Assessment of COVID-19 management and its consequences on healthcare professionals: a cross-sectional study from Bangladesh

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ABSTRACT

Objective This exploratory study aims to identify the gaps in COVID-19 management and their consequences on physicians in terms of contracting infection and psychological well-being during the early phase of the pandemic.

Methods We conducted a nationwide cross-sectional online study to collect information from 420 intern doctors who were at their internship in government medical colleges from February to August 2020.

Results Findings indicate a delay in first-case detection and identify people’s tendency to hide COVID-19 symptoms as one of the possible causes of that delay. About 56% of the intern doctors experienced that patients were trying to hide COVID-19 symptoms in the earlier phase of the pandemic. More than half of the respondents did not get any training on COVID-19 from their working institutions. About 30% and 20% of the respondents did not use personal protective equipment (PPE) and masks while treating patients. Respondents who treated patients without PPE, masks, face shields and gloves were almost two times as likely to be infected by COVID-19. The odds of experiencing COVID-19-related stress was almost twofold among respondents who treated patients without wearing PPE and masks. Experiencing COVID-19-related stress was further associated with an increased risk of developing anxiety and depression that led to sleep disturbance.

Conclusion Ensuring the maximum utilization of limited resources during any public health crisis such as COVID-19 needs developing coping mechanisms by projecting future demand. Ensuring proper training and safety measures can reduce physical and psychological hazards among physicians.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study assesses COVID-19 management from the eye of front-line doctors.
⇒ Online-based data collection enables reaching doctors despite the lockdown and their busy schedules.
⇒ Adequate sample size has made the conclusion robust.
⇒ There is a lack of validation of the questionnaire instrument used in this study.
⇒ Establishing any causal relationship is beyond the scope of this study.

INTRODUCTION

For more than 2 years, the entire world has been suffering from the outbreak of SARS-CoV-2, also commonly known as COVID-19, first emerged in Wuhan province, China.1 Countries all over the world adopted emergency control measures such as travel restriction, home quarantine, lockdown, contract tracing, testing, etc., based on their population structure and healthcare infrastructure. Developed countries such as Australia, New Zealand and Canada achieved early successes in the crisis challenges of COVID-19 by controlling internal borders and lockdown measures.2 3 To combat COVID-19, Canada and South Korea used artificial intelligence techniques to notify people about potential exposures before they develop symptoms.4 5

Bangladesh context

Bangladesh is a low-and-middle-income densely South Asian country that confirmed 1 948 798 cases and 29 100 deaths until 10 March 2022.5 South Asian countries struggled to take measures such as testing, contact tracing, ensuring movement restriction and arranging separate treatment facilities for patients with COVID-19.6–10 On the day of first COVID-19 death in Bangladesh, the Government of Bangladesh (GoB) adopted the National Preparedness and Response Plan for COVID-19 which was almost one and...
half months (46 days) later from WHO declared public health emergency for international concern and 10 days later from first COVID-19 case detection (8 March 2020) in Bangladesh.10–13 The GoB imposed a ‘lockdown’ on 26 March 2020, which was extended seven times until 30 May 2020. People got confused about the English language terms such as ‘lockdown’, ‘social distancing’, ‘stay at home’, ‘quarantine’.14 However, the lockdown created financial constraints among the vulnerable groups in the country.15 16 As a result, the lockdown and the social distancing strategy did not work properly in Bangladesh.17

Alongside the lockdown and sealed land borders, the GoB arranged COVID-19 dedicated hospitals, conducted national campaigns on preventive measures for COVID-19, set hotline numbers and many stimulus packages to combat the COVID-19 outbreak.18 Bangladesh yet encountered logistical challenges, because this country largely depends on imports for essential medical supplies which got extorted and multiplied the existing scarcity.18 In Bangladesh, testing capacity was quite limited during the initial month of the epidemic (March 2020), but later it expanded to 99 laboratories nationally.19 After the first case detection, people experienced an enormous crisis of masks, hand sanitizers and cleaning equipment.20 21 The GoB also faced unprecedented challenges regarding healthcare supplies and providing safety equipment such as personal protective equipment (PPE), masks, gloves and face shields to front-line healthcare workers.22–26 Drug shortages were a serious issue during the lockdown due to the rapid increase in demand.27

COVID-19 infection among healthcare professionals in Bangladesh

Based on the reported cases until 1 May 2020, the WHO stated that healthcare workers accounted for 11% of all COVID-19 cases in Bangladesh which exacerbated the regular scarcity of human resources in the health sector.28 In November 2020, Kumar and Pinky reported that Bangladesh experienced the highest physician fatality rate in the world.19 A total of 105 doctors died within the first 5 months of the first case detected in Bangladesh.29 Among them, 94 were confirmed cases and 11 were symptomatic.29 During the same period, about 7500 healthcare workers, including 2500 doctors, got infected.29 Nevertheless, no studies investigated how the inadequacy of safety equipment increased the chance of contracting COVID-19 infection among healthcare professionals in Bangladesh.

Psychological conditions of healthcare professionals in Bangladesh

The healthcare workers of developed countries where the COVID-19 management was better than in the least developed countries, not only experienced a high risk of contracting infection but also encountered anxiety, stress, trauma and other mental health conditions.30–33 Frontline healthcare workers of low-income and middle-income countries (LMICs) were even more vulnerable to the detrimental effects of COVID-19 due to the fragmented infrastructure and severe shortages of safety measures.34 A study conducted in Nepal, a neighbouring country of Bangladesh, found that 41.9%, 37.5% and 33.9% of healthcare workers had the symptoms of anxiety, depression and insomnia, respectively.35 Studies conducted in India and Pakistan, two other neighbouring countries of Bangladesh, found similar psychological distress among healthcare professionals.36 37 The scenarios in Bangladesh were not different from its neighbouring countries.38–43

Contribution of intern doctors

From the early phase of the pandemic, public hospitals were providing treatment to COVID-19 suspected and infected patients. The engine of the driving force of any tertiary public hospital is its intern doctors who perform a 1-year log-book-based rotatory prerequisite internship programme for Bangladesh Medical and Dental Council registration after passing the 5-year-long Bachelor of Medicine and Bachelor of Surgery (MBBS) degree.44 These intern doctors are the first entry point for taking service in tertiary public hospitals. They work 72 hours per week and enjoy a day off after ‘one night posting and handover’.45 During the COVID-19 pandemic, they restlessly worked to tackle the extra load of patients with limited resources.

Research gaps and objective

In Bangladesh, only a few pieces of research assessed the psychological distress among healthcare professionals during COVID-19 and mostly showed which sociodemographic characteristics of them were associated with the elevated risk of experiencing psychological distress.38–43 However, there is a dearth of evidence regarding the state of preparedness, safety measurements and COVID-19 treatment management from the eye of front liners, particularly the intern doctors. Nonetheless, how the overall COVID-19 management was associated with the increased risk of contracting the infection and psychological distress among healthcare professionals is still unexplored. To the best of the authors’ knowledge, only one study estimated the prevalence of stress, anxiety, depression and insomnia, and their interrelation among 108 intern doctors from a tertiary public hospital amid the pandemic.46

This explorative study aims to identify the gaps in COVID-19 management and their consequences on intern doctors in terms of contracting infection and psychological well-being during the early phase of the pandemic.

MATERIALS AND METHODS

Study design and participants

Intern doctors who were at their internship in government medical colleges (located in urban areas) from February to August 2020 were the targeted population.
We conducted a nationwide cross-sectional online study to collect information from the targeted group.

Sample size calculation

There are 29 government medical colleges and hospitals in Bangladesh, where approximately 3700 intern doctors perform their internship every year. Taking it as the primary population, we calculated the sample size using Modified Cochrans’s formula—the single population proportion formula of binary outcome used in a descriptive study. A 95% confidence level with a 5% margin of error was set to calculate the sample size. We considered a 50% prevalence of anxiety, depression and sleep disturbance to attain the maximum sample size of 348. Considering an 85% complete response rate, the sample size to be 410. For safety, we aimed to have 10 more interviews, which yielded the final sample size to be 420.

Study instruments

The questionnaire included respondents’ sociodemographic information, comorbidity and health-related information, training and treatment experience amid COVID-19, safety measures adoption and mental health assessment. To ensure maximum participation in this web-based survey, it was essential to make the questionnaire easily understandable to the respondents and shorter the interview duration. Thus, rather than using the official psychological tools, this study used self-reporting questionnaires to evaluate the psychological status, which is the most widely practised tool for evaluating mental and physical health. Using personal networks, the authors selected seven volunteers (intern doctors) from seven different government hospitals. They provided their feedback on the sequence, wording and digitisation of the questionnaire. We updated the tools as per their constructive feedback. Therefore, understanding the questions may not distort the data quality. The online supplemental file 1 containing the questionnaire and a little discussion on the questions which may reflect the credibility of the data generated from this survey. Some key sections of the questionnaire are described below.

Sociodemographic information: the sociodemographic section of the questionnaire included information regarding age, sex, residence, administrative division and working hours.

Personal comorbidity and health-related information: the second section comprised questions related to participants’ comorbidity profiles including chronic obstructive pulmonary disease (COPD), asthma, heart disease, chronic kidney disease, diabetes mellitus (DM), chronic lung disease, other non-communicable diseases (NCDs) and finally whether they got infected by COVID-19 or not with choices: not infected yet, during March–May 2020, June–August 2020, September–November 2020, after November 2020.

Training and treatment experience amid COVID-19: this section included information about their perception regarding the first case detection, people’s attitudes during the early phase of COVID-19 (February–August 2020), whether they received any training on COVID-19 from their working station, awareness and participation in available training courses and the type of patients they treated.

Safety measures adoption: this section included information regarding the safety measures they adopted from February to August 2020. They were asked ‘without which safety equipment you treated patients during February–August 2020?’ with choices: PPE, mask (other than surgical), face shield, gloves; ‘how did you get the PPE, mask (other than surgical), face shield, gloves for the first time?’ with choices: never used, bought yourself, from institution; ‘where did you wash the PPE, mask (other than surgical), face shield, gloves to reuse it?’ with choices: never reuse, at working station, at home. This study collected responses for each of the safety equipment separately. Throughout the paper, the term ‘mask’ refers to masks other than the regular surgical masks doctors usually used in Bangladesh.

Mental health assessment: this section included information about the psychological difficulties they experienced from February to August 2020. They were asked whether they experienced stress due to COVID-19 (yes/no); whether they were worried about spreading infection among colleagues (yes/no), family members (yes/no) and themselves (yes/no); whether they experienced anxiety, depression, sleep disturbance with choices: no, new onset, exacerbate the old one; information regarding their and their family history of experiencing anxiety, depression and sleep disturbance with choices: yes, no. This study collected responses separately for each psychological difficulty.

Data collection procedure

Considering the infection risk during data collection inside the hospital amid the active COVID-19 outbreak in Bangladesh, similar to other studies, this study collected data using online platforms. The seven volunteers repeatedly circulated the KoBoToolbox prepared online questionnaire link with the consent form, objective and risk benefits of the study in the closed social media groups of intern doctors. All intern doctors using these closed groups across the country have an equal probability to participate in the survey. The survey was completely voluntary, non-commercial and respondents had the right to quit the survey at any point or refuse to answer any question without giving any reason. The survey started in February 2021 and the server got closed in August 2021, until collecting 420 responses. After omitting 27 interviews with missing information, this study included 393 observations in the analytical sample.

Statistical analyses

This study used descriptive statistics to assess COVID-19 management. We performed five sets of bivariate and multivariable analyses to investigate the consequences of COVID-19 management in terms
of infection risk and psychological well-being. All of the five outcome variables were binary in type. They were categorised as follows: infected by COVID-19: no (not infected yet), yes (infected during March–May 2020 or June–August 2020 or September–November 2020 or after November 2020); experienced stress due to COVID-19: no, yes; developed anxiety during February–August 2020: no, yes (new onset, exacerbate the old one); developed depression during February–August 2020: no, yes (new onset, exacerbate the old one); developed sleep disturbance during February–August 2020: no, yes (new onset, exacerbate the old one).

This study employed the \( \chi^2 \) test of independence and multivariable logistic regression as bivariate and multivariable analyses, respectively. We selected the variables showing an association at a 10% level of significance in the \( \chi^2 \) test to be part of the multivariable model. The area under the curve (AUC) of the receiver operating characteristic (ROC) curve is used as a performance measure of a multivariable logistic regression model. This explains the model’s performance by evaluating sensitivity vs specificity.\(^5^2\) We estimated the AUC of ROC along with its standard error by using its equivalence to the Wilcoxon statistic,\(^5^3\) to assess the statistical significance of the performance of the models we used. We performed all the analyses using Stata V.14.0 (Stata SE V.14, Stata Corp, College Station, Texas, USA) and R (V.4.2.2, RStudio V.2022.07.2-576).

### RESULTS

#### Sample characteristics

Among 393 participants, 51.4% were women. The age of the participants ranges between 23 and 26 years with a mean of 24.9 and standard deviation of 0.93. All the respondents were from urban areas as the government medical colleges that offer MBBS degree are located in urban areas.

#### Case detection

The majority of the respondents think that the first case of COVID-19 in Bangladesh occurred before the government announced the first case on 8 March 2020 (figure 1). About 11% of the respondents directly treated COVID-19 symptomatic patients before the announced date. Although three-fifths of the respondents did not treat COVID-19 symptomatic patients, they heard that other doctors were receiving COVID-19 symptomatic patients before the announced date. More than half of the intern doctors experienced that patients were trying to hide COVID-19 symptoms in the earlier phase of COVID-19 and almost half of the participants heard about patients’ unwillingness to exhibit COVID-19 symptoms.

![Did you think that the first case of COVID-19 occurred before the announced date?](image_url)

**Did you think that the first case of COVID-19 occurred before the announced date?**

- No [23%]
- Yes [77%]

**Did you treat symptomatic COVID-19 patients before announced date?**

- Yes [11%]
- No, but were hearing that others were receiving [61%]

**Were patients trying to hide COVID-19 symptoms in the earlier phase?**

- Yes, experienced it [56%]
- Yes, heard it [48%]

*Figure 1* Delay in COVID-19 case detection.
Training measure assessment

Figure 2 depicts that more than half of the respondents did not get any training on COVID-19 from their working institutions. Around one-fourth of the respondents never heard about the ‘Muktopaath’ online course on COVID-19—an open governmental e-learning platform. In total, 43% of the respondents participated in that course, while almost half of them stated that they did not get any benefit from the course. More than one-third of the respondents learnt to deal with COVID-19 infected patients after the first case announcement and about half of the respondents learnt it after the lockdown enforcement.

Safety measure assessment

Table 1 shows the safety measures adopted by intern doctors. The percentages of using safety equipments such as PPE, mask, face shield and gloves while treating patients were 70%, 80%, 55% and 69%, respectively. Among the respondents, 82% received their first PPE from their institutions, while 15% spent from their pocket to get the first one. About half of the respondents bought masks. Except for gloves, reusing the safety equipment was common. Reusing rates for PPE, mask and face shields were 61%, 65%, and 73%, respectively. The washing place of the safety equipment was mostly home.

COVID-19 management and infection risk

Figure 3 displays that despite having comorbidities, intern doctors treated COVID-19 infected patients. Almost one-fifth of 109 respondents who treated COVID-19 infected patients had asthma. About 3% had COPD, 3% had DM, 2% had heart disease and 6% had other NCDs. Figure 3 also reveals poor safety measures adoption among the respondents who directly treated COVID-19 infected patients. Almost one-third were without PPE. Treating even without masks and gloves were also found in a large proportion.

About 27% of the respondents got infected. The usage of safety equipment during treatment time had a significant negative association with getting infected by COVID-19 (table 2). Of respondents who treated patients without PPE, 33.62% got infected while it was only 24.19% among respondents who treated patients by wearing PPE. The prevalence of infection was significantly higher among respondents who treated patients without masks, face shields and gloves. The χ² test (p value=0.641) indicates no association between treating COVID-19 symptomatic patients and being infected. Respondents treated patients without knowing their symptoms and later found those COVID-19 positive, and respondents who directly treated...
patients with COVID-19 had a higher prevalence of infection than their counterparts.

After performing the multivariable logistic regression, only the safety measure adoption practice was found to be associated with getting infected. Respondents who treated patients without PPE were almost two times as likely to be infected than those who treated patients with PPE. Respondents who treated patients without masks, face shields and gloves had, respectively, 79%, 64% and 87% higher odds of being infected than those who used these safety measures. AUC of model 1 suggests a 68.6% chance of distinguishing between the positive and negative class of infection status using the estimates of model 1. The AUC of model 1 was significantly greater than 50% (p-value<0.001).

**COVID-19 management and psychological well-being**

COVID-19-related stress

Table 3 explores the potential factors associated with experiencing stress due to COVID-19 among participants. About half of the participants (50.13%) claimed to experience COVID-19-related stress. Receiving training from their institutions, treating patients without PPE and masks and treating patients with COVID-19 were significantly associated with higher odds of experiencing COVID-19-related stress. Respondents who received training from their working institutions were two times as likely to experience COVID-19-related stress than their counterparts. The odds of experiencing stress was almost two times among respondents who treated patients without PPE and masks. The participants who treated patients infected with COVID-19 directly were also around two times as likely to experience stress than their counterparts. AUC of model 2 suggests a 71% chance of distinguishing between the positive and negative class of stress status using the estimates of model 2. The AUC of model 2 was significantly greater than 50% (p-value<0.001).

**Anxiety, depression, and sleep disturbance**

Table 4 shows the association of COVID-19-related stress with anxiety, depression and sleep disturbance. Overall, 60.3% of the participants developed anxiety during the early COVID-19 period (February–August 2020). The χ² test showed a significantly higher prevalence of anxiety among the respondents who had

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**Table 1** Safety measure assessment (n=393)

<table>
<thead>
<tr>
<th></th>
<th>PPE</th>
<th>Mask</th>
<th>Face shield</th>
<th>Gloves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used</td>
<td>70%</td>
<td>80%</td>
<td>55%</td>
<td>69%</td>
</tr>
<tr>
<td>Did not use</td>
<td>30%</td>
<td>20%</td>
<td>45%</td>
<td>31%</td>
</tr>
<tr>
<td>Total</td>
<td>(100%)</td>
<td>(100%)</td>
<td>(100%)</td>
<td>(100%)</td>
</tr>
</tbody>
</table>

Source of obtaining safety equipment for the first time

<table>
<thead>
<tr>
<th></th>
<th>Bought their self</th>
<th>From institution</th>
<th>Do not remember</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15%</td>
<td>82%</td>
<td>4%</td>
<td>(100%)</td>
</tr>
<tr>
<td></td>
<td>51%</td>
<td>48%</td>
<td>1%</td>
<td>(100%)</td>
</tr>
<tr>
<td></td>
<td>29%</td>
<td>64%</td>
<td>7%</td>
<td>(100%)</td>
</tr>
<tr>
<td></td>
<td>34%</td>
<td>62%</td>
<td>4%</td>
<td>(100%)</td>
</tr>
</tbody>
</table>

Reuse of safety equipment

<table>
<thead>
<tr>
<th></th>
<th>Washed at home</th>
<th>Washed at working station</th>
<th>Never reused</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>53%</td>
<td>9%</td>
<td>39%</td>
<td>(100%)</td>
</tr>
<tr>
<td></td>
<td>56%</td>
<td>9%</td>
<td>35%</td>
<td>(100%)</td>
</tr>
<tr>
<td></td>
<td>59%</td>
<td>14%</td>
<td>27%</td>
<td>(100%)</td>
</tr>
<tr>
<td></td>
<td>10%</td>
<td>10%</td>
<td>80%</td>
<td>(100%)</td>
</tr>
</tbody>
</table>

PPE, personal protective equipment.

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**Figure 3** Comorbidity and safety measure adoption when treating patients with COVID-19. CKD, chronic kidney disease; CLD, chronic lung disease; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; NCDs, non-communicable diseases; PPE, personal protective equipment.
experienced stress in that specified period table 4, (online supplemental table 1). Respondents’ and their familial history of anxiety were also significant in the $\chi^2$ test (online supplemental table 1). The association between stress and anxiety remains significant even after controlling for the effect of respondents’ and their familial history of anxiety in multivariable logistic regression. The odds of developing anxiety were almost four times among the respondents who experienced stress than those who did not experience stress.

Results reveal that 45.8% of the respondents developed depression. The $X^2$ test suggests an association of experiencing stress, respondents’ and familial history of depression with developing depression (online supplemental table 1). The association between stress and depression remains significant even after controlling for the effect of respondents’ and their familial history of depression.
Table 3  Correlates of COVID-19-related stress (n=393)

<table>
<thead>
<tr>
<th>Factors</th>
<th>n (%)</th>
<th>Experienced stress due to COVID-19</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Prevalence</td>
<td>(\chi^2) (p-value)</td>
<td>Model 2: AOR (95% CI)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>202 (51.40)</td>
<td>47.52</td>
<td>1.13 (0.289)</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>191 (48.60)</td>
<td>52.88</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>Age (in years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>33 (8.40)</td>
<td>27.27</td>
<td>12.57 (0.006)</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>88 (22.39)</td>
<td>42.05</td>
<td>2.09 (0.82 to 5.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>144 (36.64)</td>
<td>54.17</td>
<td>3.01† (1.19 to 7.63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>128 (32.57)</td>
<td>57.03</td>
<td>3.93* (1.54 to 10.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Received training from working institution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>243 (61.83)</td>
<td>45.28</td>
<td>6.01 (0.014)</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>150 (38.17)</td>
<td>58.00</td>
<td>2.34* (1.44 to 3.81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PPE usage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used</td>
<td>277 (70.48)</td>
<td>45.13</td>
<td>9.39 (0.002)</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>Did not use</td>
<td>116 (29.52)</td>
<td>62.07</td>
<td>1.72† (1.02 to 2.79)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mask usage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used</td>
<td>316 (80.41)</td>
<td>45.89</td>
<td>11.60 (0.001)</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>Did not use</td>
<td>77 (19.59)</td>
<td>67.53</td>
<td>1.84† (1.02 to 3.31)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Face shield usage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used</td>
<td>216 (54.96)</td>
<td>52.31</td>
<td>0.918 (0.338)</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Did not use</td>
<td>177 (45.04)</td>
<td>47.46</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>Gloves usage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Used</td>
<td>271 (68.96)</td>
<td>50.18</td>
<td>&lt;0.01 (0.973)</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Did not use</td>
<td>122 (31.04)</td>
<td>50.00</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>Treated symptomatic patient</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>90 (22.90)</td>
<td>54.44</td>
<td>0.87 (0.351)</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>303 (77.10)</td>
<td>48.84</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>After treatment, the patient was found to be COVID-19 positive</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>269 (68.45)</td>
<td>50.56</td>
<td>0.06 (0.802)</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>124 (31.55)</td>
<td>49.19</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>Treated patient infected with COVID-19</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>284 (72.26)</td>
<td>42.96</td>
<td>21.05 (&lt;0.001)</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>109 (27.74)</td>
<td>68.81</td>
<td>2.17* (1.29 to 3.63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fear of infection (own)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>168 (42.75)</td>
<td>52.38</td>
<td>0.60 (0.440)</td>
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</tr>
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<td>225 (57.25)</td>
<td>48.44</td>
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<td>–</td>
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</tr>
<tr>
<td><strong>Fear of infection (family)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>125 (31.81)</td>
<td>50.4</td>
<td>0.01 (0.941)</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>268 (68.19)</td>
<td>50</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>Fear of infection (colleagues)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>252 (64.12)</td>
<td>46.83</td>
<td>3.06 (0.080)</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>141 (35.88)</td>
<td>56.03</td>
<td>1.46 (0.93 to 2.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Goodness of fit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUC</td>
<td></td>
<td>70.9*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued
familial history of depression in multivariable logistic regression. Compared with the respondents who did not experience stress, the odds of developing depression were more than threefold among the respondents who experienced stress. AUC of models 3 and 4 suggests 80% and 78% chance of distinguishing between the positive and the negative class of anxiety and depression status using the estimates of models 3 and 4, respectively. The AUC of models 3 and 4 was significantly greater than 50% (p value<0.001).

Half of the respondents claimed to develop sleep disturbance. Sleep disturbance was not associated with experiencing COVID-19 stress (table 5). After controlling the effect of gender and the history of sleep disturbance, the association of anxiety and depression with sleep disturbance remains significant (table 5). Participants who developed anxiety and depression during the COVID-19 period were three times as likely to develop sleep disturbance than their counterparts. AUC of model 5 suggests an 80% chance of distinguishing between the positive and negative class of sleep disturbance status using the estimates of model 5. The AUC of model 5 was significantly greater than 50% (p value<0.001).

### DISCUSSION

#### Main findings

Gaps in COVID-19 management and their consequences on front-line intern doctors in terms of infection risk and psychological well-being are poorly understood in Bangladesh. Study findings indicate a delay in first-case detection and identify people’s tendency to hide COVID-19 symptoms as a possible cause of delay in case detection. This study reveals a lack of training facilities, inadequate coverage of online training courses, communication gap in designing content, vast reuse of safety equipment, poor reuse management and unsafe duty allocation. Poor safety measure adoption was significantly associated with the increased risk of contracting the infection and experiencing stress due to COVID-19. Further, this COVID-19-induced stress was associated with an increased probability of experiencing anxiety and depression that led to sleep disturbance.

#### Assessment of COVID-19 management

**Delay in early case detection**

In terms of laboratory COVID-19 tests per million population, Bangladesh lagged behind its neighbouring countries during the early phase of COVID-19. Study findings reveal an indication of delay in the first COVID-19 case detection in Bangladesh. If the first case could be detected earlier, it could lead to the control measure adoption earlier which might flatten the upward trajectory of positive cases and strengthen the preparedness. The lack of COVID-19 testing kits in the early phase of the pandemic was a common story in LMICs,22 55 which could be a possible reason behind the delay in early case detection. In addition, this study reveals an important finding that might be another potential reason behind the late detection of COVID-19 in the context of LMICs. More than half of the participants experienced that patients were trying to hide COVID-19 symptoms. This tendency of hiding the COVID-19 symptoms among patients could act as a hidden layer of late case detection. This finding indicates a programmatic lack in COVID-19-related awareness building among the mass population. The scarcity of resources was not a new thing for LMICs. Findings inform policy to engage people for ensuring the maximum effective utilisation of the resources.

**Co-ordination lack in training management**

Healthcare workers who did not previously work in infectious disease units needed extensive training to respond effectively.56 However, health professionals from South Asian nations had insufficient training on COVID-19.57–59 Study findings suggest that the majority of intern doctors did not receive COVID-19 training from their working institutions. Another study from Bangladesh also reported similar results to our findings that 86.1% of the intern doctors did not receive proper training.46 We found that about half of the respondents learnt to deal with COVID-19 infected patients at least 18 days after the first case was announced. This indicates a delay in arranging the training. Though the government has made a step forward by introducing the ‘Muktopaath’ online course to train doctors, a quarter of the participants

### Table 3

Continued

<table>
<thead>
<tr>
<th>Factors</th>
<th>n (%)</th>
<th>Experienced stress due to COVID-19</th>
<th>Prevalence</th>
<th>χ² (p-value)</th>
<th>Model 2: AOR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE of AUC</td>
<td></td>
<td></td>
<td></td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
<td></td>
</tr>
</tbody>
</table>

Significant factors are in bold font.

*p-value<0.01.

†p-value<0.05.

AOR, adjusted OR; AUC, area under the receiver operating characteristic (ROC) curve; CI, Confidence interval; PPE, personal protective equipment; SE, Standard error.

---

were unaware of it. This finding indicates a programmatic weakness in ensuring adequate coverage of that great initiative taken by the GoB. About 21% of the respondents reported that they did not get benefits by participating in the course and 6% did not enrol in the course because others said it was not useful. This indicates a communication gap between the supply side (the GoB) and the demand side (healthcare professional). To make such initiative a success, the GoB should develop a system where the consumer of any service can convey their need anytime and keep the door open for programme modification.

Table 4  Association of COVID-19-related stress with anxiety and depression (n=393)

<table>
<thead>
<tr>
<th>Factors</th>
<th>Anxiety</th>
<th>Depression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prevalence Model 3: AOR (95% CI)</td>
<td>Prevalence Model 4: AOR (95% CI)</td>
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<tr>
<td>Stress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>196 (49.87) 45.92 Reference</td>
<td>28.57 Reference</td>
</tr>
<tr>
<td>Yes</td>
<td>197 (50.13) 74.62 3.76* (2.32 to 6.09)</td>
<td>3.65* (2.31 to 5.76)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>202 (51.40) 61.39 –</td>
<td>45.54 –</td>
</tr>
<tr>
<td>Male</td>
<td>191 (48.60) 59.16 –</td>
<td>46.07 –</td>
</tr>
<tr>
<td>Age (in years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>33 (8.40) 39.39 Reference</td>
<td>21.21 Reference</td>
</tr>
<tr>
<td>24</td>
<td>88 (22.39) 40.91 0.85 (0.34 to 2.13)</td>
<td>31.82 1.32 (0.47 to 3.67)</td>
</tr>
<tr>
<td>25</td>
<td>144 (36.64) 64.58 2.09 (0.87 to 4.98)</td>
<td>47.92 2.57 (0.96 to 6.83)</td>
</tr>
<tr>
<td>26</td>
<td>128 (32.57) 74.22 3.01† (1.22 to 7.41)</td>
<td>59.38 4.78* (1.76 to 12.96)</td>
</tr>
<tr>
<td>History of anxiety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>206 (52.42) 48.06 Reference</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>187 (47.58) 73.8 3.21* (1.96 to 5.25)</td>
<td></td>
</tr>
<tr>
<td>Family history of anxiety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>186 (47.33) 45.16 Reference</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>207 (52.67) 73.91 2.52* (1.56 to 4.06)</td>
<td></td>
</tr>
<tr>
<td>History of depression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>274 (69.72) 37.23 Reference</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>119 (30.28) 65.55 2.91* (1.75 to 4.83)</td>
<td></td>
</tr>
<tr>
<td>Family history of depression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>284 (72.26) 39.44 Reference</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>109 (27.74) 62.39 2.75* (1.60 to 4.70)</td>
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</tbody>
</table>

Goodness of fit

<table>
<thead>
<tr>
<th></th>
<th>Estimates from model 3</th>
<th>Estimates from model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUC</td>
<td>79.5*</td>
<td>78.4*</td>
</tr>
<tr>
<td>SE of AUC</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>p-value</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Significant factors are in bold font.

*p-value<0.01.

†p-value<0.05.

AOR, adjusted OR; AUC, area under the receiver operating characteristic (ROC) curve; CI, Confidence interval; SE, Standard error.

Dispute in safety measure management

In addition to training, it is critical to guarantee a safe working environment for doctors as well as access to adequate safety measures. In the early phase of COVID-19, the GoB experienced an insufficient supply of safety equipment. The situation was quite similar in other LMICs, as well. Even in developed nations the supply of PPE was insufficient, resulting in widespread reuse of safety equipment. Despite the scarcity of safety equipment, most of the participants were well equipped, which was a great success for the GoB. Success could reach its highest level if the GoB could ensure safe reuse...
management for front liners. Findings reveal a dire situation in scarcity-induced reuse management. Among reusers, the majority washed their used safety equipment at home. Only few reusers washed the safety equipment at the working station. As the reuse of safety equipment was easily predictable, policies should have been taken to ensure a safe in house reuse management setup.

**Consequences of COVID-19 management**

**Increased risk of contracting infection**

In countries such as Japan, Singapore and Hong Kong, thorough training and adherence to infection prevention and control (IPC) protocols helped keep COVID-19 infection rate at a minimal level among their healthcare professionals. However, the implementation of IPC measures in hospitals remains poor in South Asia. Like others, Bangladeshi physicians had a high infection and mortality rate. Several studies showed protective gear such as PPE, face masks, hand gloves and safety goggles helped prevent infection and mortality among front-line healthcare personnel and doctors. Similarly, we found a positive association between lack of safety measures adoption during treating patients and increased risk of contracting the infection. Insufficient human resources in the health sector is an old challenge in Bangladesh. Weakness in preventing the doctors from contracting COVID-19 worsened the insufficiency of human resources and negatively impacted the quality of the service offered to the citizens.

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**Table 5 Correlates of sleep disturbance (n=393)**

<table>
<thead>
<tr>
<th>Factors</th>
<th>n (%)</th>
<th>Sleep disturbance</th>
<th>$\chi^2$ (p-value)</th>
<th>Model 5: AOR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stress</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>196 (49.87)</td>
<td>54.08</td>
<td>0.12 (0.726)</td>
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<tr>
<td>Yes</td>
<td>197 (50.13)</td>
<td>55.84</td>
<td></td>
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</tr>
<tr>
<td><strong>Gender</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>202 (51.40)</td>
<td>49.01</td>
<td>5.95 (0.015)</td>
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</tr>
<tr>
<td>Male</td>
<td>191 (48.60)</td>
<td>61.26</td>
<td></td>
<td></td>
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<tr>
<td><strong>Age (in years)</strong></td>
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<td></td>
</tr>
<tr>
<td>23</td>
<td>33 (8.40)</td>
<td>72.73</td>
<td>13.66 (0.003)</td>
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<td>24</td>
<td>88 (22.39)</td>
<td>52.27</td>
<td></td>
<td></td>
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<tr>
<td>25</td>
<td>144 (36.64)</td>
<td>45.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>128 (32.57)</td>
<td>63.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Developed anxiety</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>156 (39.70)</td>
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<td>28.45 (&lt;0.001)</td>
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<tr>
<td>Yes</td>
<td>237 (60.30)</td>
<td>65.82</td>
<td></td>
<td></td>
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<tr>
<td><strong>Developed depression</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>213 (54.20)</td>
<td>43.19</td>
<td>26.02 (&lt;0.001)</td>
<td></td>
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<tr>
<td>Yes</td>
<td>180 (45.80)</td>
<td>68.89</td>
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<td><strong>History of sleep disturbance</strong></td>
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<tr>
<td>No</td>
<td>266 (67.68)</td>
<td>43.61</td>
<td>42.86 (&lt;0.001)</td>
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<tr>
<td>Yes</td>
<td>127 (32.32)</td>
<td>78.74</td>
<td></td>
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<td><strong>Family history of sleep disturbance</strong></td>
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<tr>
<td>No</td>
<td>306 (77.86)</td>
<td>56.86</td>
<td>2.02 (0.155)</td>
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</tr>
<tr>
<td>Yes</td>
<td>87 (22.13)</td>
<td>48.28</td>
<td></td>
<td>–</td>
</tr>
</tbody>
</table>

**Goodness of fit**

| AUC | 80.1* |
| SE of AUC | 0.02 |
| p-value | <0.001 |

Significant factors are in bold font.

*p-value<0.01.

AOR, adjusted OR; AUC, area under the receiver operating characteristic (ROC) curve; CI, Confidence interval; SE, Standard error.
Increased risk of psychological distress

Front-line healthcare workers were at a greater risk of contracting infection than general people, which created a sense of insecurity. Inadequate precautionary measures further intensified the insecurity that led to psychological distress. Health workers from India,30 Pakistan31 and Nepal35 (three neighbouring countries of Bangladesh) faced COVID-19-related stigma. All these brought unprecedented challenges to them and severely affected their mental health. Studies from India and Pakistan showed that about 80% of the health workers experienced moderate-to-high-level stress,72 73 whereas in Nepal it was about 50%.74 The present study estimates the prevalence of stress to be 50.1%, which is consistent with previous estimates for Bangladeshi healthcare workers.75 An earlier study conducted on healthcare workers in India found 55.6%, 32.1% and 47.0% had anxiety, depression and sleep disturbance, respectively.36 In Nepal, these prevalences were quite similar to India, while in Pakistan these prevalences were much higher.35 37 However, comparing cross-country estimates is complex due to different study designs, targeted populations, sample sizes and time frames of the study period. Several studies conducted on doctors, nurses and other healthcare professionals in Bangladesh found 20.7%–69.5% had anxiety, 26.5%–52.1% had depression and 18.6%–54.2% had insomnia amid the pandemic.38–45 Consistent with the existing literature, the study estimates the prevalence of stress, anxiety, depression and sleep disturbance to be 50.1%, 60.3%, 45.8% and 50.0% respectively.

The present study reconfirms the earlier finding of the association between inadequate resources in the workplace and the mental health of front-line doctors in Bangladesh with a more in-depth investigation.40 For the first time, this study reveals an increased risk of experiencing psychological stress among PPE and mask non-user physicians in Bangladesh. Importantly, we find receiving training from the working institution as a risk factor for experiencing stress due to COVID-19. This warrants further investigation regarding the quality of the in-house training programme arranged by the authorities. Findings indicate that this COVID-19-induced stress then further triggered the risk of experiencing anxiety and depression, which were associated with an increased risk of developing sleep disturbance. It seems that ensuring adequate safety measures and proper training could reduce the burden of these psychological distresses.

Most countries undertook special measures to support the mental health of front-line health workers through helplines and remote or in-house counselling provided by psychiatrists and psychologists.70 But the mental health and well-being of front-line health workers are often overlooked in Bangladesh. While physicians are serving the community, their well-being becomes the highest priority. And well-being never excludes mental health. Therefore, the mental health status of healthcare workers should be closely monitored and action plans should be developed for effective responses.

Limitations

As this study retrospectively collected information from the participants regarding their experience during the early phase of COVID-19 (February–August 2020), this study is also not completely free of recall bias. However, the short recall period makes the findings reliable.

There was a lack of validation of the questionnaire instrument used in this study. Rather than using official psychological tools, this study used self-reporting questionnaires to evaluate the psychological status. Using self-reported questionnaires has made it easy for intern doctors to quickly go through the questionnaire in their busy schedules. However, in community surveys, self-reported psychological status is the most widely used tool for evaluating mental and physical health.60–61 A sound psychological condition is a prerequisite for health service providers. If a provider perceives psychological distress even though the psychological tool does not say so, it may affect his/her service. Thus, studying perceived mental health status is crucial. Most importantly, this study’s results on the prevalence of psychological conditions (stress, anxiety, depression and sleep disturbance) are strongly aligned with other studies38–45 75 conducted in Bangladesh amid COVID-19 that used official psychological tools. It is also noteworthy to mention that the respondents were not from the general population of Bangladesh who usually have no or limited knowledge about the symptoms of psychological distresses. As all the respondents already passed their 5-year-long MBBS degree before participating in this study, it is quite reasonable to assume that the respondents have at least basic knowledge about the symptoms of stress, anxiety, depression and sleep disturbance.

Establishing any causal relationship is not possible because of its cross-sectional study design. This study draws readers’ attention to carefully interpret the odds. It is important to mention that the p-values of the odds of infection among mask and face shield users were just above the 5% level of significance, but below even the 5.7% level of significance. Thus, grossly ignoring these associations might not be prudent. This explorative study reveals no gender difference in infection, stress, anxiety and depression. Explaining the gender-related findings was beyond the scope of the data we collected in this study. Reveiling the reasons for these findings demands further research with a focused objective and sampling design that can serve the objective.

The aim was not to perform a test of hypothesis comparing the proportion of any indicator between two population sub-groups. Thus, we did not calculate the sample size using a power-based formula. This study is a descriptive one. Therefore, such as other published descriptive studies,40 41 46 76 we calculated the sample size using Modified Cochrans’s formula—the single population proportion formula of binary outcome used in a descriptive study. This explorative study may shed light on many crucial aspects of health system management and its consequences.
CONCLUSION

The present study has some important policy suggestions regarding rectifying the programmatic weakness in a time of combating the public health crisis in Bangladesh, which might help other LMICs, as well. Findings highlight the need for strengthening awareness-building programmes at the community level, as it has been identified as a barrier to case detection in the early phase of COVID-19. Study results suggest ensuring adequate advertising of the initiatives and provider–consumer coordination to achieve the success of the great initiatives. Ensuring the maximum utilisation of limited resources needs developing coping mechanisms by projecting future demand. In conclusion, findings inform policy ensuring proper training and safety measures to protect the frontliners from physical and psychological hazards, which is one of the crucial components in achieving victory against any public health crisis such as COVID-19.

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Contributors

TA and LR conceptualised the study, MMR developed the questionnaire with TA and LR and constructed the study methodology. MSR managed the study resources. SBC performed the management and coordination activities. TA did the data analysis. TA, ZF, MM and EA drafted the manuscript. MMR supervised the study and critically reviewed and edited the manuscript. All authors reviewed the final draft and agreed with the findings and interpretations. MMR is responsible for the overall content as the guarantor.

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Competing interests

None declared.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication

Not applicable.

Ethics approval

This study involves human participants. The study was conducted in accordance with the Institutional Research Ethics guidelines and ethical guidelines involving human participation (ie, Declaration of Helsinki). Formal ethics approval was granted by the Institutional Review Board of the National Institute of Preventive and Social Medicine (NIPSOM/IRB/2017/09). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review

Not commissioned; externally peer reviewed.

Data availability statement

Data are available upon reasonable request.

Supplemental material

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