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Editorial Board Member of *World Journal of Psychiatry*, Guo-Gang Xing, MD, PhD, Professor, Department of Neurobiology, School of Basic Medical Sciences, Peking University Health Science Center, Neuroscience Research Institute, Peking University, Beijing 100191, China. ggxing@bjmu.edu.cn

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ORIGINAL ARTICLE

Observational Study

Dimensions of emotional distress among Brazilian workers in a COVID-19 reference hospital: A factor analytical study

Marcos O Carvalho-Alves, Vitor A Petrilli-Mazon, Andre R Brunoni, Andre Malbergier, Pedro Fukuti, Guilherme V Polanczyk, Euripedes C Miguel, Felipe Corchs, Yuan-Pang Wang

Marcos O Carvalho-Alves, Vitor A Petrilli-Mazon, Andre R Brunoni, Andre Malbergier, Pedro Fukuti, Guilherme V Polanczyk, Yuan-Pang Wang, Department of Psychiatry, School of Medicine, University of Sao Paulo, Sao Paulo 05403-010, Brazil

Marcos O Carvalho-Alves, Felipe Corchs, Program in Neuroscience and Behavior, Department of Experimental Psychology, Institute of Psychology, University of Sao Paulo, Sao Paulo 01060-970, Brazil

Euripedes C Miguel, Department and Institute of Psychiatry, University of Sao Paulo, Sao Paulo 05403-010, Brazil

Felipe Corchs, Department of Psychiatry, University of Sao Paulo, Sao Paulo 05403-010, Brazil

Corresponding author: Yuan-Pang Wang, MD, MSc, PhD, Research Scientist, Department of Psychiatry, School of Medicine, University of Sao Paulo, Rua Dr. Ovídio Pires de Campos, 785, Cerqueira César, Sao Paulo 05403-010, Brazil. gnap_inbox@hotmail.com

Abstract

BACKGROUND

The coronavirus disease 2019 (COVID-19) pandemic is an unprecedented challenge for public health and has caused the loss of millions of lives worldwide. Hospital workers play a key role in averting the collapse of the health system, but the mental health of many has deteriorated during the pandemic. Few studies have been devoted to identifying the needs of workers on frontline duty.

AIM

To investigate dimensions of common emotional symptoms and associated predictors among Brazilian workers in a COVID-19 reference hospital.

METHODS

This is an observational study of the mental health of professionals in a COVID-19 hospital in the city of São Paulo. We invited all hospital employees to respond to an online survey between July and August 2020, during the first peak of the pandemic. Data of 1000 participants who completed the survey were analyzed (83.9% were women and 34.3% were aged 30 to 40). Hospital workers self-reported the presence of symptoms of depression, anxiety, trauma-related stress, and burnout through the Patient Health Questionnaire-9, the Generalized Anxiety

Disorder-7, the Impact of Event Scale-Revised and the Mini-Z Burnout Assessment respectively. Responses were assembled and subjected to exploratory factor analysis to reveal workers' core emotional distress. Multiple linear regression models were subsequently carried out to estimate the likelihood of dimensions of distress using questions on personal motivation, threatening events, and institutional support.

RESULTS
Around one in three participants in our sample scored above the threshold of depression, anxiety, post-traumatic stress disorder, and burnout. The factor analysis revealed a three-factor structure that explained 58% of the total data variance. Core distressing emotional domains were avoidance and re-experience, depression-anxiety, and sleep changes. Regression analysis revealed that institutional support was a significant protective factor for each of these dimensions (β range = -0.41 to -0.20, $P < 0.001$). However, participants' personal motivation to work in healthcare service was not associated with these emotional domains. Moreover, the likelihood of presenting the avoidance and re-experience dimension was associated with having a family member or close friend be hospitalized or die due to COVID-19 and having faced an ethical conflict.

CONCLUSION
Distressing emotional domains among hospital workers were avoidance and re-experience, depression and anxiety, and sleep changes. Improving working conditions through institutional support could protect hospital workers' mental health during devastating public health crises.

Core Tip: Although the literature contains many reports on the deteriorating mental health of hospital workers during pandemics, few investigations have focused on the core mental health needs of this specific population. Hence, we subjected the common emotional symptoms of hospital workers to exploratory factor analysis. The main emotional dimensions were avoidance and re-experience, depression-anxiety, and sleep changes. Institutional support was found to be the most relevant protective factor for these emotional dimensions. This investigation could contribute to a better understanding of work-related distress from a dimensional perspective and has indicated comprehensive coping strategies in healthcare settings during a public health emergency.

INTRODUCTION

The coronavirus disease 2019 (COVID-19) is an infectious disease that emerged in Wuhan, China in late 2019, and rapidly spread worldwide. A dramatic loss of human life, economic disruption, unemployment, and food insecurity, all caused by the pandemic, have imposed a monumental challenge on communities. Millions of people are at risk of being infected by a life-threatening virus and falling into extreme poverty due to economic and social hardships. During the lockdown, to mitigate the spread of the epidemic, hospital workers (HWs) have played a key role in the fight against disease outbreaks, but without the privilege of confinement. Besides saving lives in exhaustive duties, HWs face an insurmountable burden of increased risk of infection, fear of infecting family members, increased workload, inadequate support, and discrimination[1]. The healthcare workforce is a particularly vulnerable population because the majority lack work protection and access to quality personal protection equipment (PPE). Thus, HWs are exposed to an overwhelmingly stressful environment, which contributes to the deterioration of their mental health, with subsequent development of multiple emotional symptoms.

Frontline HWs directly involved with patient care present greater vulnerability to developing disabling emotional symptoms, as shown in previous epidemics of Ebola virus disease and severe acute

respiratory syndrome[2,3]. Among different psychological reactions, symptoms of anxiety were the first to emerge in the early stages of epidemics. Although anxiety sometimes wanes over the course of the observation, symptoms of depression and distress may persist or intensify[4]. A recent cross-sectional study involving 1257 Chinese COVID-19 healthcare workers (HCWs) has indicated that 71.5% of the sample experienced symptoms of distress, 44.6% anxiety, 50.4% depression, and 34% insomnia[5]. Globally, a comprehensive review confirmed the high frequency of depression (24.3%), anxiety (25.8%), and stress (45%) among frontline HCWs caring for COVID-19 patients[6]. Likewise, a high frequency of symptoms of burnout was also reported in over one-third of Italian healthcare professionals[7]. Regarding the Brazilian context, a study composed of Brazilian HCWs from different regions also found high rates of anxiety (43.3%), depression (40.2%), trauma (36%), and insomnia (61.5%)[8]. Nevertheless, these rates present large fluctuations because data collection relies on individual and contextual aspects of vulnerability, such as socio-demographic characteristics, social support, time of data collection, institutional infrastructure, and public responses, among other factors. Thus, these quantitative rates are limited indicators for clarifying the psychological impact of the COVID-19 and the possibilities of coping with it.

Bearing in mind the plethora of observational studies describing the poor mental health of HWs during the pandemic, few studies have determined the symptomatic clustering of occupational distress during the pandemic. Because most of the emotional symptoms of HWs appear at the same time, we took advantage of a data reduction method of factor analysis to examine the structure of self-reported symptoms in this population. We estimated both individual and contextual factors that were potentially associated with dimensions of distress. The next logical step is to understand how to prevent or reduce emotional distress in healthcare settings. Hypothetically, we posited that core dimensions of emotional distress among HWs would manifest as a sound structure, and that protective or risk factors for this distress would indicate meaningful coping strategies.

The primary objective of the present study was to determine the structure of the mental health of HWs during the COVID-19 pandemic, as related to anxiety, depression, event-related stress, and burnout. Secondarily, we aimed to determine correlated factors of HWs' mental health. These findings could contribute to a greater understanding of the human capacity to face extreme working conditions during global sanitary crises. The implications of potential factors that could improve preventive and supportive strategies in pandemic contexts are discussed.

MATERIALS AND METHODS

Study design

Data of the current observational study were cross-sectionally collected between July 1 and August 28, 2020, using an online survey on the REDCap platform (https://www.project-redcap.org/). This is the baseline data of an ongoing longitudinal study on HWs' mental health.

At the time of data collection for this study, Brazil was one of the pandemic epicenters of the world, with high rates of new cases and deaths per day. The country had 2662485 confirmed cases, and 92475 deaths as of July 31, 2020[9]. Most of these cases were reported in the state of São Paulo, the most populous in Brazil. São Paulo had 542304 confirmed cases and 22997 deaths in the same period[9]. The Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (HCFMUSP) became the main reference healthcare facility for COVID-19 care in the state. Wards of the HCFMUSP main building were entirely reconfigured into a full capacity of 900 beds for the exclusive care of COVID-19 patients. Between July and August of 2020 - around the decline of the first wave of the pandemic - the well-being of hospital professionals in this large care center was on the verge of collapse.

Participants

The inclusion criterion was that participants had to be working at the hospital, in person or from home, at the time of data collection. Medical doctors, nurses, nursing assistants, dentists, speech therapists, psychologists, occupational therapists, dieticians, physical therapists, social workers, pharmacists, clinical laboratory technicians, radiological technologists, and administrative professionals were included as HWs. Professionals from all hospital sites were invited, including the emergency room, inpatient wards, intensive care units, outpatient care, operating room, pharmacy, and laboratory. There were few exclusions as current workers were all adults and able to respond to an online questionnaire. Potential participants did not present linguistic problems, but limited access to the internet from a computer or mobile phone could have been an obstacle to participation.

At the time of the baseline survey, 22056 employees were working in the hospital complex. The online invitation was sent to all HWs through the institutional e-mail, in addition to social media advertising and wall posters in the hospital. Moreover, participants were also encouraged to forward the online survey to eligible colleagues. Respondents could complete the survey, which took approximately 15 min to answer in its entirety, at any time. Using non-probabilistic sampling, data were gathered from 1377 respondents, but only 1000 provided complete data for inclusion in the analysis.

Measurement tools

The following instruments were used: Socio-demographic questionnaire: This instrument consisted of questions about age, gender, marital status, educational level, occupational status, living with children or elderly adults, and time of direct contact with COVID-19 patients (hours per week, as an ordinal scale). Questions related to changes in daily routine and individual's ability to cope with distress were also included.

The Impact of Event Scale-Revised (IES-R) was used to screen and rate the severity of distress symptoms in the previous seven days, based on the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria of post-traumatic stress disorder (PTSD)[10]. The IES-R is a 22-item self-report scale, with a five-point ordinal scale from "not at all" (score 0) to "extremely" (score 4) for each item[10]. Total scores ranged from 0 to 88. Scores of 9, 26, and 44 are used as the cut-off points for mild, moderate, and severe post-traumatic symptoms, respectively[10]. The cut-off point ≥ 26 was adopted in this study, based on previous literature for a probable case of PTSD[5]. Cronbach's alpha coefficient of the IES-R was α = 0.96, indicating an adequate internal consistency.

The Patient Health Questionnaire-9 (PHQ-9) was used to screen and rate the severity of depressive symptoms in the previous two weeks, based on the DSM-IV[11]. The PHQ-9 is a nine-item self-report scale, with a four-point ordinal scale from "not at all" (score 0) to "nearly every day" (score 3) for each item[11]. The total score ranged from 0 to 27. Scores of 5, 10, 15, and 20 are used as the cut-off points for mild, moderate, moderately severe, and severe depression, respectively[11]. The cut-off point ≥ 10 has a sensitivity of 88% and a specificity of 88%, in comparison to the diagnosis of major depressive disorder [12]. Cronbach's alpha coefficient of the PHQ-9 was α = 0.90, indicating good internal consistency.

The Generalized Anxiety Disorder-7 (GAD-7) was used to screen and rate the severity of anxiety symptoms in the previous two weeks, based on DSM-IV criteria[13]. The GAD-7 is a seven-item self-report scale, with a four-point ordinal scale from "not at all" (score 0) to "nearly every day" (score 3) for each item[13]. The total score ranged from 0 to 21. Scores of 5, 10, and 15 are used as the cut-off points for mild, moderate, and severe anxiety, respectively[13]. The cut-off point ≥ 10 has a sensitivity of 89% and a specificity of 82%, in comparison to the diagnosis of generalized anxiety disorder[14]. Cronbach's alpha coefficient of the GAD-7 was α = 0.92, indicating appropriate internal consistency.

The validated single-item Mini-Z Burnout Assessment was used to evaluate the experience of burnout[15,16]. This question instructs respondents to define burnout for themselves: "Overall, based on your definition of burnout, how would you rate your level of burnout?". Responses are scored on a five-category ordinal scale and the threshold of burnout was indicated by a rating ≥ 3. Score 3 was applied to respondents who chose "I am definitely burning out and have one or more symptoms of burnout, such as physical and emotional exhaustion"; score 4 for those who chose "The symptoms of burnout that I'm experiencing won't go away. I think about frustration at work a lot"; and score 5 for those who chose "I feel completely burned out and often wonder if I can go on. I am at the point where I may need some changes or may need to seek some sort of help.". This single-item scale was validated against the exhaustion subscale of the Maslach Burnout Inventory, with a correlation of 0.64 (*P* < 0.001) [15], and previous studies have used it to evaluate burnout during the current pandemic[17].

Psychoactive substance use: Straightforward questions about increased consumption of alcohol and tobacco were included to assess changes in substance use patterns. Answers were recorded as dichotomous yes/no answers.

Threatening events: HWs were asked about the following three self-reported items, with dichotomous yes/no answers, to assess COVID-19 related threatening events: having had a confirmed COVID-19 diagnosis, having had a close family member or friend hospitalized or dying due to COVID-19, and having experienced an ethical conflict during COVID-19 patient care. Ethical issues covered a broad array of extreme contexts such as lack of PPE, disagreement with clinical decisions, overwork, mandatory work despite belonging to a risk group for COVID-19, use of public transportation, *etc*.

Personal motivation: To evaluate contextual variables in the occupational setting, questions about personal motivation and stressors were formulated based on previous literature[2,4,18]. All answers were scored on a five-point Likert scale: "I feel my family, friends or colleagues recognize me for the work I am doing during the COVID-19 pandemic"; "I feel like I'm gaining new knowledge while I am working on the COVID-19 pandemic"; "I feel that my work on the COVID-19 pandemic helps people"; "I am willing to accept the risks because I want to help infected people"; "I feel like I'm developing myself by working on the COVID-19 pandemic"; "I feel motivated to work on the COVID-19 pandemic"; and "I feel part of a movement in my community to take care of infected people".

For statistical analysis, the cumulative score of each of the seven items was calculated, generating a total score labeled "personal motivation". Cronbach's alpha coefficient of personal motivation questions was α = 0.85, indicating appropriate internal consistency.

Institutional support: Based on previous studies[2,4,18], support related to the organizational environment was evaluated using questions on a five-point Likert scale: "I have access to adequate PPE in situations where this is required"; "I have access to equipment and resources needed to provide adequate care to patients"; "I feel that I received adequate training to carry out my work in the COVID-19 pandemic"; "I feel supported by my bosses and by the institution"; "I feel supported by my work team"; "I feel that the patient care protocols are clear in the institution, and I know what must be done"; "If I get infected, I will receive care at my institution"; "If I get infected, my family will receive support";

and "I feel that I have enough rest to continue my job as long as it is necessary".

For statistical analysis, the cumulative score for each of these items was calculated, leading to a total score labeled as "institutional support". These items yielded a Cronbach's alpha coefficient of 0.85, indicating adequate internal consistency.

Statistical analysis

All analyses were performed using R software, version 4.0.4 (https://www.r-project.org/), and corresponding packages detailed below. The significance level was set at α = 0.05 for 2-tailed tests. Because data were not normally distributed according to the Shapiro-Wilk test ($P < 0.05$), a descriptive analysis of participant socio-demographic characteristics was presented as percentage (%) for categorical variables and medians with interquartile ranges for continuous variables.

To investigate the factorial structure of mental health in our sample, an exploratory factor analysis (EFA) was performed. All 39 items of the PHQ-9, the GAD-7, the IES-R, and the single-item Mini-Z Burnout Assessment were assembled in a single dataset to determine the underlying latent constructs of separate items. Before factor extraction, the factorability of the data was checked using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The data were considered adequate for performing EFA because Bartlett's test of sphericity χ^2 value was 31085.35 ($P <$ 0.001) and the KMO value was 0.98. The between-item correlation was examined in a matrix containing all 39 individual items of the scales. Factors were extracted using the principal axis factoring method. We used criteria such as Kaiser's eigenvalues > 1[19,20], Cattell's scree plot inspection[19,20], and clinical interpretability of the resulting factor structure to determine the number of factors to be extracted[19,20]. To aid in factor interpretation, the initial solution was subjected to oblique (Oblimin) rotation, assuming that extracted factors would be correlated to reflect the structure of HWs' emotional distress[19,20]. Items presenting factor loadings above 0.40 were retained in each factor, due to their substantial contribution to data variance. The EFA was run with *psych* and *GTArotation* packages in R.

A collinearity analysis was subsequently conducted using the *polycor* package to rule out the correlation between independent variables. All analyzed variables had a Variance Inflation Factor below 3 (for more details, see Supplementary Table 1), suggesting that multicollinearity was not a problem in our data. Two multiple linear regression models were carried out to identify potential predictors for each of the retained factors, using the *beta.lm* function. Factor scores of each of the retained factors were used as dependent variables. After checking for independence, homoscedasticity, normality, and linearity, two regression models were run for each retained factor. First, a crude model included predictor questions on threatening events, personal motivation, and institutional support. Second, the final adjusted model was controlled for sociodemographic variables such as gender, age, marital status, educational level, and occupation. Results were reported as β, 95% confidence interval, and *P* value. Model fit was estimated in terms of R^2.

The statistical methods were reviewed by Wang YP from the Department of Psychiatry, School of Medicine, University of Sao Paulo.

Ethics

The online survey was anonymous and participant confidentiality was assured. Due to social isolation, data were collected by means of an online survey which included an informed consent form explaining the study design, its purpose, and the responsible researcher of the study. This study was approved by the Institutional Board of Research Ethics, protocol # 30710620.2.0000.0068.

RESULTS

Demographic and mental health characteristics

Considering Table 1, out of 1000 participants who completed the survey, 83.9% were women, 34.3% were aged 30 years old to 40 years old, 57.4% were married or living with a partner, and 72.9% had an educational level of university graduate or higher. In terms of occupational characteristics, 74.1% were HCWs directly involved in patient care and the remaining 25.9% had no direct contact with patients infected with COVID-19 (office workers and clinical clerks). Regarding participant occupations, 14% were medical doctors, 34.8% were nurses or nursing assistants, and 25.3% were other healthcare professionals. Although participants were recruited using a non-probabilistic strategy, the distribution of socio-demographic characteristics was similar to the total sample of employees in the institution, in terms of gender, age, and occupation. Regarding threatening events directly related to COVID-19 care, 79.6% had direct contact with COVID-19 patients and 32.8% reported having had COVID-19 themselves. An additional 38.6% reported having had a close family member or friend hospitalized or dying due to COVID-19. Approximately one in five participants reported having had to deal with an ethical conflict related to COVID-19 patient care. Regarding the previous history of mental disorders, 28% reported previous psychiatric or psychological treatment and 13.8% reported psychological or psychiatric treatment after the onset of the pandemic.

Table 1 Sociodemographic and clinical characteristics of participants (*n* = 1000)

Characteristics	*n* (%)
Age bracket	
18-30	211 (21.1)
30-40	343 (34.3)
40-50	252 (25.2)
> 50	194 (19.4)
Gender	
Female	839 (83.9)
Male	159 (15.9)
Other	2 (0.2)
Marital status	
Unmarried	426 (42.6)
Married	574 (57.4)
Educational level	
< University graduate	271 (27.1)
≥ University graduate	729 (72.9)
Living with elderly (> 60 yr)	
Yes	233 (23.3)
No	767 (76.7)
Living with children	
Yes	450 (45.0)
No	550 (55.0)
Occupation	
Medical doctor	140 (14.0)
Nurse and nursing assistants	348 (34.8)
Other healthcare professionals[1]	253 (25.3)
Administrative workers[2]	259 (25.9)
Work sector	
Emergency room	60 (6.0)
Inpatient ward	176 (17.6)
Intensive care unit	157 (15.7)
Outpatient care	128 (12.8)
Operating room	44 (4.4)
Pharmacy	36 (3.6)
Laboratory	84 (8.4)
Other sectors	163 (16.3)
Direct contact with COVID-19 patient (h/wk)	
0	204 (20.4)
1-20	311 (31.1)
21-40	285 (28.5)
> 40	200 (20.0)
Had COVID-19 (self-reported)	

Yes	328 (32.8)
No	672 (67.2)
Close family or friend hospitalized or who died due to COVID-19	
Yes	386 (38.6)
No	614 (61.4)
Changes in daily routine due to pandemic	
Financial failure	387 (38.7)
Lack of public safety	199 (19.9)
Lack of public transport	297 (29.7)
Lack of medical care	292 (29.2)
Distancing from family and friends	620 (62.0)
Previous psychiatric or psychological treatment	
Yes	280 (28.0)
No	720 (72.0)
Previous self-reported diagnoses	
Anxiety	91 (9.1)
Depression	78 (7.8)
PTSD	6 (0.6)
Previous psychotherapy treatment	199 (19.9)
Previous pharmacological treatment	177 (17.7)
Psychological or psychiatric treatment after pandemic beginning	138 (13.8)
Protective health actions	
Physical activities	274 (27.4)
Meditative practices	182 (18.2)
Leisure activities/hobbies	320 (32.0)
Religious practices	310 (31.0)
I'm not doing anything in this sense	354 (35.4)
Ethical conflict	119 (11.9)

[1]Other healthcare professionals: dentists, speech therapists, psychologists, occupational therapists, dieticians, physical therapists, social workers, pharmacists, clinical laboratory technicians, and radiological technologists.
[2]Administrative workers: receptionist, information technicians, secretary, security guard.
COVID-19: Coronavirus disease 2019; PTSD: Post-traumatic stress disorder.

Table 2 shows the range and frequency of the scores of the rating scales IES-R, PHQ-9, GAD-7, and Mini-Z Burnout Assessment. The score was categorized into severity levels, according to the established cut-offs. With reference to clinically significant levels of assessed psychiatric categories, 46.8% of participants scored above the level for a probable case of PTSD, 37.9% for depression, 32.5% for anxiety, and 34.9% for burnout. An additional 7.6% of participants reported increased tobacco consumption and 17.1% reported increased alcohol consumption.

Factor analysis
Table 3 shows the rotated pattern matrix of the EFA solution. The initial solution for the 39 items yielded two factors meeting Kaiser's eigenvalue > 1 criterion. Nevertheless, the scree test suggested a three- or four-factor solution, according to Cattell's criterion. Taking into account these two criteria and the clinical interpretability of the resulting factorial structure, a three-factor solution was chosen as the optimal model, in view of the balance between parsimony and comprehensiveness.

After oblique rotation, salient factor loadings (≥ 0.40) for 38 items were observed in a single factor. Cross-loading occurred with the item "trouble falling or staying asleep, or sleeping too much?" (PHQ-9 #3), which contributed to both factors 2 and 3. All three factors accounted cumulatively for 58% of the total data variance. The correlation between factor 1 and factor 2 was 0.64, 0.56 between factor 1 and

Table 2 Frequency of categories of distress symptoms (*n* = 1000)

Scale and severity categories	*n* (%)
The Patient Health Questionnaire-9	7 (4-13)[1]
Minimal (< 5)	312 (31.2)
Mild (5-9)	309 (30.9)
Moderate (10-14)	177 (17.7)
Moderately severe (15-19)	116 (11.6)
Severe (≥ 20)	86 (8.6)
The Generalized Anxiety Disorder-7	6 (3-12)[1]
Minimal (< 5)	347 (34.7)
Mild (5-9)	328 (32.8)
Moderate (10-14)	154 (15.4)
Severe (≥ 15)	171 (17.1)
The Impact of Event Scale-Revised	24 (11-42)[1]
Minimal (< 9)	197 (19.7)
Mild (9-25)	335 (33.5)
Moderate (26-43)	225 (22.5)
Severe (≥ 44)	243 (24.3)
Mini-Z Burnout Assessment (≥ 3)[2]	349 (34.9)
Increased tobacco consumption	76 (7.6)
Increased alcohol consumption	171 (17.1)

[1]Interquatile range.
[2]Participants with a score above the cut-off point for burnout.

factor 3, and 0.55 between factor 2 and factor 3. Cronbach's alpha coefficient for factors 1, 2, and 3 was α = 0.96, 0.94, and 0.87, respectively, indicating adequate internal consistency of each extracted factor.

The first dominant factor explained 28% of the total variance and included 20 items from the IES-R but excluded #15 - "I had trouble falling asleep" - and #2 - "I had trouble staying asleep". The second factor explained 24% of the total variance and included all the items from the GAD-7, 8 items from the PHQ-9 (except #3 - "Trouble falling or staying asleep, or sleeping too much?"), and the Mini-Z Burnout Assessment. The third factor explained an additional 6% of the total variance and included two items from the IES-R (#15 and #2) and one item from the PHQ-9 (#3).

We consistently examined how each item loaded in each factor to label each one of the latent factors. The first factor was composed of all the IES-R items, except two items related to sleep ("I had trouble falling asleep" and "I had trouble staying asleep"). The following three items presented the highest loadings: "I tried to remove it from my memory", "I found myself acting or feeling as though I was back at that time" and "I was aware that I still had a lot of feelings about it, but I didn't deal with them". These items are related to major PTSD-associated symptom clusters, namely avoidance, and re-experiencing.

The second factor was composed of all the items from the GAD-7, almost all the items from the PHQ-9 (except one item related to sleep, "trouble falling or staying asleep, or sleeping too much?"), and the Mini-Z Burnout Assessment. The following three items presented the highest loadings: "Feeling down, depressed, or hopeless?", "Feeling tired or having little energy?" and "Little interest or pleasure in doing things?". These items mostly relate to major symptoms associated with depression. Hence, the second factor was labeled Depression-anxiety. Lastly, the third factor was composed of three items associated with sleep, two of which loaded 0.7 or higher: "I had trouble falling asleep" and "I had trouble staying asleep". The third factor was labeled Sleep changes.

Predictors of the mental health dimensions
Table 4 shows crude and adjusted multiple linear regression models which were built to evaluate potential predictors for each of the emotional dimensions retained from the EFA. First, models were carried out using the following independent variables: direct contact with a COVID-19 patient, previous psychiatric and psychological treatment, had COVID-19, close family or friend hospitalized or died due to COVID-19, ethical conflict, personal motivation, and institutional support. The fitness of all three

Table 3 Pattern matrix of rotated Oblimin solution as extracted through principal axis factoring

Description	Item	Avoidance and re-experience	Depression-anxiety	Sleep changes	Communality
I tried to remove it from my memory	IES-R-17	**0.81**	-0.10	0.05	0.60
I found myself acting or feeling as though I was back at that time	IES-R-14	**0.79**	0.03	-0.01	0.66
I was aware that I still had a lot of feelings about it, but I didn't deal with them	IES-R-12	**0.79**	-0.13	0.02	0.53
I tried not to think about it	IES-R-11	**0.78**	-0.12	0.04	0.53
Pictures about it popped into my mind	IES-R-9	**0.76**	0.10	0.01	0.70
I was jumpy and easily startled	IES-R-10	**0.75**	0.12	0.02	0.71
I tried not to talk about it	IES-R-22	**0.75**	-0.06	-0.03	0.48
My feelings about it were kind of numb	IES-R-13	**0.72**	-0.02	-0.02	0.48
I thought about it when I didn't mean to	IES-R-6	**0.70**	0.14	0.09	0.73
I had waves of strong feelings about it	IES-R-16	**0.68**	0.12	0.12	0.71
I stayed away from reminders about it	IES-R-8	**0.68**	-0.10	0.03	0.40
I felt watchful or on-guard	IES-R-21	**0.65**	0.19	0.01	0.62
I felt as if it hadn't happened or wasn't real	IES-R-7	**0.62**	0.05	-0.02	0.42
I avoided letting myself get upset when I thought about it or was reminded of it	IES-R-5	**0.62**	0.05	0.07	0.48
Other things kept making me think about it	IES-R-3	**0.61**	0.12	0.22	0.70
Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart	IES-R-19	**0.60**	0.20	0.03	0.59
Any reminder brought back feelings about it	IES-R-1	**0.59**	0.19	0.07	0.59
I had dreams about it	IES-R-20	**0.49**	0.12	0.10	0.41
I had trouble concentrating	IES-R-18	**0.45**	0.32	0.12	0.61
I felt irritable and angry	IES-R-4	**0.45**	0.34	0.09	0.60
Feeling down, depressed, or hopeless	PHQ-9-2	0.01	**0.84**	-0.05	0.68
Feeling tired or having little energy	PHQ-9-4	-0.15	**0.78**	0.15	0.60
Little interest or pleasure in doing things	PHQ-9-1	-0.07	**0.75**	0.09	0.58
Feeling nervous, anxious, or on edge	GAD-7-1	0.06	**0.74**	0.02	0.63
Feeling bad about yourself - or that you are a failure or have let yourself or your family down	PHQ-9-6	0.05	**0.74**	-0.09	0.52
Not being able to stop or control worrying	GAD-7-2	0.16	**0.72**	-0.01	0.69
Becoming easily annoyed or irritable	GAD-7-6	0.11	**0.72**	-0.03	0.61
Trouble concentrating on things, such as reading the newspaper or watching television	PHQ-9-7	0.04	**0.68**	0.07	0.55
Worrying too much about different things	GAD-	0.13	**0.68**	0.03	0.62

	7-3				
Trouble relaxing	GAD-7-4	0.01	**0.68**	0.22	0.69
Overall, based on your definition of burnout, how would you rate your level of burnout	Mini-Z	-0.05	**0.67**	0.05	0.45
Moving or speaking so slowly that other people could have noticed	PHQ-9-8	0.18	**0.62**	-0.08	0.49
Poor appetite or overeating	PHQ-9-5	0.04	**0.56**	0.13	0.45
Feeling afraid as if something awful might happen	GAD-7-7	0.31	**0.56**	-0.12	0.53
Or the opposite - being so fidgety or restless that you have been moving around a lot more than usual	PHQ-9-9	0.02	**0.49**	-0.08	0.21
Being so restless that it's hard to sit still	GAD-7-5	0.27	**0.46**	-0.06	0.41
I had trouble falling asleep	IES-R-15	0.21	-0.03	**0.81**	0.85
I had trouble staying asleep	IES-R-2	0.17	0.05	**0.74**	0.77
Trouble falling or staying asleep, or sleeping too much	PHQ-9-3	-0.16	**0.46**	**0.53**	0.60
Eigenvalue; Explained variance (%)			10.76; 28.00	9.22; 24.00	2.50; 6.00
Total explained variance (%)			28.00	52.00	58.00

Loadings above 0.40 are typed in bold. PHQ-9: The Patient Health Questionnaire-9; GAD-7: The Generalized Anxiety Disorder-7; IES-R: The Impact of Event Scale-Revised; Mini-Z: Single-item Mini-Z Burnout Assessment.

Table 4 Multiple linear regressions between predictable variables and each of the emotional dimensions of hospital workers (*n* = 1000)

	Avoidance and re-experience		Depression-anxiety		Sleep changes	
	β (95%CI)	β (95%CI)[1]	β (95%CI)	β (95%CI)[1]	β (95%CI)	β (95%CI)[1]
Direct contact with COVID-19 patient (h/wk)	0.05 (-0.01 to 0.11)	0.02 (-0.04 to 0.09)	0.08 (0.02 to 0.13)[b]	0.02 (-0.04 to 0.09)	0.03 (-0.03 to 0.08)	-0.02 (-0.08 to 0.05)
Previous psychiatric or psychological treatment (self-reported)	0.33 (0.2 to 0.46)[c]	0.33 (0.21 to 0.46)[c]	0.38 (0.27 to 0.5)[c]	0.38 (0.26 to 0.49)[c]	0.26 (0.13 to 0.38)[c]	0.25 (0.12 to 0.38)[c]
Had COVID-19 (self-reported)	0.14 (0.02 to 0.26)[a]	0.09 (-0.03 to 0.21)	-0.03 (-0.14 to 0.08)	-0.07 (-0.18 to 0.04)	0.09 (-0.03 to 0.21)	0.05 (-0.07 to 0.17)
Close family or friend hospitalized or who died due to COVID-19	0.14 (0.03 to 0.26)[a]	0.13 (0.02 to 0.25)[a]	0.06 (-0.06 to 0.16)	0.06 (-0.04 to 0.17)	0.14 (0.02 to 0.26)[a]	0.13 (0.01 to 0.24)[a]
Ethical conflict	0.21 (0.03 to 0.39)[a]	0.26 (0.08 to 0.44)[b]	0.08 (-0.09 to 0.25)	0.12 (-0.04 to 0.29)	0.02 (-0.16 to 0.2)	0.03 (-0.15 to 0.21)
Personal motivation	-0.03 (-0.11 to 0.04)	-0.02 (-0.09 to 0.06)	-0.03 (-0.1 to 0.04)	-0.02 (-0.09 to 0.05)	-0.01 (-0.09 to 0.06)	0.01 (-0.07 to 0.08)
Institutional support	-0.26 (-0.34 to -0.18)[c]	-0.26 (-0.33 to -0.18)[c]	-0.41 (-0.49 to -0.33)[c]	-0.41 (-0.48 to -0.34)[c]	-0.2 (-0.28 to -0.12)[c]	-0.2 (-0.28 to -0.13)[c]

[1]Adjusted for age, gender, marital status, educational level, and occupation.
[a]*P* < 0.05.
[b]*P* < 0.01.
[c]*P* < 0.001.
All models were statistically significant (*P* < 0.001). CI: Confidence interval.

crude models was statistically significant (*P* < 0.001). Likewise, the adjusted R^2 for each of the models was 0.14, 0.25, and 0.08 respectively. Second, three final models were adjusted for age, gender, marital status, educational level, and occupation, yielding an adjusted R^2 of 0.18, 0.29, and 0.09, respectively. All adjusted models were statistically significant (*P* < 0.001) by *F* test, considering the Bonferroni test for multiple models.

The analysis revealed that institutional support presented a negative association with all dimensions of emotional distress (β = -0.26, *P* < 0.001; β = -0.41, *P* < 0.001; β = -0.22, *P* < 0.001). Personal motivation was not a significantly correlated variable with dimensions of emotional distress. Moreover, the final sociodemographic adjusted models indicated that participants with previous psychiatric or psychological treatments presented a significant likelihood of manifesting the three mental health dimensions (β = 0.33, 0.38, and 0.25, *P* < 0.001, respectively). Chi-squared tests were carried out to evaluate the association between this variable and scores of each used scale, showing a *P* value < 0.001 for all tests, which points out that pre-pandemic psychopathology was associated with higher rates of mental health outcomes (data not shown, available upon request).

In terms of events related to COVID-19 care, the dimension of avoidance and re-experience also presented a significant association with those HWs who had a close family member or friend who was hospitalized or died due to COVID-19 (β = 0.13, *P* < 0.05) and had experienced an ethical conflict during COVID-19 patient care (β = 0.26, *P < 0.01*). Furthermore, direct contact with COVID-19 patients was positively associated with the depression-anxiety dimension (β = 0.08; *P* < 0.01) and having had COVID-19 (β = 0.14; *P* < 0.05) was associated with avoidance and re-experience in the non-adjusted crude model.

Regarding sociodemographic predictors as data not shown, high educational level was negatively associated with all factors (*P* < 0.01; *P* < 0.01; *P* < 0.05). Age presented a negative association with factors 1 and 2 (*P* < 0.01; *P* < 0.001). Being a nurse was a significant factor associated with the first dimension (*P* < 0.01) when compared with being a medical doctor.

DISCUSSION

The mental health status of 1000 workers in a large COVID-19 reference hospital was assessed through self-reporting scales as applied online during the 2020 pandemic peak, a hectic period for HWs when exhausted professionals needed to continue to fight to stop the frightening level of deaths caused by COVID-19. Unsurprisingly, the results indicated a high frequency of depression, anxiety, stress, and burnout, as well as increased consumption of tobacco and alcohol, which were in line with reported rates found in previous studies[21-23]. Over one in four participants reported previous psychological or psychiatric treatment and an additional 14% of participants reported that they started treatment after the beginning of the pandemic. This incremental figure of HWs in need of care confirmed the vulnerability of this population to emotional distress during a demanding global health crisis. We showed a three-factor structure as a well-fit model for data variance of multiple co-occurring symptoms among HWs. Avoidance and re-experience, depression-anxiety, and sleep changes represent core dimensions of their prevalent emotional symptoms. Moreover, our findings suggested that the support of the organizational environment was the preventive intervention most associated with workers' emotional reactions. Also, professionals who had a close relative or friend present severe COVID-19 or had experienced an ethical challenge also presented a significant likelihood of association with the PTSD-like dimension of avoidance and re-experience. These results only include the suffering experience of a sample of HWs; however, their relevance should be examined in light of their fundamental role in the battle against the COVID-19 pandemic. Protecting their mental health by providing sufficient institutional support could make a difference to HWs' well-being.

Although the method of factor analysis used for examining underlying dimensions of psychopathologies is a well-known technique for data reduction in psychiatry, we are aware of only one factorial study on the mental health of HWs during the pandemic. Chatterjee *et al*[24] conducted a factor analysis of distress among 140 Hindu HCWs and observed a four-factor structure: sleeplessness, anxiety, irritability, and hopelessness. In line with our findings, they also found that symptoms of sleep, anxiety, and depression play an important role in HWs' distress. Unlike them, however, we found that stress-related responses were the most relevant dimension for data variance and sleep changes had the lowest impact. While our second factor included symptoms of depression and anxiety, symptoms such as hopelessness prevailed over irritability or anxiety. The difference could be explained by the fact that they selected a smaller sample size of participants, collected data in different stages of the pandemic course, and used specific instruments to assess only insomnia and perceived stress. Direct comparison between factorial models and their generalizability is not feasible.

Our dominant factor was the stress-related Avoidance and re-experience dimension, which was correlated with the depression-anxiety and sleep changes dimensions. This finding might support the argument that the current pandemic is considered a stressor event capable of triggering PTSD-like responses as well as worsening other related mental health problems such as depression and anxiety [25]. Furthermore, depressive, anxiety and burnout symptoms could be more associated with chronic stressors not directly related to COVID-19 care. Regarding externalizing behaviors, our questionnaire indicated that HWs increased their consumption of psychoactive substances, namely 7.6% tobacco and 17.1% alcohol. However, we did not include these variables in the analysis because of their weak contribution to the factorial model (communality < 0.10, data not shown). Hypothetically, HWs might be using more psychoactive substances to alleviate their distress[26]. This increased consumption is one of the aspects that might be bi-directionally related to their sleep problems[27], disturbing their sleep, or

being a way of dealing with distress caused by inefficient rest. However, a more consistent investigation is warranted.

This study was conducted during the peak of the first wave of COVID-19 in Brazil, which was associated with the highest level of hospitalization of infected patients and produced an overwhelmingly stressful environment for HWs[28]. Our frequency of symptoms of traumatic events (46.8%) was similar to the rate of 49.4% found during the contagion peak in Italy[29]. The current data revealed that while working as a nurse was associated with the likelihood of presenting the avoidance and re-experience dimension, being a HW of older age and higher education level were both protective factors. These findings are in accordance with a recent systematic review that revealed that nurses facing pandemic crises experienced more stress when compared to doctors and that having more experience in healthcare work was a protective factor[30]. We also found that having had a close family member or friend hospitalized or die due to COVID-19 and having experienced an ethical conflict related to COVID-19 patient care had a significant positive association with this dimension. In this regard, recent studies have indicated that the loss of colleagues and dealing with ethical challenges in a time of acute resource shortages were associated with an increased risk of mental disorders[31-33]. Our results suggested that stress-related symptoms like avoidance and intrusive traumatic thoughts are a part of hospital professionals' emotional response to demanding conditions and adverse settings. Hence, it is recommended that hospital providers and administrators pay special attention to the occurrence of these symptoms among workers.

The second factor was labeled Depression-anxiety and the included items were taken from the PHQ-9, the GAD-7, and the burnout assessment. Previous studies have reported high levels of depression, anxiety, and burnout among HWs dealing with the pandemic[31,34,35]. Our findings were in accordance with these studies, showing that the retained dimension accounted for a substantial 24% of the data variance, with symptoms of hopelessness, anhedonia, and anergia being more represented than complaints of anxiety and burnout. A possible explanation for this dimension may be the important role of chronic stress in the workplace and decreased protective health actions for the development of psychological conditions among those professionals, such as high workload, changes in daily routine, reduced physical activity, scarcity of resources, and lack of rest[36-38]. Corroborating this proposition, our analysis did not find a significant correlation between acute threatening events and this dimension, which is also consistent with the suggestion that the association between direct contact with COVID-19 patients and anxiety and depression is based on weak evidence[23].

The third factor, Sleep changes, included three sleep-related items from the IES-R and the PHQ-9. Although no specific scale for screening sleep disorders was employed in this study, our factor analysis suggested an independent and unobservable sleep pattern, with the difficulty of falling or staying asleep having a high impact. This is consistent with previous studies[30,39,40] that have demonstrated an increased level of sleep problems among such professionals, with a frequency reaching 45%. A study describing the experience of supporting HWs in the current pandemic also reported a high frequency of sleep complaints and suggested specific support be provided for this condition[41]. Several aspects may be associated with these sleep changes, including physical exhaustion, quarantine, sleeping in unfamiliar places, separation from family, concerns about getting infected or infecting close contacts, and long work shifts[42,43]. Therefore, this sleep factor represents a neurovegetative dimension and may be triggered by other aspects apart from trauma-related stress, depression, anxiety, and burnout, which might justify its inclusion in a different emotional distress dimension.

Regarding coping strategies, the strongest finding was that aspects related to the organizational environment had a protective effect on overall emotional dimensions, which is in line with previous literature[44,45]. Amid a paucity of information on specific psychological interventions that could be useful to cope with the current pandemic[46], our findings provide some support to interventions that have already been applied in practice[47-51], such as providing adequate PPE and receiving adequate training, implementing an adequate and clear protocol for dealing with possible ethical conflicts, supporting HWs' families, and providing enough rest time for workers to continue their job. For the purposes of the present paper, we only evaluated the institutional support during the peak of the first wave in Brazil. However, several studies have demonstrated concerns about chronic COVID-19 sequelae, which could be associated with mental health outcomes among other clinical conditions, requiring specific treatments and continuous aid[52,53]. Moreover, although altruistic acceptance of risk and support from family and friends have been considered protective coping factors in previous studies [30], our results did not confirm this relationship, showing any association between motivational coping strategies and emotional distress. However, this finding corroborates a recent study that did not find an association between adaptive coping strategies and symptoms of anxiety, depression, and stress[54]. A possible explanation for this is that we analyzed these aspects together as a personal motivation predictor, including items feeling recognized, motivated, and altruistic, which may enable a more consistent assessment of the role of all these variables in preventing the worsening of HWs' well-being.

This study has some limitations. First, although our sample size was large enough, it was not representative of our institutional HWs, with a low response rate of 4.5%, and might be vulnerable to self-selection and response bias. Nevertheless, a good fit factorial model does not require a representative sample, but a large enough size with correlated items[19]. Second, self-reported online questionnaires were used, hence response bias may have occurred, where over or underreporting could not be ruled

out. Third, considering the study design, we could not distinguish preexisting mental health symptoms from new-onset symptoms. Many participants self-reported previous history of mental disorders and treatment, but our rates clearly surpass the pre-pandemic level. Finally, because data were cross-sectionally collected in the baseline wave of an ongoing longitudinal study, causal relationships with predictors should not be stated definitively.

CONCLUSION

This factor analytical study of common psychological symptoms among HWs during the first wave of the current pandemic revealed that avoidance and re-experience, depression-anxiety, and sleep changes were the core reported manifestations. Institutional support was the most relevant protective aspect of the workers' well-being. Mental health professionals, health service administrators, and policy-makers should be mindful of the core dimensions of emotional distress of frontline workers and implement sound safeguarding measures. In the future, interventions should be tailored to improve occupational well-being in health services during subsequent waves of COVID-19 as well as possible forthcoming pandemic crises. Moreover, tracking the longitudinal course of HWs' reactions may help clarify their coping mechanisms for adversity.

ARTICLE HIGHLIGHTS

Research background

The current pandemic has generated a dramatic challenge to public health, in a set of contextual changes throughout the world, including millions of deaths, the collapse of health systems, economic disruption, and food insecurity. During frontline service, hospital workers (HWs) were exposed to an increased risk of becoming infected, fear of infecting family members, ethical conflicts, overwhelming workload, among other stressors. Facing these stressors may contribute to a decline in their psychological well-being. Supporting this suggestion, high rates of depression, anxiety, stress, burnout, and insomnia have been reported among hospital professionals.

Research motivation

Several observational studies have described rates of common psychological responses of HWs facing the current pandemic. Nevertheless, few studies have examined the structure of multiple co-occurring symptoms through exploratory factor analysis. The data reduction approach is a potential asset to expand our understanding of how to prevent or reduce emotional distress in healthcare settings using a smaller number of variables.

Research objectives

We aimed to show core dimensions of common psychological symptoms as well as their associated predictors among HWs in a coronavirus disease 2019 (COVID-19) reference hospital.

Research methods

This is an observational study, and the data were cross-sectionally collected using an online survey during the first peak of the pandemic in Brazil. Data of 1000 HWs who completed the survey were analyzed (83.9% women and 34.3% aged 30 to 40). Self-reported symptoms of depression, anxiety, trauma-related stress, and burnout were subjected to exploratory factor analysis. Multiple linear regression models were then carried out to estimate predictors for each of the factors retained using questions on personal motivation, threatening events, and institutional support as independent variables.

Research results

HWs presented high rates of depression, anxiety, stress, and burnout during their frontline duty, as well as increased tobacco and alcohol consumption. The following three factors were the main dimensions of HWs' distress: avoidance and re-experience, depression-anxiety, and sleep changes. Institutional support was the most significant protective factor for each of these dimensions. Furthermore, scores of the avoidance and re-experience dimension were associated with having a family member or a close friend with severe COVID-19 and having dealt with an ethical challenge. Contrary to expectation, participants' personal motivation to work with COVID-19 patients was not associated with these factors.

Research conclusions

This factor analytic study revealed distressing dimensions of avoidance and re-experience, depression-

anxiety, and sleep changes as the core psychological reactions of a sample of Brazilian HWs during the pandemic. It also highlighted the importance of institutional support in preventing a worsening of hospital professionals' mental health during their pandemic service. These findings have implications for tailoring interventions to maintain HWs' mental health.

Research perspectives

Data reduction methods, such as exploratory factor analysis, contribute to enlarging our understanding of the core psychological reactions of hospital professionals during a sanitary crisis. Multiple co-occurring symptoms can be clustered in a sound dimensional structure. In the future, institutional strategies based on these unobservable patterns could be planned to improve occupational well-being in health settings, either during subsequent waves of COVID-19 or during other future pandemic crises. Lastly, analyzing the longitudinal trajectory of the HWs' reactions could help to elucidate coping mechanisms in similar stressful periods.

FOOTNOTES

ORCID number: Marcos O Carvalho-Alves 0000-0002-4136-6311; Vitor A Petrilli-Mazon 0000-0002-5874-7401; Andre R Brunoni 0000-0002-6310-3571; Andre Malbergier 0000-0001-6093-8381; Pedro Fukuti 0000-0002-7690-0895; Guilherme V Polanczyk 0000-0003-2311-3289; Euripedes C Miguel 0000-0002-9393-3103; Felipe Corchs 0000-0002-9935-5658; Yuan-Pang Wang 0000-0001-7076-8312.

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