxiety, insomnia, distress and burnout, measured using standardized questionnaires. Multivariable logistic regression analysis was performed to identify factors associated with mental health disorders.

Results:

A total 433 (65.2% response rate) individuals agreed to participate in the survey. Median age was 32.75 years, 58.4% were females and 68.8% were frontline workers. Depression, anxiety, insomnia, distress, and burnout were reported in 53.6%, 44.3%, 41.1%, 31.0%, and 45.8% of all participants respectively. Frontline HCWs, females, and doctors were at higher risk of mental health symptoms. Nearly half of participants reported inadequate resources or training to care for COVID-19 patients, and those in the government hospital were more likely to report mental health symptoms.

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Conclusions:

To our knowledge, this is the first study looking at mental health outcomes among health care workers during the COVID-19 pandemic in Kenya. Similar to other studies from around the world, HCWs directly involved with COVID-19 patients reported higher rates of mental health symptoms. Mitigating strategies specific to Kenyan HCWs are urgently needed to help cope with mental health symptoms during the pandemic.

Strengths and Limitations

- This is one of the first articles reporting the prevalence of mental health disorders among HCWs in sub-Saharan Africa during the COVID-19 pandemic.
- Mental health disorders were measured using specific standardized questionnaires.
- The study was conducted between the first and second waves of the virus outbreak and the results might not be suggestive of the long-term psychological disorders within our HCW population.
- There is need for urgent and cost-effective mitigating strategies to help curb the burden of mental health disorders among healthcare workers caring for COVID-19 patients in Kenya.

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BACKGROUND

The immense toll of the global SARS CoV-2 pandemic continues to rise, with over 87 million confirmed cases and almost 1.9 million deaths to date [1]. COVID-19 reached Kenya in March 2020, and as of December 2020, there were over 97,000 confirmed cases and 1,700 deaths [1]. COVID-19 has had a significant impact on the healthcare workforce. Increased work-load, long hours, inadequate personal protective equipment (PPE), the need to make ethically and morally difficult decisions, a lack of social support, isolation from and fear of infecting family members and oneself can have major impacts on the mental health of frontline workers [2]. Multiple recent studies conducted in Turkey, Singapore, India, Italy, Spain, China and the United States have shown increased rates of stress, depression, anxiety and burnout among healthcare workers (HCW) taking care of COVID-19 patients compared with those not caring for COVID-19 patients [3-14]. Risk factors for mental health symptoms among HCWs caring for COVID-19 patients include being female, young, single, having minimal work experience and working on the frontlines [3]. Unfortunately, the psychological impact of the COVID-19 pandemic has also resulted in HCWs suicides [15].

Quality healthcare, especially during a pandemic, requires a robust health workforce with adequate numbers, optimal physical and mental well-being and a supportive environment. Many parts of Africa continue to struggle with the rising cases of COVID-19 amidst limited medical resources and infrastructure, inadequate health care workforce and minimal ICU beds. The Organization for Economic Co-operation and Development (OECD) in 2020 reported 2.6 and 3 physicians and 11.9 and 7.8 nurses per 1,000 people in the United States and United Kingdom respectively. Austria reported the most physicians (5.2) while Norway reported the most nurses (18) per 1,000 people [16]. Most recent corresponding figures from the WHO in Kenya were 0.2 physicians and 1.2 nurses

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per 1,000 people [17]. Additionally, Kenya has approximately 14 hospital beds per 10,000 people with 537 ICU beds and 256 ventilators serving a population of close to 50 million people [17 18]. In contrast, the WHO in 2019 reported 25 hospital beds per 10,000 people in the United Kingdom with a population of approximately 67 million people [17]. Many African countries have fragile health care systems with fewer than 30 critical care beds for their entire population and only a handful of fully trained critical care physicians, highlighting the lack of critical resources to adequately address the COVID-19 pandemic in Africa [2 19]. Mental health resources and providers are also lacking in Kenya. As of 2016, Kenya reported 0.18 psychiatrists and 0.002 psychologists per 10,000 people with less than 1% of the public sector having access to any form of mental health care services [17 20]. Furthermore, similar to other sub-Saharan African (SSA) countries, Kenya has no formal mental health response plan within the larger COVID-19 strategic response [20].

Historical experiences with deadly pandemics can offer invaluable lessons to resource limited settings. During the Ebola pandemic in Western Africa in the early parts of 2014, the pandemic swiftly crippled an already weak health care system, resulting in approximately 69% of HCWs deaths with anecdotal evidence of increasing mental health disorders among survivors [21-23]. However, few studies have been conducted on the association of the Ebola pandemic on HCWs mental health symptoms. Similarly, a year into the COVID-19 pandemic, little is known on the effect of the pandemic on the mental health of HCWs in SSA or in any resource-limited setting. We therefore aimed to measure the prevalence of mental health symptoms among HCWs in 3 major hospitals in Kenya, and to evaluate risk factors for mental health symptoms among HCWs in these hospitals.

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METHODS

Study Design

We carried out a cross sectional study between August and November, 2020.

Participants and Study Site

Physicians, including residents and fellows, and nurses were recruited from 1 government (Coast General Teaching and Referral Hospital, Mombasa (CGTRH)) and 2 private hospitals (Aga Khan University Hospital, Nairobi (AKUHN), and Avenue Hospital, Nairobi).

Recruitment and Enrollment

Email addresses of all physicians and nurses in each hospital were obtained by the principal site investigator in each hospital with help of the Information Technology Department. Physicians and nurses were recruited from AKUHN, CGTRH and Avenue Hospital. Email invitations with a link to a voluntary, de-identified survey were sent to 725 HCWs.

Ethical Approval

Approval for this study was obtained from the Institutional Ethics and Review Committee at the Aga Khan University, Nairobi and the hospital leadership at CGTRH and Avenue Hospital. Online consent was obtained from all the participants. Participants were allowed to withdraw from the study at any time without any consequences. The survey was anonymous, and confidentiality of information was assured. On conclusion of the survey, a score for each mental health disorder was computed and shared with the participants. If the scores indicated a mental health issue, the participants were directed to seek medical consultation with their primary care provider or the counselling services at the respective hospitals. If any of the participants indicated suicidal or homicidal ideations, they were directed to the mental health hotline at the Aga Khan University Hospital or an assigned physician at the CGTRH and Avenue Hospital.

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Procedures

Online survey data were collected through the Research Electronic Data Capture - REDCap platform (Vanderbilt and National Institute of Health) [24]. Email reminders were sent out twice a week from REDCap for participation in the survey. Every participant received a unique link allowing them to complete the survey only once. The survey questionnaire consisted of six components: demographic characteristics (including job title, experiences providing care to patients with COVID-19), and sections on symptoms of depression, anxiety, insomnia, distress and burnout. On average the surveys took about five to seven minutes to complete. Mental health symptoms were measured using the 9-item Patient Health Questionnaire (PHQ-9) for depression [25], the 7-item Generalized Anxiety Disorder Questionnaire (GAD-7) for anxiety [26], the 7-item Insomnia Severity Index Questionnaire (ISI) for insomnia [27], the 22-item Impact of Event Scale–Revised (IES-R) for distress [28] and the 16-item Stanford Professional Fulfillment Index Questionnaire (SPFI) for burnout [29]. The cutoff score for detecting symptoms of major depression, anxiety, insomnia, and distress were 10, 7, 15, and 26, respectively [10]. The categories of the severity of each mental health disorder are presented in Table 1.

Statistical Analysis

Categorical data were analyzed as frequencies and percentages whereas continuous data were analyzed as medians with interquartile ranges (IQR). The nonparametric Kruskal-Wallis test was utilized to compare the continuous variables and Fishers exact test was used to compare the categorical variables between two groups. To determine potential risk factors for symptoms of depression, anxiety, insomnia, distress, burnout and professional fulfillment in participants, a multivariate logistic regression analysis was performed, and the associations between risk factors and outcomes are presented as odds ratios (ORs) and 95% confidence intervals (CIs). The outcome

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variables for the multivariate logistic regressions were mental health disorders dichotomized using the standard cutoffs as above. Data analysis was performed using SPSS statistical software version 20.0 (IBM Corp). The significance level was set at $\alpha = .05$, and all tests were 2-tailed.

Patient and public involvement

Patients or the public were not involved in the research design, reporting, or survey dissemination strategies of this study.

RESULTS

Of the 725 invited HCWs across the three hospitals, 473 (65.2%) responded to the survey and 433 (91.5%) consented to complete the survey (Table 2). The median age of the participants was 32.8 years (IQR: 29.71, 36.75). Of the 433 responding participants, 253 (58.4%) were females, and 244 (56.7%) were married. Most of the participants were medical doctors (243 [56.1%]) and of African ethnicity (354 [82.5%]). A total of 298 participants (68.8%) were frontline HCWs directly engaged in COVID-19 care and treatment. Of the frontline workers, 122 (41.1%) had cared for about 5-20 patients and 174 (58.8%) had lost a patient to COVID-19. Only 3.7% of all participants reported a prior history or diagnosis of any mental health disorder.

Using the standardized screening tools, depression, anxiety, insomnia, distress, and burnout were reported in 53.6%, 44.3%, 41.1%, 31.0%, and 45.8% of all participants, respectively. Severe symptoms of depression, anxiety, insomnia, distress, and burnout were more commonly reported among frontline HCWs than colleagues who were not frontline HCWs. For example, severe depression was reported among 11.6% of frontline HCWs (n=34) compared with 3.8% (n=5) among workers not directly caring for COVID-19 patients ($p < 0.001$, Table 3).

Multivariate logistic regression analysis showed that after adjustment, working on the frontlines was an independent risk variable for all the mental health disorders (depression, OR 3.55; 95% CI, 1.77-7.11; $p<0.001$; anxiety, OR 2.51; 95% CI, 1.20-5.25; $p=0.014$; insomnia, OR 4.45; 95% CI,

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1.51-13.10; p=0.007; distress: OR, 1.89, 95% CI, 1.10-3.17; p=0.021 and burnout: OR, 2.74, 95% CI, 1.69-4.42; p<0.001). Furthermore, being a doctor and being a female were associated with severe symptoms of depression and anxiety, with an OR of 1.95 for severe depression among women compared with men, (95% CI, 1.12-3.42; p=0.019) and an OR of 2.29 for severe anxiety among doctors compared with nurses (95% CI, 1.21-4.32; p=0.011) (Table 4).

Nearly half of frontline workers stated that they lacked adequate resources and PPE to care for COVID-19 patients, and fewer felt that they needed additional training to take care of or treat COVID-19 patients (resources: 45.8%, trained: 46.0%). On further analysis, we found that HCWs employed in public institutions were more likely to report having inadequate resources than those in the private hospital (OR 14.55, 95% CI, 5.99-35.34; p<0.001), and were more likely to report being inadequately trained (OR 3.61, 95% CI, 1.91-6.81; p<0.001).

Furthermore, respondents from the public institution reported experiencing more moderate to severe symptom levels of depression, anxiety, insomnia, and distress (eg, moderate and severe depression among private vs public: 67 [18.7%] vs 22 [32.4%]; p=0.014, moderate and severe anxiety among private vs public: 43 [12.3%] vs 19 [28.3%]; p=0.008; moderate and severe insomnia among private vs public: 30 [8.5%] vs 15 [22.4%]; p=0.004 and distress among private vs public: 62 [17.8%] vs 21 [33.3%]; p=0.014) (Table 5).

DISCUSSION

To our knowledge, this is the first study investigating mental health disorders among HCWs during the COVID-19 pandemic in Kenya, and among the first to evaluate the associations between COVID-19 and mental health symptoms in any resource-limited setting. Our study examined HCWs in one government and two private hospitals in Kenya actively involved in the care of

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COVID-19 patients. Two of the institutions were located in Nairobi and one in Mombasa; both major cities have been greatly affected by COVID-19.

In our study depression, anxiety, insomnia, distress, and burnout were reported in 53.6%, 44.3%, 41.1%, 31.0%, and 45.8% of all participants despite only 3.7% reporting ever having mental health disorders previously. Most participants were married, female and doctors. Similar to studies conducted in other countries, being a frontline worker was associated with higher scores for depression, anxiety, insomnia, distress and burnout. Our study also showed that being a female and a doctor was significantly associated with severe symptoms of depression and anxiety. This is in contrast to other studies in which nurses experienced more psychological symptoms associated with caring for COVID-19 patients [8 10 30].

The median age of our study population was 32.8 years. Unlike other studies in which younger HCWs experienced a higher prevalence of stress, anxiety and poor psychological well-being, our study did not find an association between HCWs' age and mental health disorders [5 31 32]. Furthermore, in contrast to other studies conducted in higher income countries, our study showed higher overall percentages of depression, anxiety, and insomnia among frontline HCWs. This important finding in our setting could be attributed to the limited resources and lack of mitigating strategies such as a formal mental health response plan, readily available mental health services, regulation of work hours and adequate medical resources in Kenya.

A recent study on mental health disorders among trainees at three American academic medical centers found that trainees taking care of COVID-19 patients had higher rates of burnout compared to those not taking care of COVID-19 patients, but found no significant difference in professional fulfillment scores [33]. On the contrary, a study in Turkey showed a lower level of burnout in physicians taking care of COVID-19 patients compared with physicians who took care of non

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COVID-19 patients [34]. In our study, we found statistically higher rates of burnout among all cadres of HCWs at all institutions taking care of COVID-19 patients compared to those not taking care of COVID-19 patients. We found no statistical difference in professional fulfillment scores.

Overall, we found that half of the respondents felt inadequately trained and reported lack of enough resources and PPE to safely care for COVID-19 patients. A study looking at HCW knowledge, attitude and practices in Uganda found that 69% reported sufficient knowledge and 74% had a positive attitude around COVID-19 [35]. Similarly, Mbachu and colleagues reported excellent knowledge and good preventative practices towards COVID-19 in Nigeria [36].

In our study, HCWs at the government hospital felt less trained with inadequate resources and PPE to take care of COVID-19 patients than those in the private hospitals. Mbachu and colleagues showed that a lack of PPE had a negative impact on the attitudes of HCWs in Nigeria [36]. Likewise, in our study, HCWs in the government institution also showed significantly higher rates of depression, anxiety, insomnia and distress than those in the private hospitals. We could find no other study comparing mental health outcomes between private and government hospital in our or any other settings. In addition to the absence of mitigating strategies unique to HCWs taking care of COVID-19 patients, our findings also stress the importance of adequate medical personnel, training, critical care beds and other key resources to help fortify fragile health care systems within many African countries and to better tackle the COVID-19 pandemic.

Like many other countries in SSA, Kenya lacks a formal mental health response plan to the COVID-19 pandemic. A dynamic mental health response plan designed by mental health experts specific to the needs of the country and grassroots training of community health workers and volunteers, especially HIV counsellors and retired nurses, remains key not only to target the population at large but also to focus on providing key mental health services to HCWs in

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institutions across the country [2]. Like many other African countries, regular press releases on television and radios are used to disseminate key information on COVID-19 in Kenya [37]. We propose that such platforms not only be used to educate the population on COVID-19 but also to demystify the stigma around seeking mental health services related to COVID-19. Of note, Kenya has a 91% penetration of mobile subscriptions allowing the use of mobile health applications to further enhance the delivery of care not only to the local population, but also health care workers [20]. In addition, toll-free mental health helplines could be a key step to improving access to mental health services especially for specific populations such as HCWs providing care to COVID-19 patients [37]. Senior leadership at every hospital, with the support of the government and donor organizations, should seek creative ways to enhance the mental health capabilities and resources especially for HCWs taking care of COVID-19 patients. This includes either investing in training and capacity building opportunities or sharing resources among various hospitals geographically and electronically to better support the response process. Providing daily allowances to frontline HCWs, additional tax relief, as well as publicly acknowledging their heroic efforts might be ways to boost morale and improve mental health outcomes in limited resource settings [2].

Our study has several limitations. It was conducted in one government hospital in Mombasa and two private hospitals in Nairobi, with different funding structures. Secondly, our study was conducted between the first and second waves of the virus outbreak and our results might not be suggestive of the long-term psychological disorders within our HCW population. Thirdly, we primarily used electronic mail with frequent reminders, which could have potentially limited our response rate. Lastly, there may have been a response bias in that non-responders may have been suffering from mental health symptoms, limiting the motivation to respond.

CONCLUSION

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Our study, the first conducted in Kenya and one of the first in a low-resource healthcare setting, shows markedly higher rates of mental health disorders including depression and anxiety in all health care workers taking care of COVID-19 patients than those not caring for COVID-19 patients, and higher rates than those reported in higher-income countries. Being a doctor and a female were associated with severe symptoms of depression and anxiety. Furthermore, HCWs in the government institution experienced higher rates of mental health symptoms than their counterparts in private institutions. This study highlights the urgent need for cost-effective, easy to replicate and rapid to implement mitigating strategies to help curb the burden of mental health disorders associated with caring for COVID-19 patients in Kenya and other resource-limited countries. Special attention should be paid to HCWs in the government hospitals.

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ABBREVIATIONS

PPE	Personal protective equipment
HCW	Healthcare worker
ICU	Intensive care unit
OECD	Organization for Economic Co-operation and Development
WHO	World Health Organization
SSA	sub-Saharan Africa
CGTRH	Coast General Teaching and Referral Hospital, Mombasa
AKUHN	Aga Khan University Hospital, Nairobi
REDCap	Research Electronic Data Capture
PHQ	Patient Health Questionnaire
GAD	Generalized Anxiety Disorder
ISI	Insomnia Severity Index
IES-R	Impact of Event Scale–Revised
SPFI	Stanford Professional Fulfillment Index
IQR	Interquartile ranges
OR	Odds Ratio
CI	Confidence Interval

FOOTNOTES

Contributors: SKA developed the concept study and proposal, supervised the overall project and coordinated the study at AKUHN. AMW, ZT, and AN assisted in the study concept, design and editing of the survey. MS supervised data collection at the Avenue Hospital. AA, MAM and SM supervised the data collection at CGTRH. SKA and JS verified the underlying data. JS did the data analysis. JS and SA wrote the first draft of the paper. All authors reviewed, edited and provided comments on the first and subsequent drafts. All authors reviewed and approved the final manuscript.

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Scoring Categories for Mental Health Disorders	
PHQ-9 (Depression)	***IES-R (Distress)***
Normal (0 – 4)	Normal (0 – 8)
Mild (5 – 9)	Mild (9 – 25)
Moderate (10 – 14)	Moderate (26 – 43)
Severe (15 – 27)	Severe (44 – 88)
Binary Cut off - 10	*Binary Cut off - 26*
GAD-7 (Anxiety)	***SPFI (Burnout)***
Normal (0 – 4)	Yes (> 1.33)
Mild (5 – 9)	No (≤ 1.33)
Moderate (10 – 14)	
Severe (15 – 21)	***SPFI (Professional Fulfillment)***
Binary Cut off - 7	Yes (> 3.0)
	No (≤ 3.0)
ISI (Insomnia)	
Normal (0 – 7)	
Subthreshold (8 – 14)	
Moderate (15 – 21)	
Severe (22 – 28)	
Binary Cut off - 15	

Table 1: Scoring categories for the mental health disorders

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Characteristics	**N (%)**
Age (years) (n = 401) (median [IQR])	32.75 [29.71, 36.75]
Gender	
Male	176 (40.6%)
Female	253 (58.4%)
Prefer not to disclose	4 (1.0%)
Marital Status (n = 430)	
Single	172 (40.0%)
Married	244 (56.7%)
Other	14 (3.3%)
Ethnicity (n = 429)	
African	354 (82.5%)
Asian	51 (11.9%)
Other	24 (5.6%)
Health Care Profession	
Nurses	190 (43.9%)
Doctors	243 (56.1%)
Direct care COVID	
Yes	298 (68.8%)
No	135 (31.2%)
Patients cared (n = 297)	
< 5 Patients	101 (34.0%)
5 - 20 Patients	122 (41.1%)
> 20 Patients	74 (24.9%)
Lost any patients (n = 296)	
Yes	174 (58.8%)
No	122 (41.2%)
Enough Resources to care for COVID (n = 297)	
Yes	161 (54.2%)
No	136 (45.8%)
Adequately Trained for COVID (n = 298)	
Yes	161 (54.0%)
No	137 (46.0%)
History of Mental Health Disorder	
Yes	16 (3.70%)
No	398 (91.9%)
Not Sure	15 (3.4%)
Prefer not to disclose	4 (1.0%)
Diagnosis (n = 15)	
Anxiety	5 (33.3%)
Depression	7 (46.7%)
Epilepsy	1 (6.7%)

Depression and Anxiety	2 (13.3%)
Still have symptoms	
Yes	8 (50.0%)
No	8 (50.0%)

Table 2: Baseline characteristics of study participants (N = 433)

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		Total	Have you ever directly cared for a patient with COVID-19?		
			Yes	No	P Value
Depression		**(n = 425)**	**(n = 292)**	**(n = 133)**	
PHQ-9	None	197 (46.4%)	116 (39.7%)	81 (60.9%)	
	Mild	139 (32.7%)	99 (33.9%)	40 (30.1%)	*<0.001*
	Moderate	50 (11.8%)	43 (14.7%)	7 (5.3%)	
	Severe	39 (9.2%)	34 (11.6%)	5 (3.8%)	
	PHQ-9 Score	5.00 [2.00, 9.00]	6.00 [3.00, 10.00]	3.00 [1.00, 6.00]	*<0.001*
Anxiety		**(n = 418)**	**(n = 287)**	**(n = 131)**	
GAD-7	Minimal	208 (49.8%)	131 (45.6%)	77 (58.8%)	
	Mild	148 (35.4%)	104 (36.2%)	44 (33.6%)	*0.017*
	Moderate	33 (7.9%)	27 (9.4%)	6 (4.6%)	
	Severe	29 (6.9%)	25 (8.7%)	4 (3.1%)	
	GAD-7 Score	5.00 [2.00, 8.00]	5.00 [2.00, 8.00]	4.00 [1.00, 6.00]	*0.002*
Insomnia		**(n = 418)**	**(n = 287)**	**(n = 131)**	
ISI	None	246 (58.9%)	156 (54.4%)	90 (68.7%)	
	Subthreshold	127 (30.4%)	90 (31.4%)	37 (28.2%)	*0.001*
	Moderate	39 (9.3%)	36 (12.5%)	3 (2.3%)	
	Severe	6 (1.4%)	5 (1.7%)	1 (0.8%)	
	ISI Score	6.00 [2.00, 10.00]	7.00 [2.00, 11.00]	5.00 [2.00, 8.00]	*0.011*
Distress		**(n = 410)**	**(n = 281)**	**(n = 129)**	
IESR	Normal	283 (69.0%)	185 (65.8%)	98 (76.0%)	
	Mild	44 (10.7%)	28 (10.0%)	16 (12.4%)	*0.008*
	Moderate	24 (5.9%)	17 (6.0%)	7 (5.4%)	
	Severe	59 (14.4%)	51 (18.1%)	8 (6.2%)	
	IES-R Score	14.00 [3.00, 28.00]	15.00 [3.00, 32.00]	12.00 [1.00, 23.00]	*0.029*
Avoidance Subscale		0.80 [0.10, 1.40]	0.90 [0.10, 1.80]	0.60 [0.00, 1.10]	*0.032*
Intrusion Subscale		0.65 [0.10, 1.30]	0.80 [0.10, 1.50]	0.60 [0.00, 1.10]	*0.065*
Hyperarousal Subscale		0.40 [0.00, 1.20]	0.50 [0.20, 1.30]	0.30 [0.00, 0.80]	*0.041*
SPFI		**(n = 404)**	**(n = 278)**	**(n = 126)**	
Professional Fulfillment		54.17 [37.50, 75.00]	50.00 [33.33, 75.00]	58.33 [45.83, 75.00]	*<0.001*
Work Exhaustion		43.75 [25.00, 68.75]	50.00 [25.00, 75.00]	31.25 [18.75, 50.00]	*<0.001*
Interpersonal Disengagement		20.42 [0.00, 37.50]	25.00 [0.00, 41.67]	8.33 [0.00, 25.00]	*<0.001*
Burnout					
	≤ 1.33	219 (54.2%)	130 (46.8%)	89 (70.6%)	*<0.001*
	> 1.33	185 (45.8%)	148 (53.2%)	37 (29.4%)	
Professional Fulfillment					
	≤ 3.00	327 (81.1%)	231 (83.1%)	96 (76.8%)	*0.168*
	> 3.00	76 (18.9%)	47 (16.9%)	29 (23.2%)	

Table 3: Severity categories and scores of Depression, Anxiety, Insomnia, Distress, Burnout, and Professional Fulfillment Measurements in Total Cohort and Categorized Between Direct COVID Care.

Variable	Adj OR [a]	(95% CI)	P Value
PHQ-9: Depression			
Gender			
Male	1 [Reference]		N/A
Female	1.95	(1.12, 3.42)	0.019
Health Care			
Nurse	1 [Reference]		N/A
Doctor	2.24	(1.27, 3.94)	0.005
COVID Care			
Second-line	1 [Reference]		N/A
Frontline	3.55	(1.77, 7.11)	<0.001
GAD-7: Anxiety			
Gender			
Male	1 [Reference]		N/A
Female	1.95	(1.04, 3.65)	0.036
Health Care			
Nurse	1 [Reference]		N/A
Doctor	2.29	(1.21, 4,32)	0.011
COVID Care			
Second-line	1 [Reference]		N/A
Frontline	2.51	(1.20, 5,25)	0.014
ISI: Insomnia			
Gender			
Male	1 [Reference]		N/A
Female	1.77	(0.85, 3.70)	0.127
Health Care			
Nurse	1 [Reference]		N/A
Doctor	3.08	(1.38, 6.89)	0.006
COVID Care			
Second-line	1 [Reference]		N/A
Frontline	4.45	(1.51, 13.1)	0.007

Variable	Adj OR [a]	(95% CI)	P Value
IES-R: Distress			
Gender			
Male	1 [Reference]		N/A
Female	2.18	(1.32, 3.60)	0.002
Health Care			
Nurse	1 [Reference]		N/A
Doctor	1.09	(0.67, 1.76)	0.738
COVID Care			
Second-line	1 [Reference]		N/A
Frontline	1.89	(1.10, 3.17)	0.021
SPFI: Burnout			
Gender			
Male	1 [Reference]		N/A
Female	1.73	(1.11, 2.71)	0.017
Health Care			
Nurse	1 [Reference]		N/A
Doctor	0.86	(0.55, 1.34)	0.858
COVID Care			
Second-line	1 [Reference]		N/A
Frontline	2.74	(1.69, 4.42)	<0.001
SPFI: Professional Fulfillment			
Gender			
Male	1 [Reference]		N/A
Female	0.72	(0.42, 1.24)	0.234
Health Care			
Nurse	1 [Reference]		N/A
Doctor	0.90	(0.52, 1.57)	0.900
COVID Care			
Second-line	1 [Reference]		N/A
Frontline	0.78	(0.45, 1.37)	0.788

Table 4: Multivariate logistic regression analysis. Adj OR: adjusted odds ratio, CI: confidence interval.
[a]Adjusted for age, gender, marital status, working title and COVID care where appropriate.

		Hospital		
		Private (n =365)	***Public (n = 68)***	***P Value***
Depression		**(n = 357)**	**(n = 68)**	
PHQ-9	None	176 (49.3%)	21 (30.9%)	
	Mild	114 (31.9%)	25 (36.8%)	*0.014*
	Moderate	39 (10.9%)	11 (16.2%)	
	Severe	28 (7.8%)	11 (16.2%)	
Anxiety		**(n = 351)**	**(n = 67)**	
GAD-7	Minimal	183 (52.1%)	25 (37.3%)	
	Mild	125 (35.6%)	23 (34.3%)	*0.008*
	Moderate	23 (6.6%)	10 (14.9%)	
	Severe	20 (5.7%)	9 (13.4%)	
Insomnia		**(n = 351)**	**(n = 67)**	
ISI	None	216 (61.5%)	30 (44.8%)	
	Subthreshold	105 (29.9%)	22 (32.8%)	*0.004*
	Moderate	25 (7.1%)	14 (20.9%)	
	Severe	5 (1.4%)	1 (1.5%)	
Distress		**(n = 347)**	**(n = 63)**	
IESR	Normal	246 (70.9%)	37 (58.7%)	
	Mild	39 (11.2%)	5 (7.9%)	*0.014*
	Moderate	15 (4.3%)	9 (14.3%)	
	Severe	47 (13.5%)	12 (19.0%)	
SPFI		**(n = 343)**	**(n = 61)**	
Burnout				
	≤ 1.33	190 (55.4%)	29 (47.5%)	*0.268*
	> 1.33	153 (44.6%)	32 (52.5%)	
Professional Fulfillment				
	≤ 3.00	275 (80.4%)	52 (85.2%)	*0.478*
	> 3.00	67 (19.6%)	9 (14.8%)	

Table 5: Severity categories of Depression, Anxiety, Insomnia, Distress, Burnout, and Professional Fulfillment Measurements in Total Cohort and Categorized Between Private and Public Hospital.

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MENTAL HEALTH DISORDERS AMONG HEALTH CARE WORKERS DURING THE COVID-19 PANDEMIC: A CROSS-SECTIONAL SURVEY FROM THREE MAJOR HOSPITALS IN KENYA.

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MENTAL HEALTH DISORDERS AMONG HEALTH CARE WORKERS DURING THE COVID-19 PANDEMIC: A CROSS-SECTIONAL SURVEY FROM THREE MAJOR HOSPITALS IN KENYA.

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ABSTRACT

Background:

COVID-19 is an international global health emergency and has posed a great challenge to mental well-being and resilience. Little is known about the mental health impact of COVID-19 among HCWs in sub-Saharan Africa or other low-resource settings.

Methods:

We conducted a cross-sectional study between August and November 2020 among HCWs recruited from three major hospitals in Kenya. The survey questionnaire consisted of six components- demographic and work title characteristics, information regarding care of COVID-19 patients, symptoms of depression, anxiety, insomnia, distress and burnout, measured using standardized questionnaires. Multivariable logistic regression analysis was performed to identify factors associated with mental health disorders.

Results:

A total 433 (65.2% response rate) individuals agreed to participate in the survey. Median age was 32.75 years, 58.4% were females and 68.8% were frontline workers. Depression, anxiety, insomnia, distress, and burnout were reported in 53.6%, 44.3%, 41.1%, 31.0%, and 45.8% of all participants respectively. Frontline HCWs, females, and doctors were at higher risk of mental health symptoms. Nearly half of participants reported inadequate resources or training to care for COVID-19 patients, and those in the government hospital were more likely to report mental health symptoms.

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Conclusions:

To our knowledge, this is one of the first study looking at mental health outcomes among health care workers during the COVID-19 pandemic in Kenya. Similar to other studies from around the world, HCWs directly involved with COVID-19 patients reported higher rates of mental health symptoms. Mitigating strategies specific to Kenyan HCWs are urgently needed to help cope with mental health symptoms during the pandemic.

Strengths and Limitations

- To the best of our knowledge, this is one of the first articles reporting the prevalence of mental health disorders among HCWs during the COVID-19 pandemic in Kenya.
- Mental health disorders were measured using specific standardized questionnaires.
- The study was conducted between the first and second waves of the virus outbreak and the results might not be suggestive of the long-term psychological disorders within our HCW population.
- There is need for cost-effective mitigating strategies to help curb the burden of mental health disorders associated with caring for COVID-19 patients in Kenya.

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BACKGROUND

The immense toll of the global SARS CoV-2 pandemic continues to rise, with over 87 million confirmed cases and almost 1.9 million deaths to date [1]. COVID-19 reached Kenya in March 2020, and as of December 2020, there were over 97,000 confirmed cases and 1,700 deaths [1]. COVID-19 has had a significant impact on the healthcare workforce. Increased work-load, long hours, inadequate personal protective equipment (PPE), the need to make ethically and morally difficult decisions, a lack of social support, isolation from and fear of infecting family members and oneself can have major impacts on the mental health of frontline workers [2]. Multiple recent studies conducted in Turkey, Singapore, India, Italy, Spain, China, Oman, and the United States have shown high rates of stress, depression, anxiety and burnout among healthcare workers (HCW) taking care of COVID-19 patients [3-9]. Other studies have shown higher rates of mental health disorders among HCWs caring for COVID-19 compared with those not caring for COVID-19 patients [10-15]. A global study done between April and May 2020 across 31 countries looking at mental health outcomes in HCWs during the initial stage of the pandemic, showed an overall prevalence of 60% anxiety and 53% depression. There were only 49 responses from eleven countries in Africa, including Kenya [16]. Risk factors for mental health symptoms among HCWs caring for COVID-19 patients include being female, young, single, having minimal work experience and working on the frontlines [10]. Unfortunately, the psychological impact of the COVID-19 pandemic has also resulted in HCWs suicides [17].

Quality healthcare, especially during a pandemic, requires a robust health workforce with adequate numbers, optimal physical and mental well-being and a supportive environment. Many parts of Africa continue to struggle with the rising cases of COVID-19 amidst limited medical resources and infrastructure, inadequate health care workforce and minimal ICU beds. The Organization for

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Economic Co-operation and Development (OECD) in 2020 reported 2.6 and 3 physicians and 11.9 and 7.8 nurses per 1,000 people in the United States and United Kingdom respectively. Austria reported the most physicians (5.2) while Norway reported the most nurses (18) per 1,000 people [18]. Most recent corresponding figures from the WHO in Kenya were 0.2 physicians and 1.2 nurses per 1,000 people [19]. Additionally, Kenya has approximately 14 hospital beds per 10,000 people with 537 ICU beds and 256 ventilators serving a population of close to 50 million people [19 20]. In contrast, the WHO in 2019 reported 25 hospital beds per 10,000 people in the United Kingdom with a population of approximately 67 million people [19]. Many African countries have fragile health care systems with fewer than 30 critical care beds for their entire population and only a handful of fully trained critical care physicians, highlighting the lack of critical resources to adequately address the COVID-19 pandemic in Africa [2 21]. Mental health resources and providers are also lacking in Kenya. As of 2016, Kenya reported 0.18 psychiatrists and 0.002 psychologists per 10,000 people with less than 1% of the public sector having access to any form of mental health care services [19 22]. Furthermore, similar to other sub-Saharan African (SSA) countries, Kenya has no formal mental health response plan within the larger COVID-19 strategic response [22].

Historical experiences with deadly pandemics can offer invaluable lessons to resource limited settings. During the Ebola pandemic in Western Africa in the early parts of 2014, the pandemic swiftly crippled an already weak health care system, resulting in approximately 69% of HCWs deaths with anecdotal evidence of increasing mental health disorders among survivors [23-25]. However, few studies have been conducted on the association of the Ebola pandemic on HCWs mental health symptoms. Similarly, a year into the COVID-19 pandemic, little is known on the effect of the pandemic on the mental health of HCWs in SSA or in any resource-limited setting. We therefore aimed to measure the prevalence of mental health symptoms among HCWs in 3

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major hospitals in Kenya, and to evaluate risk factors for mental health symptoms among HCWs in these hospitals.

METHODS

Study Design

We carried out a cross sectional study between August and November, 2020.

Participants and Study Site

Physicians, including residents and fellows, and nurses were recruited from 1 government (Coast General Teaching and Referral Hospital, Mombasa (CGTRH)) and 2 private hospitals (Aga Khan University Hospital, Nairobi (AKUHN), and Avenue Hospital, Nairobi).

Recruitment and Enrollment

Email addresses of all physicians and nurses in each hospital were obtained by the principal site investigator in each hospital with help of the Information Technology Department. Physicians and nurses were recruited from AKUHN, CGTRH and Avenue Hospital. Email invitations with a link to a voluntary, de-identified survey were sent to 725 HCWs. Responses from HCW remained anonymous.

Ethical Approval

Approval for this study was obtained from the Institutional Ethics and Review Committee at the Aga Khan University, Nairobi and the hospital leadership at CGTRH and Avenue Hospital. Online consent was obtained from all the participants. Participants were allowed to withdraw from the study at any time without any consequences. The survey was anonymous, and confidentiality of information was assured. On conclusion of the survey, a score for each mental health disorder was

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computed and shared with the participants. If the scores indicated a mental health issue, the participants were directed to seek medical consultation with their primary care provider or the counselling services at the respective hospitals. If any of the participants indicated suicidal or homicidal ideations, they were directed to the mental health hotline at the Aga Khan University Hospital or an assigned physician at the CGTRH and Avenue Hospital.

Procedures

Online survey data were collected through the Research Electronic Data Capture - REDCap platform (Vanderbilt and National Institute of Health) [26]. Email reminders were sent out twice a week from REDCap for participation in the survey. Every participant received a unique link allowing them to complete the survey only once. The survey questionnaire in English consisted of six components: demographic characteristics (including job title, experiences providing care to patients with COVID-19), and sections on symptoms of depression, anxiety, insomnia, distress and burnout. On average the surveys took about five to seven minutes to complete. Mental health symptoms were measured using validated questionnaires: the 9-item Patient Health Questionnaire (PHQ-9) for depression [27], the 7-item Generalized Anxiety Disorder Questionnaire (GAD-7) for anxiety [28], the 7-item Insomnia Severity Index Questionnaire (ISI) for insomnia [29], the 22-item Impact of Event Scale–Revised (IES-R) for distress [30] and the 16-item Stanford Professional Fulfillment Index Questionnaire (SPFI) for burnout [31]. While the 22-item Impact of Event Scale–Revised (IES-R) was initially designed for diagnosing post-traumatic stress disorder (PTSD), it has been used in multiple recent studies to measure COVID-19-related psychological distress and we have used it to measure general distress [3 13]. The cutoff score for detecting symptoms of major depression, anxiety, insomnia, and distress were 10, 7, 15, and 26, respectively [13]. The categories of the severity of each mental health disorder are presented in Table 1. Based on previously

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published literature, we defined frontline HCWs as those HCWs who reported in providing direct care (diagnosing, treating or providing nursing care) as 'frontline HCWs'. to COVID-19 patients [13 15]. HCWs who were not taking care of COVID-19 patients were mostly from the outpatient clinics as well as the non-COVID wards.

Statistical Analysis

Categorical data were analyzed as frequencies and percentages whereas continuous data were analyzed as medians with interquartile ranges (IQR). The nonparametric Kruskal-Wallis test was utilized to compare the continuous variables and Fishers exact test was used to compare the categorical variables between two groups. To determine potential risk factors for symptoms of depression, anxiety, insomnia, distress, burnout and professional fulfillment in participants, a multivariate logistic regression analysis was performed, and the associations between risk factors and outcomes are presented as odds ratios (ORs) and 95% confidence intervals (CIs). The outcome variables for the multivariate logistic regressions were mental health disorders dichotomized using the standard cutoffs as above. Data analysis was performed using SPSS statistical software version 20.0 (IBM Corp). The significance level was set at $\alpha = .05$, and all tests were 2-tailed.

Patient and public involvement

Patients or the public were not involved in the research design, reporting, or survey dissemination strategies of this study.

RESULTS

Of the 725 invited HCWs across the three hospitals, 473 (65.2%) responded to the survey and 433 (91.5%, overall: 59.7%) consented to complete the survey (Table 2). The median age of the participants was 32.8 years (IQR: 29.71, 36.75). Of the 433 responding participants, 253 (58.4%) were females, and 244 (56.7%) were married. Most of the participants were medical doctors (243

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[56.1%]) and of African ethnicity (354 [82.5%]). A total of 298 participants (68.8%) were frontline HCWs directly engaged in COVID-19 care and treatment. Of the frontline workers, 122 (41.1%) had cared for about 5-20 patients and 174 (58.8%) had lost a patient to COVID-19. Only 3.7% of all participants reported a prior history or diagnosis of any mental health disorder.

Using the standardized screening tools, depression, anxiety, insomnia, distress, and burnout were reported in 53.6%, 44.3%, 41.1%, 31.0%, and 45.8% of all participants, respectively. Severe symptoms of depression, anxiety, insomnia, distress, and burnout were more commonly reported among frontline HCWs than colleagues who were not frontline HCWs. For example, severe depression was reported among 11.6% of frontline HCWs (n=34) compared with 3.8% (n=5) among workers not directly caring for COVID-19 patients ($p < 0.001$, Table 3). The questionnaires demonstrated good internal consistency with a Cronbach alpha of 0.904, 0.912, 0.896, 0.971 and 0.935 for PHQ-9, GAD-7, ISI, IES-R and SPFI respectively.

Multivariate logistic regression analysis showed that after adjustment, working on the frontlines was an independent risk variable for all the mental health disorders (depression, OR 3.55; 95% CI, 1.77-7.11; $p<0.001$; anxiety, OR 2.51; 95% CI, 1.20-5.25; $p=0.014$; insomnia, OR 4.45; 95% CI, 1.51-13.10; $p=0.007$; distress: OR, 1.89, 95% CI, 1.10-3.17; $p=0.021$ and burnout: OR, 2.74, 95% CI, 1.69-4.42; $p<0.001$). Furthermore, being a doctor and being a female were associated with severe symptoms of depression and anxiety, with an OR of 1.95 for severe depression among women compared with men, (95% CI, 1.12-3.42; $p=0.019$) and an OR of 2.29 for severe anxiety among doctors compared with nurses (95% CI, 1.21-4.32; $p=0.011$) (Table 4).

Nearly half of frontline workers stated that they lacked adequate resources and PPE to care for COVID-19 patients, and fewer felt that they needed additional training to take care of or treat COVID-19 patients (resources: 45.8%, trained: 46.0%). On further analysis, we found that HCWs

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employed in public institutions were more likely to report having inadequate resources than those in the private hospital (OR 14.55, 95% CI, 5.99-35.34; p<0.001), and were more likely to report being inadequately trained (OR 3.61, 95% CI, 1.91-6.81; p<0.001).

Furthermore, respondents from the public institution reported experiencing more moderate to severe symptom levels of depression, anxiety, insomnia, and distress (eg, moderate and severe depression among private vs public: 67 [18.7%] vs 22 [32.4%]; p=0.014, moderate and severe anxiety among private vs public: 43 [12.3%] vs 19 [28.3%]; p=0.008; moderate and severe insomnia among private vs public: 30 [8.5%] vs 15 [22.4%]; p=0.004 and distress among private vs public: 62 [17.8%] vs 21 [33.3%]; p=0.014) (Table 5).

DISCUSSION

To our knowledge, this is among the first studies to investigate mental health disorders among HCWs during the COVID-19 pandemic in Kenya, or to evaluate the associations between COVID-19 and mental health symptoms in any resource-limited setting in sub-Saharan Africa. Our study examined HCWs in one government and two private hospitals in Kenya actively involved in the care of COVID-19 patients. Two of the institutions were located in Nairobi and one in Mombasa; both major cities have been greatly affected by COVID-19.

Despite only 3.7% reporting ever having mental health disorders previously, our study reported higher rates of depression, anxiety, insomnia, distress, and burnout. Similar to studies conducted in other countries, being a frontline worker was associated with higher scores for depression, anxiety, insomnia, distress and burnout. Our study also showed that being a female and a doctor was significantly associated with severe symptoms of depression and anxiety. This is in contrast to other studies in which nurses experienced more psychological symptoms associated with caring

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for COVID-19 patients [5 13 32]. This specific finding needs further research to understand if there is a cultural aspect related to this and whether level of knowledge and education plays a role in the anxiety level of different HCWs.

The median age of our study population was 32.8 years. Our study did not find an association between HCWs' age and mental health disorders (comparing the median values of age) but age was significantly negatively correlated with mental health disorders (range -0.118 to -0.179) which was similar to findings from other studies [11 15 33]. Furthermore, although methods vary slightly in different studies, our study showed higher overall percentages of depression, anxiety, and insomnia among frontline HCWs that have been found in other studies conducted in higher income countries using the same validated scales and diagnostic criteria [3 6 11-15]This important finding in our setting could be attributed to the limited resources and lack of mitigating strategies such as a formal mental health response plan, readily available mental health services, regulation of work hours and adequate medical resources in Kenya.

A recent study on mental health disorders among trainees at three American academic medical centers found that trainees taking care of COVID-19 patients had higher rates of burnout compared to those not taking care of COVID-19 patients, but found no significant difference in professional fulfillment scores [34]. On the contrary, a study in Turkey showed a lower level of burnout in physicians taking care of COVID-19 patients compared with physicians who took care of non COVID-19 patients [35]. In our study, we found statistically higher rates of burnout among all cadres of HCWs at all institutions taking care of COVID-19 patients compared to those not taking care of COVID-19 patients. We found no statistical difference in professional fulfillment scores.

Overall, we found that half of the respondents felt inadequately trained and reported lack of enough resources and PPE to safely care for COVID-19 patients. A study looking at HCW knowledge,

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attitude and practices in Uganda found that 69% reported sufficient knowledge and 74% had a positive attitude around COVID-19 [36]. Similarly, Mbachu and colleagues reported excellent knowledge and good preventative practices towards COVID-19 in Nigeria [37].

In our study, HCWs at the government hospital felt less trained with inadequate resources and PPE to take care of COVID-19 patients than those in the private hospitals. Most government hospitals have generally few resources as compared to private institutes that are often hard to quantify. The government hospitals are of various levels and resources greatly vary depending on their geographic locations in the country. Also due to the limited health care resources, patients are admitted to the hospitals based on the location and availability and not due to severity. The higher severity patients are admitted on both private and governmental institutes. Mbachu and colleagues showed that a lack of PPE had a negative impact on the attitudes of HCWs in Nigeria [37]. Likewise, in our study, HCWs in the government institution also showed significantly higher rates of depression, anxiety, insomnia and distress than those in the private hospitals. We could find no other study comparing mental health outcomes between private and government hospital in our or any other settings. In addition to the absence of mitigating strategies unique to HCWs taking care of COVID-19 patients, our findings also stress the importance of adequate medical personnel, training, critical care beds and other key resources to help fortify fragile health care systems within many African countries and to better tackle the COVID-19 pandemic.

Like many other countries in SSA, Kenya lacks a formal mental health response plan to the COVID-19 pandemic [22]. Some researcher in Kenya has called for key recommendations to help strengthen the mental health response to COVID-19 including a dynamic mental health response plan designed by mental health experts specific to the needs of the country and grassroots training of community health workers and volunteers, especially HIV counsellors and retired nurses,

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remains key not only to target the population at large but also to focus on providing key mental health services to HCWs in institutions across the country [2 22] . Like many other African countries, regular press releases on television and radios are used to disseminate key information on COVID-19 in Kenya [38]. These platforms can be used to educate the population on COVID-19 but also to demystify the stigma around seeking mental health services related to COVID-19. Of note, Kenya has a 91% penetration of mobile subscriptions allowing the use of mobile health applications to further enhance the delivery of care not only to the local population, but also health care workers [22]. In addition, toll-free mental health helplines could be a key step to improving access to mental health services especially for specific populations such as HCWs providing care to COVID-19 patients [38]. Senior leadership at every hospital, with the support of the government and donor organizations, should seek creative ways to enhance the mental health capabilities and resources especially for HCWs taking care of COVID-19 patients. This includes either investing in training and capacity building opportunities or sharing resources among various hospitals geographically and electronically to better support the response process. Providing daily allowances to frontline HCWs, additional tax relief, as well as publicly acknowledging their heroic efforts might be ways to boost morale and improve mental health outcomes in limited resource settings [2].

Our study has several limitations. It was conducted in one government hospital in Mombasa and two private hospitals in Nairobi, with different funding structures. This was a cross-sectional survey and the responses were not equally distributed among the HCW cadres, which could bias the results. This may have occurred due to higher email utilization among doctors than among nurses. Also being a cross-sectional survey, the study could only describe the prevalence of mental health symptoms. Our study was conducted between the first and second waves of the virus outbreak and our results might not be suggestive of the long-term psychological disorders within

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our HCW population. We also did not ask the participants if they had contracted COVID-19 themselves or if they had unprotected exposure to COVID-19. Electronic mail with frequent reminders was only used, which could have potentially limited our response rate. Lastly, there may have been a response bias in that the non-responders may have been suffering from mental health symptoms, limiting the motivation to respond.

CONCLUSION

Our study, the first conducted in Kenya and one of the first in a low-resource healthcare setting, shows markedly higher rates of mental health disorders including depression and anxiety in all health care workers taking care of COVID-19 patients than those not caring for COVID-19 patients, and higher rates than those reported in higher-income countries. Being a doctor and a female were associated with severe symptoms of depression and anxiety. Furthermore, HCWs in the government institution experienced higher rates of mental health symptoms than their counterparts in private institutions. This study highlights the urgent need for cost-effective, easy to replicate and rapid to implement mitigating strategies to help curb the burden of mental health disorders associated with caring for COVID-19 patients in Kenya and other resource-limited countries. Special attention should be paid to HCWs in the government hospitals.

For peer review only

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For peer review only

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For peer review only

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ABBREVIATIONS

PPE	Personal protective equipment
HCW	Healthcare worker
ICU	Intensive care unit
OECD	Organization for Economic Co-operation and Development
WHO	World Health Organization
SSA	sub-Saharan Africa
CGTRH	Coast General Teaching and Referral Hospital, Mombasa
AKUHN	Aga Khan University Hospital, Nairobi
REDCap	Research Electronic Data Capture
PHQ	Patient Health Questionnaire
GAD	Generalized Anxiety Disorder
ISI	Insomnia Severity Index
IES-R	Impact of Event Scale–Revised
SPFI	Stanford Professional Fulfillment Index
IQR	Interquartile ranges
OR	Odds Ratio
CI	Confidence Interval

FOOTNOTES

Contributors: SKA developed the concept study and proposal, supervised the overall project and coordinated the study at AKUHN. AMW, ZT, and AN assisted in the study concept, design and editing of the survey. MS supervised data collection at the Avenue Hospital. AA, MAM and SM supervised the data collection at CGTRH. SKA and JS verified the underlying data. JS did the data analysis. JS and SA wrote the first draft of the paper. All authors reviewed, edited and provided comments on the first and subsequent drafts. All authors reviewed and approved the final manuscript.

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Patient consent for publication: Not required

Ethical approval: Approval for this study was obtained from the Institutional Ethics and Review Committee at the Aga Khan University, Nairobi and the hospital leadership at CGTRH and Avenue Hospital.

Data availability statement: All participant data used in this research are anonymous. Participant data used for analysis are available on reasonable request from corresponding author, Sayed K. Ali at sayed.karar@aku.edu.

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Scoring Categories for Mental Health Disorders	
PHQ-9 (Depression)	***IES-R (Distress)***
Normal (0 – 4)	Normal (0 – 8)
Mild (5 – 9)	Mild (9 – 25)
Moderate (10 – 14)	Moderate (26 – 43)
Severe (15 – 27)	Severe (44 – 88)
Binary Cut off - 10	*Binary Cut off - 26*
GAD-7 (Anxiety)	***SPFI (Burnout)***
Normal (0 – 4)	Yes (> 1.33)
Mild (5 – 9)	No (≤ 1.33)
Moderate (10 – 14)	
Severe (15 – 21)	***SPFI (Professional Fulfillment)***
Binary Cut off - 7	Yes (> 3.0)
	No (≤ 3.0)
ISI (Insomnia)	
Normal (0 – 7)	
Subthreshold (8 – 14)	
Moderate (15 – 21)	
Severe (22 – 28)	
Binary Cut off - 15	

Table 1: Scoring categories for the mental health disorders

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Characteristics	**N (%)**
Age (years) (n = 401) (median [IQR])	32.75 [29.71, 36.75]
Gender	
Male	176 (40.6%)
Female	253 (58.4%)
Prefer not to disclose	4 (1.0%)
Marital Status (n = 430)	
Single	172 (40.0%)
Married	244 (56.7%)
Other	14 (3.3%)
Ethnicity (n = 429)	
African	354 (82.5%)
Asian	51 (11.9%)
Other	24 (5.6%)
Health Care Profession	
Nurses	190 (43.9%)
Doctors	243 (56.1%)
Direct care COVID	
Yes	298 (68.8%)
No	135 (31.2%)
Patients cared (n = 297)	
< 5 Patients	101 (34.0%)
5 - 20 Patients	122 (41.1%)
> 20 Patients	74 (24.9%)
Lost any patients (n = 296)	
Yes	174 (58.8%)
No	122 (41.2%)
Enough Resources to care for COVID (n = 297)	
Yes	161 (54.2%)
No	136 (45.8%)
Adequately Trained for COVID (n = 298)	
Yes	161 (54.0%)
No	137 (46.0%)
History of Mental Health Disorder	
Yes	16 (3.70%)
No	398 (91.9%)
Not Sure	15 (3.4%)
Prefer not to disclose	4 (1.0%)
Diagnosis (n = 15)	
Anxiety	5 (33.3%)
Depression	7 (46.7%)
Epilepsy	1 (6.7%)

Depression and Anxiety	2 (13.3%)
Still have symptoms	
Yes	8 (50.0%)
No	8 (50.0%)

Table 2: Baseline characteristics of study participants (N = 433)

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Variable	Adj OR [a]	(95% CI)	P Value
PHQ-9: Depression			
Gender			
Male	1 [Reference]		N/A
IES-R: Distress			
Gender			
Male	1 [Reference]		N/A

		Total	***Have you ever directly cared for a patient with COVID-19?***		
			Yes	***No***	***P Value***
Depression		**(n = 425)**	**(n = 292)**	**(n = 133)**	
PHQ-9	None	197 (46.4%)	116 (39.7%)	81 (60.9%)	
	Mild	139 (32.7%)	99 (33.9%)	40 (30.1%)	*<0.001*
	Moderate	50 (11.8%)	43 (14.7%)	7 (5.3%)	
	Severe	39 (9.2%)	34 (11.6%)	5 (3.8%)	
Anxiety		**(n = 418)**	**(n = 287)**	**(n = 131)**	
GAD-7	Minimal	208 (49.8%)	131 (45.6%)	77 (58.8%)	
	Mild	148 (35.4%)	104 (36.2%)	44 (33.6%)	*0.017*
	Moderate	33 (7.9%)	27 (9.4%)	6 (4.6%)	
	Severe	29 (6.9%)	25 (8.7%)	4 (3.1%)	
Insomnia		**(n = 418)**	**(n = 287)**	**(n = 131)**	
ISI	None	246 (58.9%)	156 (54.4%)	90 (68.7%)	
	Subthreshold	127 (30.4%)	90 (31.4%)	37 (28.2%)	*0.001*
	Moderate	39 (9.3%)	36 (12.5%)	3 (2.3%)	
	Severe	6 (1.4%)	5 (1.7%)	1 (0.8%)	
Distress		**(n = 410)**	**(n = 281)**	**(n = 129)**	
IESR	Normal	283 (69.0%)	185 (65.8%)	98 (76.0%)	
	Mild	44 (10.7%)	28 (10.0%)	16 (12.4%)	*0.008*
	Moderate	24 (5.9%)	17 (6.0%)	7 (5.4%)	
	Severe	59 (14.4%)	51 (18.1%)	8 (6.2%)	
Avoidance Subscale		0.80 [0.10, 1.40]	0.90 [0.10, 1.80]	0.60 [0.00, 1.10]	*0.032*
Intrusion Subscale		0.65 [0.10, 1.30]	0.80 [0.10, 1.50]	0.60 [0.00, 1.10]	*0.065*
Hyperarousal Subscale		0.40 [0.00, 1.20]	0.50 [0.20, 1.30]	0.30 [0.00, 0.80]	*0.041*
SPFI		**(n = 404)**	**(n = 278)**	**(n = 126)**	
Professional Fulfillment		54.17 [37.50, 75.00]	50.00 [33.33, 75.00]	58.33 [45.83, 75.00]	*<0.001*
Work Exhaustion		43.75 [25.00, 68.75]	50.00 [25.00, 75.00]	31.25 [18.75, 50.00]	*<0.001*
Interpersonal Disengagement		20.42 [0.00, 37.50]	25.00 [0.00, 41.67]	8.33 [0.00, 25.00]	*<0.001*
Burnout					
	≤ 1.33	219 (54.2%)	130 (46.8%)	89 (70.6%)	*<0.001*
	> 1.33	185 (45.8%)	148 (53.2%)	37 (29.4%)	
Professional Fulfillment					
	≤ 3.00	327 (81.1%)	231 (83.1%)	96 (76.8%)	*0.168*
	> 3.00	76 (18.9%)	47 (16.9%)	29 (23.2%)	

Table 3: Severity categories and scores of Depression, Anxiety, Insomnia, Distress, Burnout, and Professional Fulfillment Measurements in Total Cohort and Categorized Between Direct COVID Care.

	Female	1.95	(1.12, 3.42)	0.019	Female	2.18	(1.32, 3.60)	0.002
Health Care					*Health Care*			
	Nurse	1 [Reference]		N/A	Nurse	1 [Reference]		N/A
	Doctor	2.24	(1.27, 3.94)	0.005	Doctor	1.09	(0.67, 1.76)	0.738
COVID Care					*COVID Care*			
	Second-line	1 [Reference]		N/A	Second-line	1 [Reference]		N/A
	Frontline	3.55	(1.77, 7.11)	<0.001	Frontline	1.89	(1.10, 3.17)	0.021
GAD-7: Anxiety					***SPFI: Burnout***			
Gender					*Gender*			
	Male	1 [Reference]		N/A	Male	1 [Reference]		N/A
	Female	1.95	(1.04, 3.65)	0.036	Female	1.73	(1.11, 2.71)	0.017
Health Care					*Health Care*			
	Nurse	1 [Reference]		N/A	Nurse	1 [Reference]		N/A
	Doctor	2.29	(1.21, 4,32)	0.011	Doctor	0.86	(0.55, 1.34)	0.858
COVID Care					*COVID Care*			
	Second-line	1 [Reference]		N/A	Second-line	1 [Reference]		N/A
	Frontline	2.51	(1.20, 5,25)	0.014	Frontline	2.74	(1.69, 4.42)	<0.001
ISI: Insomnia					***SPFI: Professional Fulfillment***			
Gender					*Gender*			
	Male	1 [Reference]		N/A	Male	1 [Reference]		N/A
	Female	1.77	(0.85, 3.70)	0.127	Female	0.72	(0.42, 1.24)	0.234
Health Care					*Health Care*			
	Nurse	1 [Reference]		N/A	Nurse	1 [Reference]		N/A
	Doctor	3.08	(1.38, 6.89)	0.006	Doctor	0.90	(0.52, 1.57)	0.900
COVID Care					*COVID Care*			
	Second-line	1 [Reference]		N/A	Second-line	1 [Reference]		N/A
	Frontline	4.45	(1.51, 13.1)	0.007	Frontline	0.78	(0.45, 1.37)	0.788

Table 4: Multivariate logistic regression analysis. Adj OR: adjusted odds ratio, CI: confidence interval.
[a]Adjusted for age, gender, marital status, working title and COVID care where appropriate.

	Hospital		
	Private (n =365)	***Public (n = 68)***	***P Value***

Depression	-	**(n = 357)**	**(n = 68)**	
PHQ-9	None	176 (49.3%)	21 (30.9%)	
	Mild	114 (31.9%)	25 (36.8%)	*0.014*
	Moderate	39 (10.9%)	11 (16.2%)	
	Severe	28 (7.8%)	11 (16.2%)	
Anxiety	-	**(n = 351)**	**(n = 67)**	
GAD-7	Minimal	183 (52.1%)	25 (37.3%)	
	Mild	125 (35.6%)	23 (34.3%)	*0.008*
	Moderate	23 (6.6%)	10 (14.9%)	
	Severe	20 (5.7%)	9 (13.4%)	
Insomnia	-	**(n = 351)**	**(n = 67)**	
ISI	None	216 (61.5%)	30 (44.8%)	
	Subthreshold	105 (29.9%)	22 (32.8%)	*0.004*
	Moderate	25 (7.1%)	14 (20.9%)	
	Severe	5 (1.4%)	1 (1.5%)	
Distress	-	**(n = 347)**	**(n = 63)**	
IESR	Normal	246 (70.9%)	37 (58.7%)	
	Mild	39 (11.2%)	5 (7.9%)	*0.014*
	Moderate	15 (4.3%)	9 (14.3%)	
	Severe	47 (13.5%)	12 (19.0%)	
SPFI	-	**(n = 343)**	**(n = 61)**	
Burnout	-			
	≤ 1.33	190 (55.4%)	29 (47.5%)	*0.268*
	> 1.33	153 (44.6%)	32 (52.5%)	
Professional Fulfillment				
	≤ 3.00	275 (80.4%)	52 (85.2%)	*0.478*
	> 3.00	67 (19.6%)	9 (14.8%)	

Table 5: Severity categories of Depression, Anxiety, Insomnia, Distress, Burnout, and Professional Fulfillment Measurements in Total Cohort and Categorized Between Private and Public Hospital.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6-7
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7-8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-9
Bias	9	Describe any efforts to address potential sources of bias	14
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	9
		(*e*) Describe any sensitivity analyses	-
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10
		(b) Indicate number of participants with missing data for each variable of interest	10
Outcome data	15*	Report numbers of outcome events or summary measures	10

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Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-11/ Tables
		(*b*) Report category boundaries when continuous variables were categorized	9-11/ Tables
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	11 – 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14 – 15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	11-15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	N/A

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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MENTAL HEALTH DISORDERS AMONG HEALTH CARE WORKERS DURING THE COVID-19 PANDEMIC: A CROSS-SECTIONAL SURVEY FROM THREE MAJOR HOSPITALS IN KENYA.

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MENTAL HEALTH DISORDERS AMONG HEALTH CARE WORKERS DURING THE COVID-19 PANDEMIC: A CROSS-SECTIONAL SURVEY FROM THREE MAJOR HOSPITALS IN KENYA.

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ABSTRACT

Background:

COVID-19 is an international global health emergency and has posed a great challenge to mental well-being and resilience. Little is known about the mental health impact of COVID-19 among healthcare workers (HCWs) in sub-Saharan Africa or other low-resource settings.

Methods:

We conducted a cross-sectional study between August and November 2020 among HCWs recruited from three major hospitals in Kenya. The survey questionnaire consisted of six components: demographic and work title characteristics; information regarding care of COVID-19 patients; and symptoms of depression, anxiety, insomnia, distress and burnout, measured using standardized questionnaires. Multivariable logistic regression analysis was performed to identify factors associated with mental health disorders.

Results:

A total 433 (65.2% response rate) individuals participated in the survey. Median age was 32.75 years, 58.4% were females and 68.8% were frontline workers. Depression, anxiety, insomnia, distress, and burnout were reported in 53.6%, 44.3%, 41.1%, 31.0%, and 45.8% of all participants respectively. Frontline HCWs, females, and doctors were at higher risk of mental health symptoms. Nearly half of participants reported inadequate resources or training to care for COVID-19 patients, and those in the government hospital were more likely to report mental health symptoms.

Conclusions:

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This among the first studies examining mental health outcomes among health care workers during the COVID-19 pandemic in Kenya. Similar to other studies from around the world, HCWs directly involved with COVID-19 patients reported higher rates of mental health symptoms. Mitigating strategies specific to Kenyan HCWs are urgently needed to help them cope with mental health symptoms during the pandemic.

Strengths and Limitations

- To the best of our knowledge, this is one of the first articles reporting the prevalence of mental health disorders among HCWs during the COVID-19 pandemic in Kenya.
- Mental health disorders were measured using specific standardized questionnaires.
- The study was conducted between the first and second waves of the virus outbreak and the results might not be suggestive of the long-term psychological disorders within our HCW population.
- There is need for cost-effective mitigating strategies to help curb the burden of mental health disorders associated with caring for COVID-19 patients in Kenya.

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BACKGROUND

The immense toll of the global SARS CoV-2 pandemic continues to rise, with over 87 million confirmed cases and almost 1.9 million deaths to date [1]. COVID-19 reached Kenya in March 2020, and as of December 2020, there were over 97,000 confirmed cases and 1,700 deaths [1]. COVID-19 has had a significant impact on the healthcare workforce. Increased work-load, long hours, inadequate personal protective equipment (PPE), the need to make ethically and morally difficult decisions, a lack of social support, isolation from and fear of infecting family members and oneself can have major impacts on the mental health of frontline workers [2]. Multiple recent studies conducted in Turkey, Singapore, India, Italy, Spain, China, the United States and Oman have shown high rates of stress, depression, anxiety and burnout among healthcare workers (HCW) taking care of COVID-19 patients [3-9]. Other studies have shown higher rates of mental health disorders among HCWs caring for COVID-19 compared with those not caring for COVID-19 patients [10-15]. Risk factors for mental health symptoms among HCWs caring for COVID-19 patients include being female, young, single, having minimal work experience and working on the frontlines [10]. Unfortunately, the psychological impact of the COVID-19 pandemic has also resulted in HCWs suicides [16]. A global study done between April and May 2020 across 31 countries looking at mental health outcomes in HCWs during the initial stage of the pandemic, showed an overall prevalence of 60% anxiety and 53% depression. There were only 49 responses from eleven countries in Africa, including Kenya [17]. This was the beginning of the COVID-19 in most African countries where the cases were still low (Kenya: April 2020 total was ~400 positive cases) [1].

Quality healthcare, especially during a pandemic, requires a robust health workforce with adequate numbers, optimal physical and mental well-being and a supportive environment. Many parts of Africa continue to struggle with the rising cases of COVID-19 amidst limited medical resources

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and infrastructure, inadequate health care workforce and minimal ICU beds. The Organization for Economic Co-operation and Development (OECD) in 2020 reported 2.6 and 3 physicians and 11.9 and 7.8 nurses per 1,000 people in the United States and United Kingdom respectively. Austria reported the most physicians (5.2) while Norway reported the most nurses (18) per 1,000 people [18]. Most recent corresponding figures from the WHO in Kenya were 0.2 physicians and 1.2 nurses per 1,000 people [19]. Additionally, Kenya has approximately 14 hospital beds per 10,000 people with 537 ICU beds and 256 ventilators serving a population of close to 50 million people [19 20]. In contrast, the WHO in 2019 reported 25 hospital beds per 10,000 people in the United Kingdom with a population of approximately 67 million people [19]. Many African countries have fragile health care systems with fewer than 30 critical care beds for their entire population and only a handful of fully trained critical care physicians, highlighting the lack of critical resources to adequately address the COVID-19 pandemic in Africa [2 21]. Mental health resources and providers are also lacking in Kenya. As of 2016, Kenya reported 0.18 psychiatrists and 0.002 psychologists per 10,000 people with less than 1% of the public sector having access to any form of mental health care services [19 22]. Furthermore, similar to other sub-Saharan African (SSA) countries, Kenya has no formal mental health response plan within the larger COVID-19 strategic response [22].

Historical experiences with deadly pandemics can offer invaluable lessons to resource limited settings. During the Ebola pandemic in Western Africa in the early parts of 2014, the pandemic swiftly crippled an already weak health care system, resulting in approximately 69% of HCWs deaths with anecdotal evidence of increasing mental health disorders among survivors [23-25]. However, few studies have been conducted on the association of the Ebola pandemic on HCWs mental health symptoms. Similarly, a year into the COVID-19 pandemic, little is known on the effect of the pandemic on the mental health of HCWs in SSA or in any resource-limited setting.

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We therefore aimed to measure the prevalence of mental health symptoms among HCWs in 3 major hospitals in Kenya, and to evaluate risk factors for mental health symptoms among HCWs in these hospitals.

METHODS

Study Design

We carried out a cross sectional study between August and November, 2020.

Participants and Study Site

Physicians, including residents and fellows, and nurses were recruited from 1 government (Coast General Teaching and Referral Hospital, Mombasa (CGTRH)) and 2 private hospitals (Aga Khan University Hospital, Nairobi (AKUHN), and Avenue Hospital, Nairobi).

Recruitment and Enrollment

Email addresses of all physicians and nurses in each hospital were obtained by the principal site investigator in each hospital with help of the Information Technology Department. Physicians and nurses were recruited from AKUHN, CGTRH and Avenue Hospital. Email invitations with a link to a voluntary, de-identified survey were sent to 725 HCWs. Responses from HCW remained anonymous.

Ethical Approval

Approval for this study was obtained from the Institutional Ethics and Review Committee at the Aga Khan University, Nairobi and the hospital leadership at CGTRH and Avenue Hospital. Online consent was obtained from all the participants. Participants were allowed to withdraw from the study at any time without any consequences. The survey was anonymous, and confidentiality of

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information was assured. On conclusion of the survey, a score for each mental health disorder was computed and shared with the participants. If the scores indicated a mental health issue, the participants were directed to seek medical consultation with their primary care provider or the counselling services at the respective hospitals. If any of the participants indicated suicidal or homicidal ideations, they were directed to the mental health hotline at the Aga Khan University Hospital or an assigned physician at the CGTRH and Avenue Hospital.

Procedures

Online survey data were collected through the Research Electronic Data Capture - REDCap platform (Vanderbilt and National Institute of Health) [26]. Email reminders were sent out twice a week from REDCap for participation in the survey. Every participant received a unique link allowing them to complete the survey only once. The survey questionnaire in English consisted of six components: demographic characteristics (including job title, experiences providing care to patients with COVID-19), and sections on symptoms of depression, anxiety, insomnia, distress and burnout. On average the surveys took about five to seven minutes to complete. Mental health symptoms were measured using validated questionnaires: the 9-item Patient Health Questionnaire (PHQ-9) for depression [27], the 7-item Generalized Anxiety Disorder Questionnaire (GAD-7) for anxiety [28], the 7-item Insomnia Severity Index Questionnaire (ISI) for insomnia [29], the 22-item Impact of Event Scale–Revised (IES-R) for distress caused by traumatic events [30] and the 16-item Stanford Professional Fulfillment Index Questionnaire (SPFI) for burnout [31]. While the 22-item Impact of Event Scale–Revised (IES-R) was initially designed for diagnosing post-traumatic stress disorder (PTSD), it has been used in multiple recent studies to measure COVID-19-related psychological distress and we have used it to measure general distress caused by traumatic events [3 13]. The cutoff score for detecting symptoms of major depression, anxiety, insomnia, and distress

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were 10, 7, 15, and 26, respectively [13]. The categories of the severity of each mental health disorder are presented in Table 1. Based on previously published literature, we defined frontline HCWs as those HCWs who reported in providing direct care (diagnosing, treating or providing nursing care) as 'frontline HCWs' to COVID-19 patients [13 15]. HCWs who were not taking care of COVID-19 patients were mostly from the outpatient clinics as well as the non-COVID wards.

Statistical Analysis

Categorical data were analyzed as frequencies and percentages whereas continuous data were analyzed as medians with interquartile ranges (IQR). The nonparametric Kruskal-Wallis test was utilized to compare the continuous variables and Fishers exact test was used to compare the categorical variables between two groups. To determine potential risk factors for symptoms of depression, anxiety, insomnia, distress, burnout and professional fulfillment in participants, a multivariate logistic regression analysis was performed, and the associations between risk factors and outcomes are presented as odds ratios (ORs) and 95% confidence intervals (CIs). The outcome variables for the multivariate logistic regressions were mental health disorders dichotomized using the standard cutoffs as above. Data analysis was performed using SPSS statistical software version 20.0 (IBM Corp). The significance level was set at $\alpha = .05$, and all tests were 2-tailed.

Patient and public involvement

Patients or the public were not involved in the research design, reporting, or survey dissemination strategies of this study.

RESULTS

Of the 725 invited HCWs across the three hospitals, 473 (65.2%) responded to the survey and 433 (91.5%, overall: 59.7%) consented to complete the survey (Table 2). The median age of the participants was 32.8 years (IQR: 29.7, 36.8). Of the 433 responding participants, 253 (58.4%)

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were females, and 244 (56.7%) were married. Most of the participants were medical doctors (243 [56.1%]) and of African ethnicity (354 [82.5%]). A total of 298 participants (68.8%) were frontline HCWs directly engaged in COVID-19 care and treatment. Of the frontline workers, 122 (41.1%) had cared for about 5-20 patients and 174 (58.8%) had lost a patient to COVID-19. Only 3.7% of all participants reported a prior history or diagnosis of any mental health disorder.

Using the standardized screening tools, depression, anxiety, insomnia, distress, and burnout were reported in 53.6%, 44.3%, 41.1%, 31.0%, and 45.8% of all participants, respectively. Severe symptoms of depression, anxiety, insomnia, distress, and burnout were more commonly reported among frontline HCWs than colleagues who were not frontline HCWs. For example, severe depression was reported among 11.6% of frontline HCWs (n=34) compared with 3.8% (n=5) among workers not directly caring for COVID-19 patients ($p < 0.001$, Table 3). The questionnaires demonstrated good internal consistency with a Cronbach alpha of 0.904, 0.912, 0.896, 0.971 and 0.935 for PHQ-9, GAD-7, ISI, IES-R and SPFI respectively.

Multivariate logistic regression analysis showed that after adjustment, working on the frontlines was an independent risk variable for all the mental health disorders (depression, OR 3.55; 95% CI, 1.77-7.11; $p<0.001$; anxiety, OR 2.51; 95% CI, 1.20-5.25; $p=0.014$; insomnia, OR 4.45; 95% CI, 1.51-13.10; $p=0.007$; distress: OR, 1.89, 95% CI, 1.10-3.17; $p=0.021$ and burnout: OR, 2.74, 95% CI, 1.69-4.42; $p<0.001$). Furthermore, being a doctor and being a female were associated with severe symptoms of depression and anxiety, with an OR of 1.95 for severe depression among women compared with men, (95% CI, 1.12-3.42; $p=0.019$) and an OR of 2.29 for severe anxiety among doctors compared with nurses (95% CI, 1.21-4.32; $p=0.011$) (Table 4). Although age was not statistically associated with dichotomized mental health outcomes in multivariate analysis, higher age was correlated with lower mental health disorder scores by Pearson's correlation. The

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correlation for age with depression, anxiety, insomnia, distress and burnout was -0.144, -0.118, -0.179, -0.144, and -0.239 (all p values <0.001).

Nearly half of frontline workers stated that they lacked adequate resources and PPE to care for COVID-19 patients, and fewer felt that they needed additional training to take care of or treat COVID-19 patients (resources: 45.8%, trained: 46.0%). On further analysis, we found that HCWs employed in public institutions were more likely to report having inadequate resources than those in the private hospital (OR 14.55, 95% CI, 5.99-35.34; p<0.001), and were more likely to report being inadequately trained (OR 3.61, 95% CI, 1.91-6.81; p<0.001).

Furthermore, respondents from the public institution reported experiencing more moderate to severe symptom levels of depression, anxiety, insomnia, and distress (eg, moderate and severe depression among private vs public: 67 [18.7%] vs 22 [32.4%]; p=0.014, moderate and severe anxiety among private vs public: 43 [12.3%] vs 19 [28.3%]; p=0.008; moderate and severe insomnia among private vs public: 30 [8.5%] vs 15 [22.4%]; p=0.004 and distress among private vs public: 62 [17.8%] vs 21 [33.3%]; p=0.014) (Table 5).

DISCUSSION

To our knowledge, this is among the first studies to investigate mental health disorders among HCWs during the COVID-19 pandemic in Kenya, or to evaluate the associations between COVID-19 and mental health symptoms in any resource-limited setting in sub-Saharan Africa. Our study examined HCWs in one government and two private hospitals in Kenya actively involved in the care of COVID-19 patients. Two of the institutions were located in Nairobi and one in Mombasa; both major cities have been greatly affected by COVID-19.

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Despite only 3.7% reporting ever having mental health disorders previously, our study reported higher rates of depression, anxiety, insomnia, distress, and burnout. Similar to studies conducted in other countries, being a frontline worker was associated with higher scores for depression, anxiety, insomnia, distress and burnout. Our study also showed that being a female and a doctor was significantly associated with severe symptoms of depression and anxiety. This is in contrast to other studies in which nurses experienced more psychological symptoms associated with caring for COVID-19 patients [5 13 32]. This specific finding needs further research to understand if there is a cultural aspect related to this and whether level of knowledge and education plays a role in the anxiety level of different HCWs.

The median age of our study population was 32.8 years. Age was significantly negatively correlated with mental health disorders which was similar to findings from other studies [11 15 33]. We observed higher overall percentages of depression, anxiety, and insomnia among frontline HCWs taking care of COVID-19 patients than have been found in similar studies conducted in higher income countries using the same validated scales and diagnostic criteria [3 6 11-15]. While methods of these studies vary slightly, this finding in our setting could be attributed to the limited resources and lack of mitigating strategies such as a formal mental health response plan, readily available mental health services, regulation of work hours and adequate medical resources in Kenya.

A recent study on mental health disorders among trainees at three American academic medical centers found that trainees taking care of COVID-19 patients had higher rates of burnout compared to those not taking care of COVID-19 patients, but found no significant difference in professional fulfillment scores [34]. On the contrary, a study in Turkey showed a lower level of burnout in physicians taking care of COVID-19 patients compared with physicians who took care of non

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COVID-19 patients [35]. In our study, we found statistically higher rates of burnout among all cadres of HCWs at all institutions taking care of COVID-19 patients compared to those not taking care of COVID-19 patients. We found no statistical difference in professional fulfillment scores.

Overall, we found that half of the respondents felt inadequately trained and reported lack of enough resources and PPE to safely care for COVID-19 patients. A study looking at HCW knowledge, attitude and practices in Uganda found that 69% reported sufficient knowledge and 74% had a positive attitude around COVID-19 [36]. Similarly, Mbachu and colleagues reported excellent knowledge and good preventative practices towards COVID-19 in Nigeria [37].

In our study, HCWs at the government hospital felt less trained with inadequate resources and PPE to take care of COVID-19 patients than those in the private hospitals. Fifty two percent of the hospitals in Kenya are funded by the government. These public hospitals frequently operate with inadequate healthcare workforce and basic amenities, with 74 of 2927 primary public hospitals (2.5%) reporting lacking a medical doctor to serve the local population [38] and only 55% of the healthcare facilities having basic amenities including sanitation facilities, communication technologies, consultation rooms, improved water sources, power supplies, emergency rooms and computers with internet access. Furthermore, only 12% of health facilities in Kenya report having items necessary for infection prevention [38]. Even though the private sector owns and manages almost two-thirds of all Kenya's healthcare facilities, basic data on healthcare resources is lacking [39 40]. A report from USAID Kenya Private Health Sector Assessment highlight the inequalities of health care resources in Kenya with three-quarters of doctors and approximately two-thirds of nurses and clinical officers employed by the private sector [39]. In addition, compared to the public sector, the private sector offers better remuneration, minimizing healthcare worker strikes and improving the overall work environment [40]. COVID-19 has significantly contributed to many

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unresolved logistical issues in public hospitals, including waste management, infrastructure and funding, affecting the morale and welfare of healthcare workers [41]. Other recent studies have shown that challenges in acquisition of PPE in public hospitals is associated with higher levels of anxiety for both clinical and support staff [41]. Mbachu and colleagues showed that a lack of PPE had a negative impact on the attitudes of HCWs in Nigeria [37]. Likewise, in our study, HCWs in the government institution also showed significantly higher rates of depression, anxiety, insomnia and distress than those in the private hospitals. We could find no other study comparing mental health outcomes between private and government hospital in our or any other settings. In addition to the absence of mitigating strategies unique to HCWs taking care of COVID-19 patients, our findings also stress the importance of adequate medical personnel, training, critical care beds and other key resources to help fortify fragile health care systems within many African countries and to better tackle the COVID-19 pandemic.

Like many other countries in SSA, Kenya lacks a formal mental health response plan to the COVID-19 pandemic [22]. Some researcher in Kenya has called for key recommendations to help strengthen the mental health response to COVID-19 including a dynamic mental health response plan designed by mental health experts specific to the needs of the country and grassroots training of community health workers and volunteers, especially HIV counsellors and retired nurses, remains key not only to target the population at large but also to focus on providing key mental health services to HCWs in institutions across the country [2 22]. Like many other African countries, regular press releases on television and radios are used to disseminate key information on COVID-19 in Kenya [42]. These platforms can be used to educate the population on COVID-19 but also to demystify the stigma around seeking mental health services related to COVID-19. Of note, Kenya has a 91% penetration of mobile subscriptions allowing the use of mobile health applications to

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further enhance the delivery of care not only to the local population, but also health care workers [22]. In addition, toll-free mental health helplines could be a key step to improving access to mental health services especially for specific populations such as HCWs providing care to COVID-19 patients [42]. Senior leadership at every hospital, with the support of the government and donor organizations, should seek creative ways to enhance the mental health capabilities and resources especially for HCWs taking care of COVID-19 patients. This includes either investing in training and capacity building opportunities or sharing resources among various hospitals geographically and electronically to better support the response process. Providing daily allowances to frontline HCWs, additional tax relief, as well as publicly acknowledging their heroic efforts might be ways to boost morale and improve mental health outcomes in limited resource settings [2].

Our study has several limitations. It was conducted in one government hospital in Mombasa and two private hospitals in Nairobi, with different funding structures. This was a cross-sectional survey and the responses were not equally distributed among the HCW cadres, which could bias the results. This may have occurred due to higher email utilization among doctors than among nurses. Also being a cross-sectional survey, the study could only describe the prevalence of mental health symptoms. Our study was conducted between the first and second waves of the virus outbreak and our results might not be suggestive of the long-term psychological disorders within our HCW population. We also did not ask the participants if they had contracted COVID-19 themselves or if they had unprotected exposure to COVID-19. Electronic mail with frequent reminders was only used, which could have potentially limited our response rate. Lastly, there may have been a response bias in that the non-responders may have been suffering from mental health symptoms, limiting the motivation to respond.

CONCLUSION

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Our study, the first conducted in Kenya and one of the first in a low-resource healthcare setting, shows markedly higher rates of mental health disorders including depression and anxiety in all health care workers taking care of COVID-19 patients than those not caring for COVID-19 patients, and higher rates than those reported in higher-income countries. Being a doctor and a female were associated with severe symptoms of depression and anxiety. Furthermore, HCWs in the government institution experienced higher rates of mental health symptoms than their counterparts in private institutions. This study highlights the urgent need for cost-effective, easy to replicate and rapid to implement mitigating strategies to help curb the burden of mental health disorders associated with caring for COVID-19 patients in Kenya and other resource-limited countries. Special attention should be paid to HCWs in the government hospitals.

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ABBREVIATIONS

PPE	Personal protective equipment
HCW	Healthcare worker
ICU	Intensive care unit
OECD	Organization for Economic Co-operation and Development
WHO	World Health Organization
SSA	sub-Saharan Africa
CGTRH	Coast General Teaching and Referral Hospital, Mombasa
AKUHN	Aga Khan University Hospital, Nairobi
REDCap	Research Electronic Data Capture
PHQ	Patient Health Questionnaire
GAD	Generalized Anxiety Disorder
ISI	Insomnia Severity Index
IES-R	Impact of Event Scale–Revised
SPFI	Stanford Professional Fulfillment Index
IQR	Interquartile ranges
OR	Odds Ratio
CI	Confidence Interval

FOOTNOTES

Contributors: SKA developed the concept study and proposal, supervised the overall project and coordinated the study at AKUHN. AMW, ZT, and AN assisted in the study concept, design and editing of the survey. MS supervised data collection at the Avenue Hospital. AA, MAM and SM supervised the data collection at CGTRH. SKA and JS verified the underlying data. JS did the data analysis. JS and SA wrote the first draft of the paper. All authors reviewed, edited and provided comments on the first and subsequent drafts. All authors reviewed and approved the final manuscript.

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Data availability statement: All participant data used in this research are anonymous. Participant data used for analysis are available on reasonable request from corresponding author, Sayed K. Ali at sayed.karar@aku.edu.

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Scoring Categories for Mental Health Disorders	
PHQ-9 (Depression)	***IES-R (Distress)***
Normal (0 – 4)	Normal (0 – 8)
Mild (5 – 9)	Mild (9 – 25)
Moderate (10 – 14)	Moderate (26 – 43)
Severe (15 – 27)	Severe (44 – 88)
Binary Cut off - 10	*Binary Cut off - 26*
GAD-7 (Anxiety)	***SPFI (Burnout)***
Normal (0 – 4)	Yes (> 1.33)
Mild (5 – 9)	No (≤ 1.33)
Moderate (10 – 14)	
Severe (15 – 21)	***SPFI (Professional Fulfillment)***
Binary Cut off - 7	Yes (> 3.0)
	No (≤ 3.0)
ISI (Insomnia)	
Normal (0 – 7)	
Subthreshold (8 – 14)	
Moderate (15 – 21)	
Severe (22 – 28)	
Binary Cut off - 15	

Table 1: Scoring categories for the mental health disorders

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Characteristics	**N (%)**
Age (years) (n = 401) (median [IQR])	32.75 [29.71, 36.75]
Gender	
Male	176 (40.6%)
Female	253 (58.4%)
Prefer not to disclose	4 (1.0%)
Marital Status (n = 430)	
Single	172 (40.0%)
Married	244 (56.7%)
Other	14 (3.3%)
Ethnicity (n = 429)	
African	354 (82.5%)
Asian	51 (11.9%)
Other	24 (5.6%)
Health Care Profession	
Nurses	190 (43.9%)
Doctors	243 (56.1%)
Direct care COVID	
Yes	298 (68.8%)
No	135 (31.2%)
Patients cared (n = 297)	
< 5 Patients	101 (34.0%)
5 - 20 Patients	122 (41.1%)
> 20 Patients	74 (24.9%)
Lost any patients (n = 296)	
Yes	174 (58.8%)
No	122 (41.2%)
Enough Resources to care for COVID (n = 297)	
Yes	161 (54.2%)
No	136 (45.8%)
Adequately Trained for COVID (n = 298)	
Yes	161 (54.0%)
No	137 (46.0%)
History of Mental Health Disorder	
Yes	16 (3.70%)
No	398 (91.9%)
Not Sure	15 (3.4%)
Prefer not to disclose	4 (1.0%)
Diagnosis (n = 15)	
Anxiety	5 (33.3%)
Depression	7 (46.7%)
Epilepsy	1 (6.7%)

Depression and Anxiety	2 (13.3%)
Still have symptoms	
Yes	8 (50.0%)
No	8 (50.0%)

Table 2: Baseline characteristics of study participants (N = 433)

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Variable	Adj OR [a]	(95% CI)	P Value	Variable	Adj OR [a]	(95% CI)	P Value
PHQ-9: Depression				***IES-R: Distress***			
		Total		***Have you ever directly cared for a patient with COVID-19?***			
				Yes	***No***		***P Value***
Depression		**(n = 425)**		**(n = 292)**	**(n = 133)**		
PHQ-9	None	197 (46.4%)		116 (39.7%)	81 (60.9%)		
	Mild	139 (32.7%)		99 (33.9%)	40 (30.1%)		*<0.001*
	Moderate	50 (11.8%)		43 (14.7%)	7 (5.3%)		
	Severe	39 (9.2%)		34 (11.6%)	5 (3.8%)		
Anxiety		**(n = 418)**		**(n = 287)**	**(n = 131)**		
GAD-7	Minimal	208 (49.8%)		131 (45.6%)	77 (58.8%)		
	Mild	148 (35.4%)		104 (36.2%)	44 (33.6%)		*0.017*
	Moderate	33 (7.9%)		27 (9.4%)	6 (4.6%)		
	Severe	29 (6.9%)		25 (8.7%)	4 (3.1%)		
Insomnia		**(n = 418)**		**(n = 287)**	**(n = 131)**		
ISI	None	246 (58.9%)		156 (54.4%)	90 (68.7%)		
	Subthreshold	127 (30.4%)		90 (31.4%)	37 (28.2%)		*0.001*
	Moderate	39 (9.3%)		36 (12.5%)	3 (2.3%)		
	Severe	6 (1.4%)		5 (1.7%)	1 (0.8%)		
Distress		**(n = 410)**		**(n = 281)**	**(n = 129)**		
IESR	Normal	283 (69.0%)		185 (65.8%)	98 (76.0%)		
	Mild	44 (10.7%)		28 (10.0%)	16 (12.4%)		*0.008*
	Moderate	24 (5.9%)		17 (6.0%)	7 (5.4%)		
	Severe	59 (14.4%)		51 (18.1%)	8 (6.2%)		
Burnout		**(n = 404)**		**(n = 278)**	**(n = 126)**		
	≤ 1.33	219 (54.2%)		130 (46.8%)	89 (70.6%)		*<0.001*
	> 1.33	185 (45.8%)		148 (53.2%)	37 (29.4%)		
Professional Fulfillment							
	≤ 3.00	327 (81.1%)		231 (83.1%)	96 (76.8%)		*0.168*
	> 3.00	76 (18.9%)		47 (16.9%)	29 (23.2%)		
IESR Subscales							
Avoidance Subscale		0.80 [0.10, 1.40]		0.90 [0.10, 1.80]	0.60 [0.00, 1.10]		*0.032*
Intrusion Subscale		0.65 [0.10, 1.30]		0.80 [0.10, 1.50]	0.60 [0.00, 1.10]		*0.065*
Hyperarousal Subscale		0.40 [0.00, 1.20]		0.50 [0.20, 1.30]	0.30 [0.00, 0.80]		*0.041*
Burnout Subscales							
Professional Fulfillment		54.17 [37.50, 75.00]		50.00 [33.33, 75.00]	58.33 [45.83, 75.00]		*<0.001*
Work Exhaustion		43.75 [25.00, 68.75]		50.00 [25.00, 75.00]	31.25 [18.75, 50.00]		*<0.001*
Interpersonal Disengagement		20.42 [0.00, 37.50]		25.00 [0.00, 41.67]	8.33 [0.00, 25.00]		*<0.001*

Table 3: Severity categories and scores of Depression, Anxiety, Insomnia, Distress, Burnout, and Professional Fulfillment Measurements in Total Cohort and Categorized Between Direct COVID Care.

Gender				*Gender*			
	Male	1 [Reference]	N/A		Male	1 [Reference]	N/A
	Female	1.95 (1.12, 3.42)	0.019		Female	2.18 (1.32, 3.60)	0.002
Health Care				*Health Care*			
	Nurse	1 [Reference]	N/A		Nurse	1 [Reference]	N/A
	Doctor	2.24 (1.27, 3.94)	0.005		Doctor	1.09 (0.67, 1.76)	0.738
COVID Care				*COVID Care*			
	Second-line	1 [Reference]	N/A		Second-line	1 [Reference]	N/A
	Frontline	3.55 (1.77, 7.11)	<0.001		Frontline	1.89 (1.10, 3.17)	0.021
GAD-7: Anxiety				***SPFI: Burnout***			
Gender				*Gender*			
	Male	1 [Reference]	N/A		Male	1 [Reference]	N/A
	Female	1.95 (1.04, 3.65)	0.036		Female	1.73 (1.11, 2.71)	0.017
Health Care				*Health Care*			
	Nurse	1 [Reference]	N/A		Nurse	1 [Reference]	N/A
	Doctor	2.29 (1.21, 4,32)	0.011		Doctor	0.86 (0.55, 1.34)	0.858
COVID Care				*COVID Care*			
	Second-line	1 [Reference]	N/A		Second-line	1 [Reference]	N/A
	Frontline	2.51 (1.20, 5,25)	0.014		Frontline	2.74 (1.69, 4.42)	<0.001
ISI: Insomnia				***SPFI: Professional Fulfillment***			
Gender				*Gender*			
	Male	1 [Reference]	N/A		Male	1 [Reference]	N/A
	Female	1.77 (0.85, 3.70)	0.127		Female	0.72 (0.42, 1.24)	0.234
Health Care				*Health Care*			
	Nurse	1 [Reference]	N/A		Nurse	1 [Reference]	N/A
	Doctor	3.08 (1.38, 6.89)	0.006		Doctor	0.90 (0.52, 1.57)	0.900
COVID Care				*COVID Care*			
	Second-line	1 [Reference]	N/A		Second-line	1 [Reference]	N/A
	Frontline	4.45 (1.51, 13.1)	0.007		Frontline	0.78 (0.45, 1.37)	0.788

Table 4: Multivariate logistic regression analysis. Adj OR: adjusted odds ratio, CI: confidence interval.
[a]Adjusted for age, gender, marital status, working title and COVID care where appropriate.

Hospital

		Private (n =365)	Public (n = 68)	P Value
Depression		**(n = 357)**	**(n = 68)**	
PHQ-9	None	176 (49.3%)	21 (30.9%)	
	Mild	114 (31.9%)	25 (36.8%)	*0.014*
	Moderate	39 (10.9%)	11 (16.2%)	
	Severe	28 (7.8%)	11 (16.2%)	
Anxiety		**(n = 351)**	**(n = 67)**	
GAD-7	Minimal	183 (52.1%)	25 (37.3%)	
	Mild	125 (35.6%)	23 (34.3%)	*0.008*
	Moderate	23 (6.6%)	10 (14.9%)	
	Severe	20 (5.7%)	9 (13.4%)	
Insomnia		**(n = 351)**	**(n = 67)**	
ISI	None	216 (61.5%)	30 (44.8%)	
	Subthreshold	105 (29.9%)	22 (32.8%)	*0.004*
	Moderate	25 (7.1%)	14 (20.9%)	
	Severe	5 (1.4%)	1 (1.5%)	
Distress		**(n = 347)**	**(n = 63)**	
IESR	Normal	246 (70.9%)	37 (58.7%)	
	Mild	39 (11.2%)	5 (7.9%)	*0.014*
	Moderate	15 (4.3%)	9 (14.3%)	
	Severe	47 (13.5%)	12 (19.0%)	
SPFI		**(n = 343)**	**(n = 61)**	
Burnout				
	≤ 1.33	190 (55.4%)	29 (47.5%)	*0.268*
	> 1.33	153 (44.6%)	32 (52.5%)	
Professional Fulfillment				
	≤ 3.00	275 (80.4%)	52 (85.2%)	*0.478*
	> 3.00	67 (19.6%)	9 (14.8%)	

Table 5: Severity categories of Depression, Anxiety, Insomnia, Distress, Burnout, and Professional Fulfillment Measurements in Total Cohort and Categorized Between Private and Public Hospital.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6-7
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7-8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8-9
Bias	9	Describe any efforts to address potential sources of bias	14
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	9
		(*e*) Describe any sensitivity analyses	-
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10
		(b) Indicate number of participants with missing data for each variable of interest	10
Outcome data	15*	Report numbers of outcome events or summary measures	10

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Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-11/ Tables
		(*b*) Report category boundaries when continuous variables were categorized	9-11/ Tables
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	11 – 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14 – 15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	11-15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	N/A

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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