Emotional Distress Among Health Professionals Involved in Care of Inpatients with COVID-19: A Survey Based Cross-Sectional Study

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Abstract: Introduction: Health care workers (HCWs) are directly involved in processes linked with diagnosis, management, and assistance of coronavirus disease-19 (COVID-19) patients which could have direct implications on their physical and emotional health. Emotional aspects of working in an infectious pandemic situation is often neglected in favour of the more obvious physical ramifications. This single point assessment study aimed to explore the factors related to stress, anxiety and depression among HCWs consequent to working in a pandemic. Material and Methods: This was a cross-sectional study involving healthcare workers who were working in COVID-19 inpatient ward, COVID-19 screening area, suspect ward, suspect intensive care unit (ICU) and COVID-19 ICU across four hospitals in India. A web-based survey questionnaire was designed to elicit responses to daily challenges faced by HCWs. The questionnaire was regressed using machine-learning algorithm (Cat Boost) against the standardized Depression, Anxiety and Stress Scale-21 (DASS 21) which was used to quantify emotional distress experienced by them. Results: A total of 156 participants were included in this study. As per DASS-21 scoring, severe stress was seen in ~17% of respondents. We could achieve an R^2 of 0.28 using our machine-learning model. The major factors responsible for stress were decreased time available for personal needs, increasing age, being posted out of core area of expertise, setting of COVID-19 care, increasing duty hours, increasing duty days, marital status and being a resident physician. Conclusions: Factors elicited in this study that are associated with stress in HCWs need to be addressed to provide wholesome emotional support to HCWs battling the pandemic. Targeted interventions may result in increased emotional resilience of the health-care system.

Keywords: COVID-19; emotional distress; anxiety; stress; depression; health-care worker

1. Introduction

In December 2019, COVID-19 infection was first detected in the Wuhan province of China, and subsequently, it has spread to all continents of the world [1]. In addition to the health consequences and economic burden caused by COVID-19, it also affects the mental health of patients as well as the HCWs caring for them [2]. The high infectivity, contagiosity and the uncertainties linked to COVID-19 has literally resulted in chaos in both the high and low-income countries. Studies have found that the emergence of pandemics viz Severe acute respiratory syndrome (SARS), Middle east respiratory syndrome (MERS), COVID-19 are associated with significant emotional distress among HCWs [3]. In such

critical situations, HCWs work in the forefront directly involved in diagnosis, management, and assistance of patients endangering their health and well-being.

Health care workers are at the forefront of handling the pandemic. The increased risk of exposure to the virus, reduced availability of personal protective equipment, and longer working hours, can inevitably lead to emotional distress in the form of stress, anxiety, depression, and burnout among health care workers [4]. Other factors like lack of mental preparedness, lacunae of knowledge of infection control practices, deployment of staff to new work areas like intensive care unit, unfamiliar settings, frequent protocol change, lack of social support, heavier workload, quarantine practice and social stigma make the situation worse contributing to emotional trauma of HCWs.

Lukasz Baka et al. [5] found that corona virus anxiety stemmed from the perspective of Hobfoll's theory of conservation of resources (COR) which states that "critical events make people fearful of losing their valuable resources". Coronavirus anxiety was associated with a higher magnitude of negative mental health outcomes like sleeping trouble and exhaustion among health care providers. Lebrague et al. [6] found that coronaphobia was prevalent among 54.76 % of hospital nurses and 70.91% of public health nurses. Predictors of COVID-19 anxiety included gender, marital status, job status and personal resilience. Lee et al. [7] demonstrated that coronaphobia resulted in additional variance in depression, generalized anxiety, and death anxiety, above sociodemographics and COVID-19 factors.

Nursing staff, female gender, front-line health care workers, younger age, and workers in areas with higher infection rates reported higher degrees of psychological symptoms than other health care workers [5–7]. Working against many odds poses serious threats to the mental health and psychological adjustment of HCWs [8]. Physiological and psychological impairment among HCWs can lead to poor vocational performance, low job satisfaction and lack of focus. This in turn can affect the entire system and our pandemic response.

Given the prevailing scenario, we decided to take up a study with the aim of understanding the various factors that are concerned with development of stress, anxiety and depression among the health care workers. Human responses are hard to model given the wide disparity in an individual's response to a given situation. Machine learning (ML) opens up avenues to model data without preconceptions about their nature. It has shown superior performance in uncovering patterns underlying the data, hence, we decided to use cutting edge developments in ML to discover the factors that are associated with stress, anxiety and depression.

2. Material and Methods

This study was a cross-sectional web-based survey involving HCWs. The study protocol was approved by the Institutional Ethics Committee vide AIIMS/IEC/2020/2039. Web-based survey questionnaire (Google-form) was sent to several groups of healthcare workers (residents and nursing staff working in COVID-19 ward) through mainstream digital media (WhatsApp and gmail). The inclusion criteria was HCWs involved in COVID-19 patient care in hospital wards.

The participants were requested to provide informed consent digitally before attempting the questionnaires. Participation in this study was voluntary and was not compensated. The questionnaires consisted of socio-demographic data and data regarding nature, hours, and days of work and the Depression, Anxiety and Stress Scale-21 (DASS 21) [9]. DASS questionnaire was used to assess the mental state of the respondent while a separate questionnaire was devised based on existing literature and consensus of the authors about the various facets of COVID-19 related work. Responses from that questionnaire were modelled against scores obtained on DASS 21. The questionnaire is attached as Appendix A.

Appendix A: Individual items in the questionnaire that was administered to predict outcome based on DASS 21 score

We used machine-learning based methodology—Catboost—to regress our questionnaire against stress levels. This is a special technique that uses a decision tree analysis with gradient boosting to develop regression equations to predict the outcomes. We used the R-square metric to optimize the results [10]. Once the model was finalized, the weights of the features that contributed to the results were computed and factors that were responsible for 80% of the model explanation were selected for further analysis. Shapley additive explanations (SHAP) methodology was used to understand the effect of each sample observation on the overall model [11]. Python 3.6 was used for statistical and graphical analysis (Python Software Foundation, Delaware, USA).

3. Results

A total of 156 responses were received from nurses and resident physicians from four different hospitals. The mean age of the participants was 29.7 ± 4.29 years. The majority of the participants were males (71.8%) and married (64.1%). Nursing officers constituted 59.6% of the responders while others were resident doctors. Among the places of work, 34.6% worked in Intensive Care Unit (ICU) care followed by 28.8% in the screening area, suspect ward and suspect ICU, and 22.4% in COVID-19 stable ward.

The mean number of duty hours daily was 8.0 ± 1.9 h during each shift. The mean number of duty days in each cycle of two months was 13.3 ± 5.4 days. The majority of the respondents (77.6%) reported receiving quarantine after work. Only 17.9% received hydroxychloroquine prophylaxis. The previous history of psychological problems was reported in 5.1% of the responses.

Nearly half of the responders reported staying alone (54.5%) while the rest stayed with their families. History of co-morbid illness was reported by 10.9% of the responders. A history of substance use was present in 7.1% of the respondents.

The mean stress score was 14.6 ± 10.6 As per DASS-21 scoring, a majority of HCWs did not experience any stress (55.4%). Mild and moderate stress were perceived by 7.7% and 19.4% HCWs respectively. About 17.4 % of respondents felt severe to extremely severe stress. The mean depression score was and mean anxiety score was 4.31 ± 50 and 5.05 ± 4.86 respectively. The overall distribution of depression score and anxiety score were positively skewed with predominantly lower scores. Hence only the stress score was further analysed (Figure 1).

Catboost algorithm yielded a mean R^2 value of 0.28 (± 0.09) over five-fold cross-validation targeting stress score as the outcome. The factors that contributed for 80% of the model explanation in our study is shown in Table 1. The effect of each sample observation for the outcome were analysed using SHAP values which is shown in Figure 2.

Table 1. Features that contribute for ~80% of the stress score in our study and the associated model feature weights are shown here.

Features	Stress	Feature Weights
Increased demand and decreased time available for other personal and family needs as work hours increased and demands increased (food hydration lodging transportation)	Increased	15.3
Increasing age	Increased	12.5
Unable to provide competent medical care if deployed to a new area (eg. non-ICU nurses having to function as ICU nurses)	Increased	9.8
Increasing duty days duration	Increased	9.2
Increasing duty hours duration	Increased	7.6
Reduced access to childcare during increased work hours and school closures	Increased	5.2
Being a resident physician	Increased	4.8
Place of work: COVID ICU	Increased	4.6
Marital status (Married)	Decreased	4.4

Place of work COVID stable ward	Decreased	3.5
Staying with family	Decreased	3.1

ICU — intensive care unit.
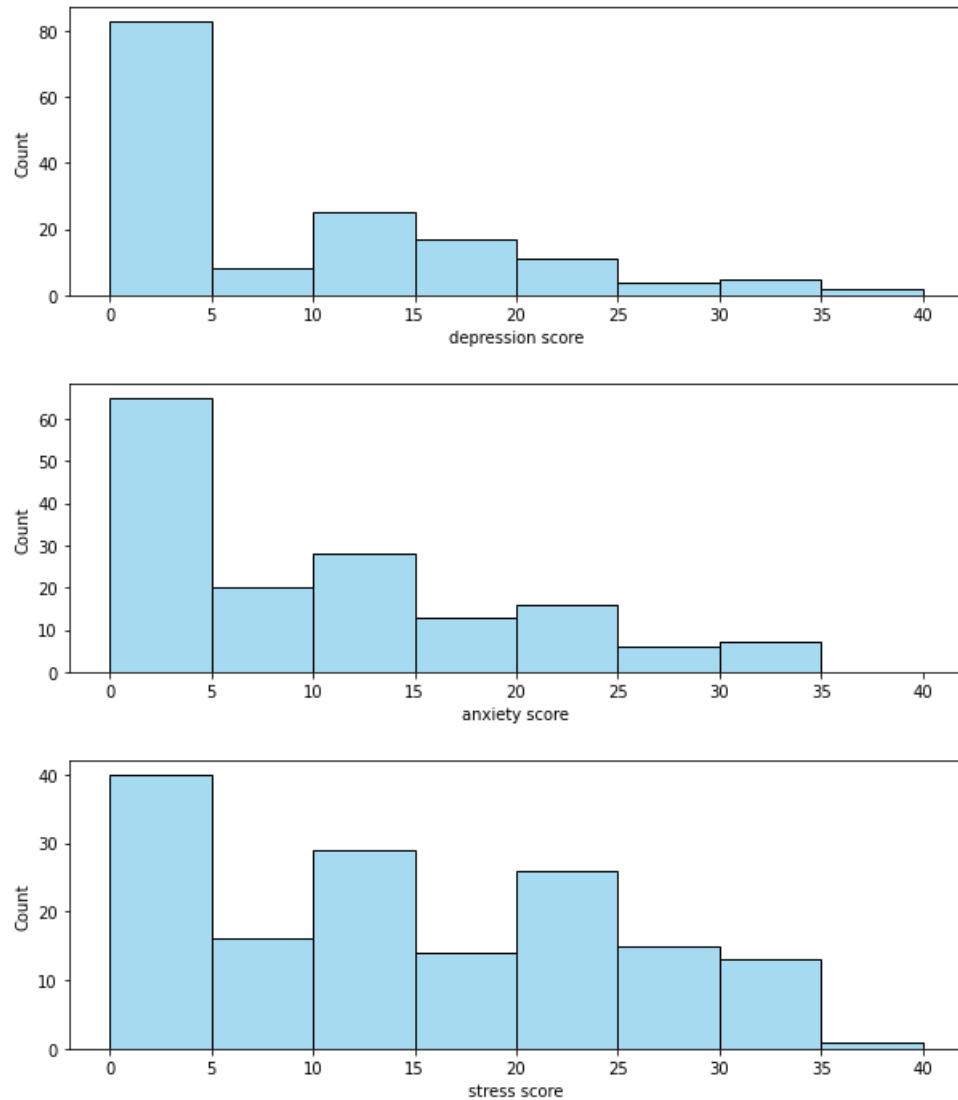
Figure 1. Distribution of DASS-21 scores among the study population.
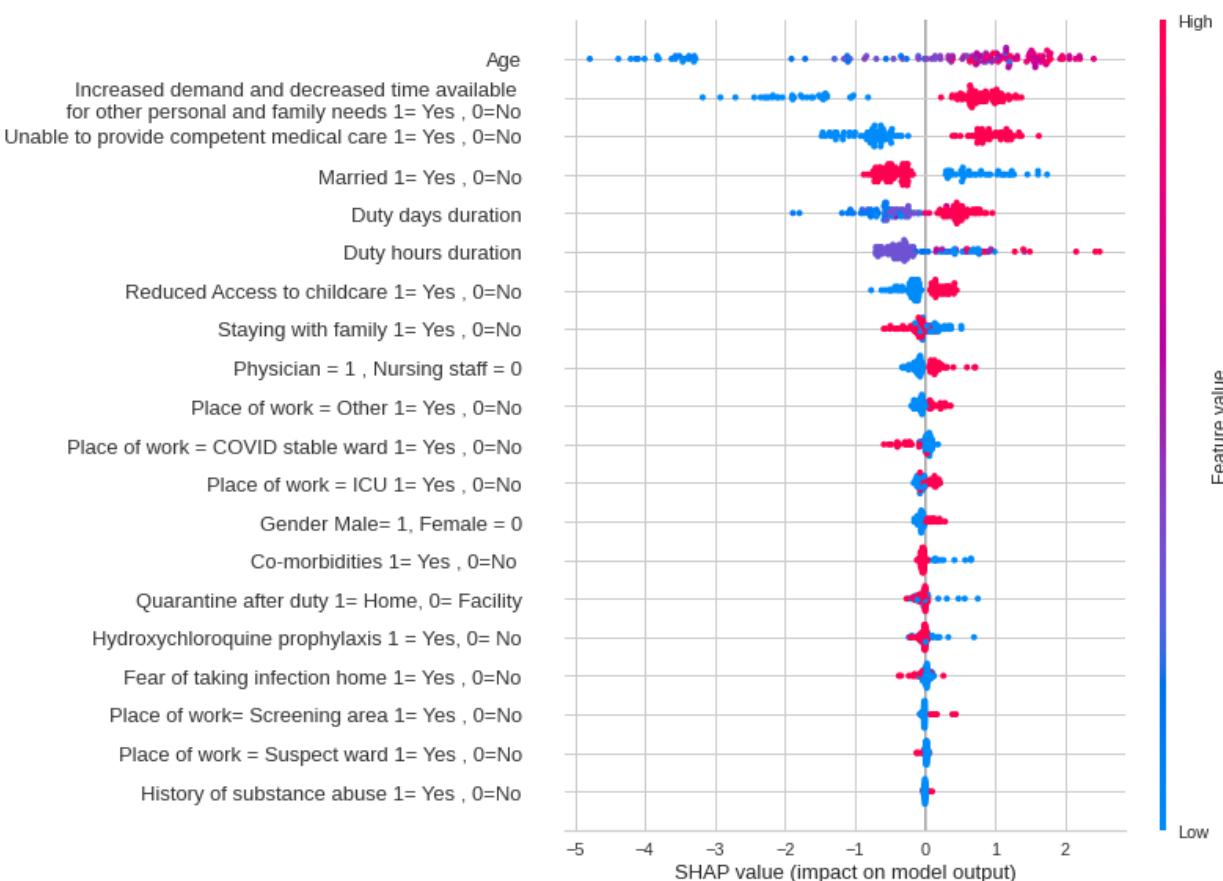
Figure 2. Factors associated with stress in decreasing order of magnitude illustrated using SHAP values.

4. Discussion

Studies from different parts of the world have reported that HCWs involved in the care of COVID-19 patients report high levels of anxiety, stress, and burnout [12,13]. Since emotional distress in this group adversely affects patient care, measures to ensure their mental well-being is essential. As a first step towards this, it is crucial to identify the levels of anxiety, stress, depression, and the contributing factors followed by preparing effective strategies to tackle them.

Our study of 156 participants comprising resident physicians and nursing officers had a mean stress score of 14.62 ± 10.55 using the DASS-21 questionnaire. A total of 44.6% of the study population experienced stress levels varying from moderate to extremely severe.

In the present study, we tried to identify the level of emotional distress among residents and nursing staff working in COVID-19 and explore the possible elements associated with such distress. Studies from Italy and China had found significantly elevated levels of stress, anxiety, burnout, secondary trauma, and depression among HCWs working with COVID-19 patients.

Our study spanned stress levels of HCWs, hence the responses were varied in nature according to the diverse coping mechanisms. Using machine learning we could get the best R2 of 0.28 i.e., the best model was able to explain only 28% of the variability using our questionnaire. This suggests the difficulty of modelling human responses and the use of machine-learning to maximise the chances of extracting useful insights from our data. Machine learning uses diverse techniques beyond the realm of regular statistical analysis. Decision tree based gradient boosting is one such methodology where the data is interpreted in increments using best break points to arrive at a regression equation that best

fits the entire data [14]. The power of a machine learning approach is the automatic determination of analysis parameters, and use of multiple models with differing parameters to maximize accuracy and generalizability. In a study by Fernandes et al. [15], they used multipurpose machine learning approach to predict COVID-19 prognosis in São Paulo, Brazil. They found that the machine learning algorithm was able to predict negative prognostic outcomes with high overall performance. Wang et al. [16] used fully automatic deep learning system using chest CT image findings to help COVID-19 diagnostic and prognostic analysis. Their system had robust performance, accuracy and precision.

Resident physicians reported higher stress levels compared to nursing officers while both groups reported higher stress levels overall when working in ICU compared to non-ICU work environment. In a study by Shrestha et al. [17], they found that 46.3% of resident physicians reported anxiety and nervousness about the pandemic circumstances on several days in a two weeks duration. There is a mismatch in the number of doctors per thousand patients which could explain higher loads on resident physicians. A similar finding was reported in another study by Tinashe et al. [18] where they found that disruptions in learning opportunities, changes in workflow within the hospital, suspension of rotations, and decreased inpatient volumes contributed to their emotional distress. In contrast, a study by Kunz et al. [19] found that general stress levels and burn out were similar between nurses and doctors. This problem appears wide-spread across different health systems. One of the postulates explaining the overall increase in stress levels faced by residents and nursing staff could be related to higher exposure to aerosol generating procedures and the need to don personal protective equipment (PPE) which could be uncomfortable especially in tropical climatic conditions. The second wave, the mutant strains, the higher mortality levels, the threat of getting infected, and increasing adverse outcomes in younger age groups could be other contributing factors. The pandemic has opened a window of online learning opportunities so that the physician trainees would acquire the requisite skill and competence.

Our findings point that feeling of inability to deliver competent care when deployed in COVID ICUs was associated with significant emotional distress. This is in line with a study by Jianbo Lai et al. [20] where they found that the frontline staff were physically and psychologically challenged when committed to provide high-quality nursing care for patients. In a study by Gabriella et al. [21], 56% of physicians and 68% of the nurses had feeling of lack of preparedness for their duties. This observation corresponds to that of Trumello et al. [22] where perceived stress was significantly higher among HCWs working in the COVID area in comparison to other areas.

As per our analysis, the decrease in time dedicated to family care due to increased working hours and reduced access to childcare was associated with significant stress levels among HCWs. More than 70% of healthcare workers reported that they had fear of exposing family members and felt that they had decreased time available for personal and family needs. Mohindra et al. [23] reported that these stressors could affect the emotional well-being of HCWs recruited in COVID-19 duties. Cai et al. [3] reported that ensuring safety of family members had the highest role in de-stressing frontline warriors.

In our study, married HCWs and those staying with family members experienced lesser stress. Norms imposed due to COVID-19 like social distancing and post-duty quarantine, staying away from family as part of self-isolation during work hours would have added to the stress experienced by the frontline workers [24].

Younger HCWs reported lesser stress levels, presumably because of less severity of outcomes associated with infection in the younger age groups. This could have provided the psychological cushion to absorb the stresses associated with working in COVID-19. Similar finding was noticed in a study by Khanal et al. [25]. Increasing duty hours and duty days both correlated with higher stress. Unprecedented health crisis called for mobilization of the entire workforce and longer working hours/days which could have contributed to higher stress levels.

It is of utmost importance that the physical and mental well-being and welfare of HCWs be taken care of. Ensuring adequate PPE, rest, nutrition, and hydration and supporting the communities and families of health care workers will go a long way in overcoming this pandemic [26]. Health care workers should be encouraged to seek help without prejudice. There is a requirement for constant support systems and mental health programs in hospitals to mitigate the emotional toll caused by pandemics on HCWs. Safeguarding the welfare of the HCWs requires urgent attention.

More than half of the study participants experienced no stress at all. This could be due to the staff welfare measures adopted by the institutions vis-à-vis, recruitment of the adequate number of staff for duties, availability of adequate PPEs, provision of well-equipped quarantine facility after duty, the adequate gap between two consequent COVID duties, helpline to provide psychological support to HCWs, measures for the welfare of family members, appropriate HCW training, instant tracking of COVID-19 positive HCWs and addressing their immediate needs. This could be used as a prototype for other hospitals also. Another such example is the CoviPsyHUS in France. This was a mental health platform that had dedicated professionals for helping out COVID patients, their families, and the health care workers. Its components were mental health hotline, relaxation room, and mobile mental health care support teams [8]. Dissemination of integrated psychoeducation appropriate to the stress levels, prompt identification of psychological troubles, and stress management advice would assist the health care worker community face this pandemic in a more robust way.

Limitations

This was a cross-sectional study that lacks follow-up data. Being a survey-based study, bias from participants could not be eliminated. Our group selection was biased towards residents and nursing officers. To overcome these limitations, studies including larger sample size with longitudinal designs can be planned. Our constructed model accounts for a subset of features that explains our findings, however, it is not an exhaustive resource and does not include the recently reported models like "coronavirus anxiety" and "coronaphobia". As more research is now available, additional features contributing to stress like coronavirus anxiety and coronaphobia may be incorporated in future studies [5,7]. Future research should also address the impact of vaccination and availability of newer drugs on COVID-19 related stress.

5. Conclusions

There have been very few studies examining the emotional hazard caused by COVID-19 on Indian HCWs. In this survey study of physicians and nurses involved in care of patients with COVID-19, health care workers reported high levels of stress. These results indicate that the mental health of frontline HCWs requires additional attention and that targeted prevention and intervention programs are necessary. Our study helps to identify the factors linked to stress levels which could be addressed to help the nations prepare for pandemics. It will assist in disaster management and pandemic preparedness. This study calls for larger studies to determine unrecognized factors associated with stress among health care staff working in COVID-19 patient care.

Conflicts of Interest: None declared.

Appendix A. Individual Items in the Questionnaire That Was Administered to Predict Outcome Based on DASS 21 Score

Age
Gender: Female/Male
Marital status: Unmarried/Married
Educational qualification: Physician/Nurses
Comorbidities: Yes/No
Did you receive hydroxychloroquine prophylaxis: Yes/No
Place of work: Screening area/suspect ward/COVID ICU/COVID stable ward/other
Duty days duration
Duty hours duration
Increased demand and decreased time available for other personal and family needs as work hours increased and demands increased (food hydration lodging transportation): Yes/No
Unable to provide competent medical care if deployed to a new area (eg. 0n-ICU nurses having to function as ICU nurses): Yes/No
Reduced access to childcare during increased work hours and school closures: Yes/No
Staying with family: Yes/No
Reduced access to childcare during increased work hours and school closures: Yes/No
Quarantine after duty: Home/Facility
Hydroxychloroquine prophylaxis: Yes/No
Fear of taking infection home: Yes/No
History of substance abuse: Yes/No

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