

Mental health outcomes in frontline healthcare workers in Brazil during the COVID-19 epidemic: Results of an online survey in four regions using respondent-driven sampling (RDS)

Mírian Cohen^{a,b,*}, Ricardo B. Cardoso^{a,b}, Ligia R.F.S. Kerr^c, Carl Kendall^{c,d}, Rosa L.F. Almeida^e, Nayê B. Schneider^{a,b}, Carolina M. Viera^f, Jorge G. Zadachliver^g, Andriele A. Castro^g, Francisco M.L. Pinheiro^c, Maria F.P.M. Albuquerque^h, Luana N.G.C. Limaⁱ, Maria A.S.M. Veras^j, Celina M.T. Martelli^h, Luciane N. Cruz^{b,g,1}, Suzi A. Camey^{k,1}

^a Graduate Program in Epidemiology, Federal University of Rio Grande do Sul (UFRGS), Ramiro Barcelos St, 2400, 2nd fl, Porto Alegre, Rio Grande do Sul, Brazil

^b National Institute of Science and Technology for Health Technology Assessment (IATS), Ramiro Barcelos St, 2350, BLDG 21, Unit 507, Porto Alegre, Rio Grande do Sul, Brazil

^c Department of Community Health, Federal University of Ceará (UFC), Prof Costa Mendes St, 1608, 5th fl, Fortaleza, Ceará, Brazil

^d Tulane University School of Public Health and Tropical Medicine, 1440 Canal St, New Orleans, Louisiana, USA

^e Graduate Program in Public Health, Fortaleza University (UNIFOR), Washington Soares Ave, 1321 Fortaleza, Ceará, Brazil

^f Medical School, Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Ipiranga Ave, 6681 Porto Alegre, Rio Grande do Sul, Brazil

^g Hospital Moinhos de Vento (HMV), Ramiro Barcelos St, 910, Porto Alegre, Rio Grande do Sul, Brazil

^h Insitute Aggeu Magalhães, FIOCRUZ-PE, Prof. Moraes Rego Ave, s/n, UFPE Campus, Recife, Pernambuco, Brazil

ⁱ Evandro Chagas Institute, BR-316 Hwy, km 7, Ananindeua, Pará, Brazil

^j School of Medical Sciences, Santa Casa de São Paulo, Dr Cesário Mota Jr. St, 61, São Paulo, São Paulo, Brazil

^k Statistics Department, Federal University of Rio Grande do Sul (UFRGS), Bento Gonçalves Ave, 9500 Porto Alegre, Rio Grande do Sul, Brazil

¹ Hospital de Clínicas de Porto Alegre (HCPA), Ramiro Barcelos St, 2350 Porto Alegre, Rio Grande do Sul, Brazil

ARTICLE INFO

Keywords:

Depression
anxiety
alcohol misuse
PTSD
healthcare workers
COVID-19

ABSTRACT

Background: The COVID-19 pandemic overwhelmed health facilities and presented healthcare workers (HCWs) with a new infectious disease threat. In addition to a sanitary crisis, Brazil still had to face major political, economic, and social challenges. This study aimed to investigate mental health outcomes in frontline HCWs in different regions of the country and at different epidemic times. We also sought to identify the main risk factors associated with these outcomes.

Methods: A cross-sectional online survey using respondent-driven sampling was conducted to recruit physicians ($n = 584$), nurses ($n = 997$), and nurse technicians ($n = 524$) in 4 regions of Brazil (North, Northeast, Southeast, and South) from August 2020 to July 2021. We used standardized instruments to screen for common mental disorders (CMD)(SRQ-20), alcohol misuse (AUDIT-C), depression (PHQ-9), anxiety (GAD-7), and post-traumatic stress disorder (PTSD)(PCL-5). Gile's successive sampling estimator was used to produce weighted estimates. We created a three-cluster data set for each HCW category and developed a hierarchical regression model with three levels: individual characteristics; workplace-related aspects; COVID-19 personal experience. The impact of the epidemic moment on the outcomes was also studied.

Results: The prevalence of probable CMD was 26.8–36.9%, alcohol misuse 8.7–13.6%, depression 16.4–21.2%, anxiety 10.8–14.2%, and PTSD 5.9–8.0%. We found a stronger association between mental health outcomes and the following factors: history of psychiatric disorders, female gender, and clinical comorbidities (level 1); work overload and family isolation (level 2); sick leave (level 3). Epidemic variables, such as the number of deaths and trend of deaths by COVID-19, had almost no impact on the outcomes.

Conclusion: An alarmingly high prevalence of depression and anxiety was found in Brazilian frontline HCWs. Individual factors were the most strongly associated with mental health outcomes. These findings indicate the

* Corresponding author at: Graduate Program in Epidemiology, Federal University of Rio Grande do Sul (UFRGS), Ramiro Barcelos St, 2nd fl, 90.035-003, - Porto Alegre, Rio Grande do Sul, Brazil.

E-mail address: mirian.cohen@22c.com.br (M. Cohen).

¹ Luciane N. Cruz and Suzi A. Camey are “co-last” authors.

<https://doi.org/10.1016/j.comppsy.2023.152402>

Available online 13 July 2023

0010-440X/© 2023 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

need to develop programs that provide emotional support, identify professionals at risk and refer them to specialized treatment when necessary.

1. Introduction

The pandemic caused by the SARS-CoV-2 virus emerged in 2019 as a highly transmissible respiratory disease with high morbidity and mortality. Healthcare workers (HCWs) who were treating patients with COVID-19 have been particularly impacted by the pandemic. In addition to a high risk of infection due to direct contact with COVID-19 patients, they also had challenges in accessing personal protective equipment (PPE) [1,2,3]. The concern with avoiding infection and infecting family members, along with the death of colleagues, brought great fear, considering it was a new disease and there was no specific treatment [4,5]. Non-voluntary assignments to work in a high-risk role, an insufficient supply of PPEs, work overload, and the collapse of the healthcare system were all factors that had major repercussions on the mental health of professionals on the front lines fighting COVID-19 [1,3,6,7]. High rates of psychological stress, burnout, somatic symptoms, and insomnia have been identified in these individuals worldwide [4,8].

HCWs in Brazil faced additional challenges. Brazil was one of the countries most affected by the pandemic, remaining from the beginning of the pandemic the second country in the world in terms of the cumulative number of deaths from COVID-19, approaching 700,000 deaths, and the third in the number of cases, approximately 35 million [9]. Even though these numbers are high, the number of cases is estimated to be even higher, given underreporting and the difficulty accessing health services and testing. The pandemic spread was facilitated by an inadequate government response. Federal and some state authorities did not recognize the seriousness of the situation, delaying measures to combat COVID-19 including purchasing and distributing vaccines, and providing oxygen and sedative drugs for serious cases [10,11]. Misguidance at the federal level resulted in three replacements of ministers of health, and the promotion of treatments without scientific evidence of efficacy, such as hydroxychloroquine and ivermectin. In the absence of a clear national policy, each state and municipality were responsible for developing its policy to fight COVID-19 [10,11,12]. All of these issues had negative consequences for the physical and mental health of HCWs [13,14].

Campos et al. (2021) [15] was among the first Brazilian studies to evaluate psychiatric symptoms in these professionals. From May to June 2020 a cross-sectional study was conducted among 1609 HCWs demonstrating a high prevalence of symptoms of depression (57.2%) and anxiety (46.2%). In a survey conducted from May to August 2020 in Brazil, Osório et al. (2021) [14] found similar rates of mental health problems in frontline HCWs. These rates are extremely high when compared to the results of an umbrella review that evaluated the prevalence of anxiety and depression among HCWs in 35 countries at the beginning of the pandemic. This review found anxiety rates ranging from 22.2% to 33.0% and depression rates ranging from 17.9% to 36.0% among these professionals [16].

Few studies have evaluated the relationship between epidemiological curves and the occurrence of mental health outcomes. A survey of an Italian population showed that there was an association between the presence of anxiety symptoms and regions with higher mortality rates from COVID-19 [17]. Higher frequency of somatic anxiety and depression symptoms were also found in HCWs during the first peak of COVID-19 in Mexico [18]. The pandemic played out differently among the regions of Brazil. These regions differ demographically, culturally, socially, economically, and in terms of health system infrastructure. Thus, they were impacted by the pandemic differently [19,20].

There are relatively few studies assessing the mental health of frontline HCWs in Brazil, taking into account different regions and their epidemic moments. The aim of this study was to evaluate the mental

health outcomes and their associated factors in frontline HCWs in Brazil according to their professional category during different stages of the COVID-19 pandemic.

2. Methods

2.1. Sampling

We conducted a longitudinal study (Stay Safe) to assess the impact of the COVID-19 pandemic on the physical and mental health of frontline HCWs in four of the five regions of Brazil: North, Northeast, Southeast, and South. The Central West region was not included due to difficulties in recruiting senior staff interested in participating in the study at the moment of design. Cities of four regions of the country were included: Belém (North), Fortaleza (Northeast), Recife (Northeast), São Paulo (Southeast), and Porto Alegre (South). The study interviewed three professional categories: physicians, nurses, and nursing technicians [21]. In this paper, we will present the results of a cross-sectional analysis of the baseline mental health data that was collected from August 2020 to July 2021.

We used *Respondent Driven-Sampling* (RDS) as the sampling method, which is commonly used for sampling hard-to-reach populations [22]. This methodology was chosen due to three main reasons: first, we could not identify a sampling frame for frontline HCWs attending COVID-19. We could have adopted a two-stage sampling design but health facilities were making efforts to reduce unnecessary access and requesting clinic staff to develop and update lists of all staff and contact information for sampling would have been extremely burdensome and time-consuming. Finally, RDS has an advantage in identifying peers best able to access colleagues and encourage participation in the study. Although frontline HCWs were not traditionally considered a “hard-to-reach” population, changing work sites was frequent, as well as leave from work for suspected infection, making it difficult to identify and access staff. Frontline HCWs were experiencing stigmatization, overload, and stress, who better to recruit them than colleagues experiencing the same circumstances.

From April to September 2020, formative research was conducted with 77 frontline health workers in a convenience sample of physicians, nurses, and nursing technicians in the 4 regions cited above. The interviews were conducted online and individually. The purpose and design of the study were explained to the participants, and we explored the likelihood of participation, logistics (e.g., use of cellphone, likelihood of recruiting more professionals), response to questions in the questionnaire, and other concerns that might affect the conduct of the study and interpretation of results.

We did not provide financial incentives or gifts to recruit HCWs to participate in the study. WhatsApp messages were used to thank these professionals for their work during the pandemic and for participating in the research. The importance of their participation in the study was emphasized to help us to demonstrate the impact of the pandemic on the physical and mental health of frontline HCWs. In addition, messages were also sent with the study's preliminary results with the logo of the project and the participating institutions to demonstrate our partnerships with highly credible institutions.

To estimate the size of the participant's professional social network we used a question cascade to arrive at: “How many colleagues (specifying job category) who you know by name, who live or work here in (city), who you have met or contacted in the last month, would you invite to participate in this study? In the analysis, we adjusted for outliers. We assigned network sizes <3 a value of 3 and network sizes >150 to 150. This study followed the STROBE-RDS (Strengthening the Reporting of Observational Studies

in Epidemiology for Respondent-Driven Sampling Studies) guidelines [23].

2.2. Questionnaire

The online format was used due to the risk of COVID-19 infection in in-person interviews and in travel to and from health clinics, aiming to protect both the participants and the researchers. While there are certainly trade-offs between online and in-person interviewing, it reduced costs to conduct the study substantially.

The questionnaire included items related to:

- 1) Sociodemographic data: gender, age, ethnicity, presence of comorbidities;
- 2) Workplace: number of work sites, work setting (emergency/ICU and others), sector (public, private, or both), time assisting patients with COVID-19 (days), frequency of N95 use (always/not always), training on PPE use (yes/no), accident with biological material (yes/no), work overload due to pandemic (yes/no), family isolation due to pandemic (yes/no);
- 3) COVID-19: infection (yes/no), sick leave due to suspected infection (yes/no), hospitalization due to infection (yes/no);
- 4) Mental Health: perceived risk of infection (low/medium/high/extremely high), level of confidence to avoid getting infected (completely confident/very confident/confident/some confidence/no confidence), previous history of psychiatric diagnosis (yes/no), current psychiatric treatment (yes/no), family history of psychiatric diagnoses (yes/no), sick leave due to a mental health condition (yes/no).

Regarding the question about the frequency of N95 use, the answer “always” meant the participant considered that he or she used the N95 mask >95% of the time when providing care to patients with suspected COVID-19. For the question regarding COVID-19 infection, the answer “yes” was when the participant had tested positive on polymerase chain reaction (PCR) or rapid immunoglobulin tests.

2.3. Mental health outcomes

We used the SRQ-20 (Self-Report Questionnaire) and AUDIT-C (Alcohol Use Disorders Identification Test) questionnaires to screen for Common Mental Disorders (CMD) and alcohol misuse, respectively. When participants scored positive on either of these questionnaires, they then were administered the screening questionnaires for anxiety (GAD-7 - Generalized Anxiety Disorder 7-item Scale), depression (PHQ-9 - Patient Health Questionnaire), and post-traumatic stress disorder (PCL-5 - post-traumatic stress disorder Checklist for DSM-5). These questionnaires are widely used to screen for psychiatric disorders and have been translated and validated for use in Brazil [24–28].

The SRQ-20 is a screening questionnaire for non-psychotic mental disorders, such as non-psychotic depression, anxiety disorders, and somatoform disorders. It is composed of 20 questions with “yes/no” answers, scoring 1 for each “yes”. The screen is considered positive when the final value is greater than or equal to 8 [24]. The AUDIT-C is a questionnaire that evaluates problematic alcohol use, with 3 questions scored from 0 to 4 that are summed at the end. The result is considered positive when the final score is greater than or equal to 6 [25].

The GAD-7 assesses the presence of symptoms of anxiety disorders, with 7 questions scored from 0 to 3. The screening result is considered positive when the sum of the values is greater than or equal to 10 [27]. The PHQ-9 is a questionnaire that screens for depressive symptoms and presents 9 questions scored from 0 to 3. When the final score is greater than or equal to 10 the result is considered positive [26]. The PCL-5 evaluates post-traumatic stress disorder (PTSD) symptoms, with 17 questions that score from 0 to 4, and the result is considered positive when the final sum is greater than or equal to 36 [28].

2.4. Statistical analysis

Continuous variables are presented as a mean with 95% confidence interval (CI 95%) and categorical variables as proportions and 95% CI. Gile's Successive Sampling (SS) estimator was used to produce weighted estimates for each participant by occupational category and city (individuals within 12 networks). This estimator assumes a finite population and requires an estimate of the size of this population for each sample, so we used as a reference the population of health professionals registered as active in the Regional Medical and Regional Nursing Boards of each state [29,30]. The analysis of each outcome was stratified according to the professional category.

A Poisson model with robust variance considering RDS weights was used to estimate the prevalence ratios of mental health outcomes. We also tested for relationships across independent variables, such as multicollinearity. Based on a literature review, we developed a theoretical model organized in hierarchical blocks with factors considered more distal and proximal regarding mental health outcomes (Fig. 1). A three-block hierarchical regression model was developed with adjustment for confounders in each block and for those hierarchically higher: Block 1 - individual variables; Block 2 - work variables; Block 3 - COVID-19 variables. A second model was developed including two fixed variables related to the epidemic moment: number of deaths and trend of deaths by COVID-19. The variables of the epidemiologic moment were linked to the date on which the HCW in a given region answered the questionnaire.

Temporal trends of the COVID-19 pandemic for each of the cities were estimated for deaths, using the JoinPoint Trend Analysis15-version 4.9 [31], from the segmented regression analysis, considering the cumulative moving average of the number of deaths as the outcome variable (Y) and the epidemiological week as the exposure variable (X). This method makes it possible to identify the existence of join points on

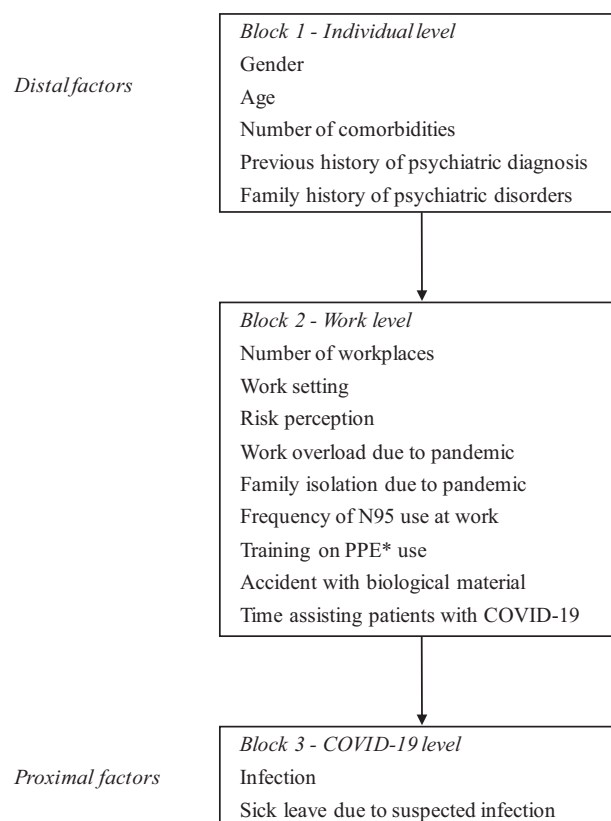


Fig. 1. Theoretical model to investigate factors associated with mental health outcomes, structured in hierarchical blocks of variables.

Table 1

Sociodemographic and occupational characteristics of the healthcare workers considering the professional category.

	Nurses n = 997	Nurse technicians n = 524	Physicians n = 584
Female	82.6 (79.5–85.4)	86.2 (82.6–89.4)	54.7 (49.2–60.2)
Age (years)	35.7 (34.9–36.5)	36.9 (35.9–37.9)	34.0 (32.7–35.4)
Race			
White	54.4 (50.2–58.6)	70.8 (65.5–76.1)	25.7 (21.2–30.1)
Non-White	38.8 (34.6–43.1)	24.5 (19.3–29.7)	54.2 (47.9–60.4)
Missing	6.8 (4.4–9.2)	4.7 (2.2–7.1)	20.1 (15.6–24.8)
Comorbidities	31.9 (28.7–35.3)	29.4 (24.7–34.5)	26.9 (22.8–31.4)
Workplace >1	46.9 (43.0–50.9)	40.2 (35.2–45.4)	80.3 (76.1–84.0)
Work Setting			
Emergency/ICU	54.7 (49.9–59.4)	51.2 (45.9–56.6)	75.8 (70.5–81.0)
Other	45.3 (40.6–50.1)	48.8 (43.5–54.1)	24.2 (19.0–29.5)
Work Sector			
Public	74.6 (71.4–77.9)	71.5 (66.7–76.2)	42.4 (37.8–47.2)
Private	14.7 (11.8–17.6)	17.4 (12.9–21.8)	11.8 (8.6–14.9)
Both	10.7 (8.3–13.0)	11.1 (8.4–14.0)	45.8 (41.1–50.4)
Time assisting patients with COVID-19 (days)	228.1 (215.4–240.8)	176.2 (160.3–192.0)	229.5 (218.3–240.8)
Frequency of N95 use			
Always	61.2 (57.4–64.9)	65.5 (60.3–70.6)	62.2 (57.5–66.8)
Not always	31.7 (28.3–35.0)	28.8 (23.9–33.7)	35.3 (30.4–40.2)
Missing	7.1 (5.1–9.3)	5.7 (3.2–8.3)	2.5 (0.7–4.4)
Training on PPE use (yes)	73.5 (70.1–76.8)	72.5 (67.6–77.0)	74.6 (70.0–78.8)
Accident with biological material (yes)	11.8 (9.5–14.3)	13.5 (10.0–17.7)	13.8 (10.8–17.2)
Risk Perception			
Low/Medium	27.5 (23.7–31.2)	23.1 (18.9–27.3)	27.3 (22.3–31.5)
High/Extremely high	72.5 (68.8–76.3)	76.9 (72.7–81.1)	72.7 (68.5–77.0)
Confidence level of avoiding infection			
None/Some	49.8 (46.1–53.6)	52.7 (47.2–58.2)	48.4 (43.2–53.5)
Confident/Very/Completely Confident	50.2 (46.4–53.9)	47.3 (41.8–52.8)	51.6 (46.5–56.8)
Work overload due to pandemic	83.5 (80.3–86.4)	70.1 (64.5–75.3)	84.6 (80.9–87.9)
Family isolation due to pandemic	66.0 (62.1–69.7)	65.9 (61.1–70.6)	60.6 (54.5–66.6)
COVID-19 infection	36.9 (33.4–40.5)	34.7 (29.8–39.7)	34.5 (29.9–39.2)
Sick leave due to suspected COVID-19 infection	46.6 (42.9–50.4)	42.5 (37.6–47.5)	44.1 (39.6–48.7)
Hospitalization due to COVID-19 infection	2.5 (1.5–3.8)	2.8 (1.4–4.8)	2.1 (1.1–3.5)
Previous history of psychiatric diagnosis	18.9 (16.1–22.0)	12.7 (9.5–16.5)	26.8 (22.5–31.4)
Current psychiatric treatment	14.8 (11.9–18.0)	6.8 (4.5–9.7)	20.2 (16.3–24.6)
Family history of psychiatric disorders	32.9 (29.5–36.5)	26.8 (22.3–31.5)	50.7 (45.7–55.6)
Sick leave due to a mental health condition	6.1 (4.4–8.1)	6.0 (4.1–8.4)	3.13 (1.9–4.8)

ICU = Intensive Care Unit; PPE = Personal Protective Equipment.

the straight line that predicts the trend of a given outcome when there is a significant change in its behavior. This allows for calculating the weekly percent change in time segments of a historical series, according to the existence of these inflection points [32]. Moreover, the segmented regression also allows for calculating the average weekly percent change (WPC), an indicator proposed by Clegg et al. (2009) [33], which represents a summarized measure of the temporal trend of the complete period and corresponds to the weighted average of the WPC obtained in the segmented analysis. This weighting is performed from the weights obtained by the time intervals of each segment.

Since only 134 participants were positive on PCL-5, it was not possible to perform the proposed regression model for this outcome. The variable *COVID-19 hospitalization* was removed from all models as only 21 professionals had been hospitalized. The variable *work overload due to the pandemic* was removed from the physician category models for lack of variation: 497 reported work overload due to the pandemic. The analyses were conducted using the RDS and the survey package of R software version 4.0.3 [34–36].

2.5. Ethical issues

This research was approved by the National Research Ethics Committee (CONEP; CAAE: 30629220.8.0000.0008) and the Research Ethics Committee of Hospital Moinhos de Vento (CAAE: 33653220.0.1001.5330). Informed consent was obtained from all individual participants included in the study. This study was performed in accordance with the ethical standards laid down in the 1964 Declaration

of Helsinki and its later amendments.

When the screening result was positive on any of the psychiatric disorder scales, the app automatically sent an alert message. The message informed that the participant had tested positive on a screening scale and suggested an evaluation by a specialist professional.

3. Results

This survey included 2,105 frontline HCWs, 997 nurses, 524 nursing technicians, and 584 physicians. Considering the metropolitan regions, 866 were from Recife, 407 from Fortaleza, 392 from Belém, 300 from São Paulo, and 139 from Porto Alegre. Most of the professionals were female, aged between 30 and 40 years, and had no clinical comorbidities (Table 1). While more than half of the nurses and nursing technicians classified themselves as non-white, most of the physicians reported being white.

About 29–35% of HCWs reported not always using the N95 mask during the care of patients with COVID-19, and 12–14% reported accidents with biological material. Although 70% of these professionals considered the risk of infection in their workplace high or extremely high, 47–52% were confident that they could avoid becoming infected. Physicians were the category that most reported a previous diagnosis of psychiatric disorder (26.8%, 95% CI: 22.5–31.4), currently being in treatment (20.2%, 95% CI: 16.3–24.6), and having a family history of psychiatric disorder (50.7%, 95% CI: 45.7–55.6).

Table 2 shows the mean score and the prevalence of positive screening in the mental health questionnaires according to the

Table 2

Prevalence of positive screening (95% CI) and mean scores (95% CI) on mental health outcomes considering the professional category.

	Nurses	Nurse technicians	Physicians
SRQ-20			
Prevalence	36.9 (33.4–40.5)	31.6 (26.9–36.6)	26.8 (23.0–30.9)
Mean	6.2 (5.9–6.5)	5.7 (5.2–6.1)	5.2 (4.8–5.5)
AUDIT-C			
Prevalence	8.7 (6.9–10.8)	12.2 (9.0–15.8)	13.6 (10.5–17.2)
Mean	2.1 (1.9–2.3)	2.0 (1.7–2.2)	2.9 (2.7–3.1)
PHQ-9			
Prevalence	21.2 (18.1–24.4)	17.5 (13.4–22.1)	16.4 (12.8–20.6)
Mean	3.9 (3.5–4.3)	3.3 (2.8–3.9)	3.3 (2.7–3.9)
GAD-7			
Prevalence	13.3 (11.0–16.0)	10.8 (8.2–13.8)	14.2 (11.0–18.0)
Mean	3.5 (3.1–3.8)	2.9 (2.4–3.4)	3.1 (2.5–3.6)
PCL-5			
Prevalence	8.0 (6.1–10.1)	6.2 (4.0–9.1)	5.9 (3.7–8.7)
Mean	7.6 (6.7–8.6)	6.7 (5.3–8.1)	4.5 (3.3–5.7)

professional category. Nurses had the highest prevalence of CMD (36.9%, 95% CI: 33.4–40.5), but the lowest prevalence of alcohol abuse (8.7%, 95% CI: 6.9–10.8). The positive screening for PTSD ranged from about 6–8% across the three professional categories.

In the three HCW categories, previous history of psychiatric disorder was the variable most strongly associated with a higher prevalence of CMD, depression, and anxiety (Table 3). Also in the first block (individual variables), female gender was associated with a higher prevalence of depression (PR = 2.82, 95% CI: 1.88–4.22 for physicians), and CMD (PR = 1.48, 95% CI: 1.15–1.90 for nurses; PR = 2.16, 95% CI: 1.57–2.96 for physicians), but with a lower prevalence of alcohol misuse (PR = 0.44, 95% CI: 0.27–0.71 for nurses; PR = 0.31, 95% CI: 0.18–0.52 for nursing technicians; PR = 0.46, 95% CI: 0.27–0.76 for physicians).

In the second block (work variables), work overload was the variable that was most often associated with mental health outcomes for nurses and nursing technicians - PR = 2.18 (95% CI: 1.03–4.61) for anxiety in nurses, PR = 2.16 (95% CI: 1.06–4.38) for anxiety for nursing technicians, PR = 1.60 (95% CI: 1.14–2.26) for CMD in nurses, PR = 1.57 (95% CI: 1.01–2.43) for CMD in nursing technicians, and PR = 1.90 (95% CI: 1.05–3.42) for depression in nurses. For physicians, family isolation was the only factor in this block associated with an increase in the prevalence of depression and anxiety.

In the third block (COVID-19 variables), sick leave was associated with an increase in the prevalence of depression in nurses PR = 1.39 (95% CI: 1.06–1.81) and physicians PR = 1.54 (95% CI: 1.04–2.26), and CMD in nurses PR = 1.23 (95% CI: 1.03–1.47). The inclusion of the two variables number and trend in deaths by COVID-19 almost did not affect the prevalence ratios for the mental health outcomes. Fig. 2 summarizes which factors were associated with the outcomes in each professional category according to the proposed theoretical model.

4. Discussion

To our knowledge, this is the largest study evaluating the mental health of frontline HCWs in Brazil exploring differences between professional categories, considering different regions and their epidemic moments. Our study reports a high prevalence of depression and anxiety in these professionals. While we could find no professional panel pre-epidemic for comparison, studies in the general population pre-pandemic report much lower rates (3–4% for depression, and 9% for anxiety) [37–40].

The greater presence of female health professionals in our study is similar to data from several studies [41,42]. Older professionals with clinical comorbidities were removed from work due to the higher risk of complications from COVID-19 infection, justifying the higher presence of individuals at a young age and without the presence of comorbidities among our participants. It is noteworthy that about 30% of these

professionals did not use an N95 mask when performing their work activities, a very high rate if we consider the risk to which these frontline professionals were exposed. Even months after the beginning of the pandemic of COVID-19, there were healthcare services that did not provide adequate protection in Brazil. Moreover, 25% of our sample had not received training in the use of PPE. According to the literature, both factors were strongly associated with mental health outcomes in HCWs [1,2,4].

We found considerably lower rates of anxiety and PTSD in our study in comparison with a meta-analysis that assessed mental health outcomes in HCW during the COVID-19 pandemic and found a pooled prevalence of 21.7% (95% CI, 18.3%–25.2%) of depression, 22.1% (95% CI, 18.2%–26.3%) of anxiety, and 21.5% (95% CI, 10.5%–34.9%) of PTSD [6]. Given that frontline professionals tend to experience greater emotional burden [1,7,43], it would be expected that our participants would have suffered greater impairment to their mental health. Osório et al. (2021) [14] assessed 916 frontline healthcare workers in Brazil from May to August 2020 and found around two times the prevalence of depression (40.2%), three times the prevalence of anxiety (43.3%), and four times the prevalence of PTSD (43.3%) when compared to our findings. One hypothesis to explain the lower rates of mental health outcomes found in our study could be the epidemic timing in which the survey was conducted, as most published studies analyzed these outcomes at the first peak of the pandemic and our survey started after the first peak of COVID-19 in Brazil. Perhaps the pandemic was no longer a novelty and these professionals had already absorbed the initial impact and adapted to the chronic situation of COVID-19, having overcome that initial despair of the unknown. Those most affected might also have withdrawn from clinical practice. We should also consider that in the 2nd half of 2020 a free online program for psychological and psychiatric care for HCWs was launched, so maybe some professionals who had presented psychological distress at the beginning were already receiving specialized care.

In our survey, the physicians had the lowest prevalence of CMD and depression and were the professional category that was most currently undergoing psychiatric treatment, which might be associated with greater access to specialized treatment and use compared to other professional categories. Nursing technicians were the category that least reported having a previous psychiatric diagnosis, as well as being currently undergoing psychiatric treatment. These professionals, in addition to having less training to identify symptoms of mental health problems, are generally drawn from a lower socioeconomic class when compared to physicians and nurses. A combination of these professional and financial circumstances may be related to this finding. In this sense, we strongly suggest that nursing technicians receive special attention from the health institutions in which they work. These institutions need to be aware of the particular circumstances of these professionals, ensuring that they receive the necessary support.

Few studies have investigated the pattern of alcohol use of HCWs during the pandemic. However, some have shown an increase in alcohol use [44,5]. The prevalence of alcohol misuse found in our study was similar to other Brazilian studies conducted before the pandemic. The National Health Survey assessed the alcohol consumption pattern of the adult Brazilian population in 2019 and observed a prevalence of 11.7% of moderate and heavy drinkers [45]. Diniz et al. (2019) [46] and Tobias et al. (2019) [47] studied the same outcome among HCWs in Brazil, identifying a prevalence of 7.2% to 10.6% of alcohol misusers, respectively. Maintaining their employment in a low- and middle-income country during a public health and economic crisis may have been a protective factor for these professionals. Frontline HCWs did not experience as many changes in their daily routine compared with the general population, as they were able to maintain their income, were not isolated working or not working from home, and probably had fewer feelings of boredom and loneliness, all factors that have been associated with increased drinking patterns during the pandemic [44].

The prevalence of PTSD found was extremely low (4–6%) when

Table 3
Prevalence Ratio (95% CI) for mental health outcomes by professional category.

	Nurses		Nurse technicians		Physicians	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Common Mental Disorders						
<i>Fixed variables</i>						
Trend of deaths	–	1.004 (0.998–1.010)	–	1.009 (0.999–1.020)	–	1.002 (0.991–1.014)
Number of deaths	–	1.000 (0.999–1.000)	–	1.000 (1.000–1.001)	–	1.000 (1.000–1.001)
<i>Block 1: Individual Variables</i>						
Female	1.49 (1.16–1.91)	1.48 (1.15–1.90)	1.43 (0.95–2.13)	1.44 (0.95–2.17)	2.13 (1.55–2.94)	2.16 (1.57–2.96)
Age (years)	0.97 (0.96–0.99)	0.98 (0.96–0.99)			0.98 (0.95–1.00)	0.97 (0.95–1.00)
Number of comorbidities	1.16 (1.02–1.31)	1.16 (1.02–1.31)	1.30 (1.14–1.48)	1.35 (1.17–1.54)	1.39 (1.17–1.66)	1.40 (1.17–1.68)
Previous history of psychiatric diagnosis	1.89 (1.57–2.29)	1.89 (1.57–2.29)	2.00 (1.55–2.59)	1.99 (1.55–2.56)	1.75 (1.34–2.27)	1.73 (1.34–2.25)
Family history of psychiatric disorders					1.49 (1.08–2.07)	1.49 (1.08–2.07)
<i>Block 2: Work Variables</i>						
Work overload (yes)	1.62 (1.14–2.29)	1.60 (1.14–2.26)	1.55 (0.99–2.42)	1.57 (1.01–2.43)		
Not always used N95			1.50 (1.11–2.03)	1.46 (1.08–1.97)		
Accident with biological material (yes)	1.38 (1.10–1.72)	1.36 (1.09–1.70)	1.53 (1.12–2.10)	1.58 (1.16–2.15)		
<i>Block 3: COVID-19 Variables</i>						
Infection					0.68 (0.48–0.97)	0.67 (0.47–0.96)
Sick leave	1.24 (1.04–1.49)	1.23 (1.03–1.47)			1.27 (0.92–1.74)	1.27 (0.93–1.73)
Alcohol misuse						
<i>Fixed variables</i>						
Trend of deaths	–	1.012 (0.997–1.027)	–	1.017 (0.997–1.038)	–	1.005 (0.987–1.024)
Number of deaths	–	0.999 (0.998–1.000)	–	1.000 (0.999–1.001)	–	1.000 (0.999–1.001)
<i>Block 1: Individual Variables</i>						
Female	0.44 (0.27–0.72)	0.44 (0.27–0.71)	0.29 (0.17–0.49)	0.31 (0.18–0.52)	0.45 (0.27–0.75)	0.46 (0.27–0.76)
Age (years)	0.97 (0.94–0.99)	0.97 (0.94–1.00)			0.98 (0.95–1.00)	0.97 (0.95–1.00)
Number of comorbidities	1.39 (1.02–1.89)	1.37 (1.01–1.87)	1.16 (0.86–1.55)	1.22 (0.90–1.65)		
<i>Block 2: Work Variables</i>						
Workplace >1					1.57 (0.74–3.34)	1.61 (0.79–3.30)
Family isolation (yes)			0.49 (0.29–0.86)	0.52 (0.30–0.90)		
Not always used N95	1.65 (1.05–2.60)	1.65 (1.05–2.60)				
<i>Block 3: COVID-19 Variables</i>						
Infection					1.27 (0.79–2.06)	1.26 (0.77–2.04)
Sick leave			1.43 (0.86–2.38)	1.29 (0.75–2.21)		
Depression						
<i>Fixed variables</i>						
Trend of deaths	–	0.999 (0.989–1.009)	–	1.010 (0.994–1.026)	–	1.000 (0.986–1.015)
Number of deaths	–	1.000 (0.999–1.000)	–	1.001 (1.000–1.002)	–	1.000 (0.999–1.001)
<i>Block 1: Individual Variables</i>						
Female	1.52 (1.01–2.28)	–			2.80 (1.86–4.22)	2.82 (1.88–4.22)
Age (years)	0.97 (0.95–0.99)	0.97 (0.96–0.99)			0.96 (0.94–0.99)	0.96 (0.94–0.99)
Number of comorbidities	1.34 (1.11–1.62)	1.32 (1.10–1.59)	1.48 (1.27–1.73)	1.58 (1.35–1.86)	1.71 (1.39–2.10)	1.72 (1.39–2.13)
Previous history of psychiatric diagnosis	2.29 (1.72–3.07)	2.30 (1.73–3.08)	3.02 (2.01–4.53)	3.14 (2.14–4.62)	3.68 (2.42–5.60)	3.66 (2.41–5.56)
Family history of psychiatric disorders					1.47 (0.95–2.29)	1.48 (0.95–2.31)
<i>Block 2: Work Variables</i>						
Family isolation (yes)					1.61 (1.13–2.29)	1.63 (1.13–2.36)
Work overload (yes)	1.96 (1.08–3.54)	1.90 (1.05–3.42)				
Not always used N95			1.56 (1.03–2.36)	–		
Accident with biological material (yes)			1.84 (1.16–2.94)	1.71 (1.06–2.76)		
<i>Block 3: COVID-19 Variables</i>						
Infection					0.77 (0.54–1.11)	0.77 (0.53–1.10)
Sick leave	1.39 (1.06–1.82)	1.39 (1.06–1.81)			1.54 (1.05–2.28)	1.54 (1.04–2.26)

(continued on next page)

Table 3 (continued)

	Nurses		Nurse technicians		Physicians	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Anxiety						
<i>Fixed variables</i>						
Trend of deaths	-	0.999 (0.987-1.011)	-	1.017 (0.997-1.037)	-	1.012 (0.996-1.030)
Number of deaths	-	0.999 (0.999-1.000)	-	0.999 (0.998-1.001)	-	1.000 (0.999-1.001)
Block 1: Individual Variables						
Age (years)	0.97 (0.95-0.99)	0.97 (0.95-0.99)			0.97 (0.94-1.01)	0.97 (0.94-1.01)
Number of comorbidities			1.37 (1.07-1.74)	1.34 (1.01-1.76)		
Previous history of psychiatric diagnosis	3.87 (2.71-5.50)	3.87 (2.71-5.51)	3.84 (2.33-6.32)	4.18 (2.53-6.91)	4.64 (2.91-7.40)	4.54 (2.86-7.21)
Family history of psychiatric disorders			1.59 (0.91-2.81)	-		
Block 2: Work Variables						
Workplace >1			0.60 (0.34-1.05)	0.52 (0.29-0.95)		
Family isolation (yes)					-	1.66 (1.05-2.64)
Work overload (yes)	2.20 (1.04-4.66)	2.18 (1.03-4.61)	-	2.16 (1.06-4.38)		
Not always used N95			1.64 (0.97-2.77)	1.63 (0.90-2.96)		
Training on PPE use (yes)	0.63 (0.47-0.86)	0.65 (0.48-0.89)				
Block 3: COVID-19 Variables						
Infection			-	1.24 (0.78-1.96)	-	0.79 (0.49-1.27)
Sick leave	1.35 (0.95-1.93)	1.35 (0.95-1.92)			1.16 (0.78-1.74)	1.30 (0.81-2.09)

Block 1 (individual variables): female, age (years), number of comorbidities, previous history of psychiatric diagnosis, family history of psychiatric disorders.
Block 2 (work-related variables): workplace >1, work setting emergency/ICU, low/medium risk perception, family isolation (yes), work overload (yes), accident with biological material (yes), time assisting patients with COVID-19 (days).
Block 3 (COVID-19-related variables): Infection, sick leave. Only variables with p<0.05 or confounders were presented in the table.
ICU = Intensive Care Unit; PPE = Personal Protective Equipment.

compared to several studies both internationally and in Brazil [14,6,48]. However, a Chinese survey that assessed the psychological status of 33,706 hospital workers after the peak of COVID-19 found the presence of symptoms of PTSD in 5% of the respondents, a rate similar to our findings [42]. Few studies have evaluated the behavior of mental health problems at different stages of the pandemic, and it is possible that the low rate of PTSD in our study is related to an improvement in symptoms after the peak moments of the pandemic. We should also consider that the study may have been less able to access HCWs who were experiencing PTSD. The affected individuals may not have participated because they had to, in addition to answering the questionnaires, also forward them to their colleagues. Furthermore, differences in results may be related to the use of different questionnaires and cut-off points. Andhavarapu et al. [49] conducted a meta-analysis to investigate the prevalence of symptoms of PTSD among HCWs during the COVID-19 pandemic and found that surveys that used the PCL-5 scale found lower PTSD rates when compared to surveys that used the Impact of Event Scale - Revised (IES-R). Although numerous studies used the IES-R scale to assess symptoms of PTSD among HCWs, the authors considered that IES-R is not used to diagnose PTSD according to the 5th Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) criteria and may not accurately reflect PTSD rates. They suggested that future studies use only the PCL-5 questionnaire.

Through hierarchical regression we have identified that previous history of psychiatric diagnosis was the factor most strongly associated with a higher prevalence of mental health outcomes in all professional categories, reinforcing the strong contribution of individual factors in the development and reporting of psychiatric disorders. Our findings are consistent with other studies that showed that, compared to the general population, individuals with pre-existing mental problems presented higher rates of symptoms of depression and anxiety during the COVID-19 pandemic [50,51,52]. Female gender and the presence of clinical comorbidities were also associated with mental health outcomes, which is in line with previous research [41,7,50].

In our findings, work-related factors were also associated with a higher prevalence of outcomes, but in a heterogeneous way, and to a lesser degree than intrinsic factors and to those identified in the literature. It is noteworthy that the only variable in this block that showed an association with depression and anxiety in physicians was social isolation, with no association with factors related to working conditions. Other factors mentioned in the literature, such as the perceived risk of COVID-19 and higher exposure to the virus at work, did not show a relationship in our study [7,51]. Our results are consistent with some previous studies [41,50], demonstrating that individual characteristics continue to be among the most important factors associated with the development of mental health problems.

Regarding COVID-19 variables, there was an interesting association between COVID-19 infection and a lower prevalence of CMD in physicians. At the time of the survey, it was still believed that COVID-19 infection occurred only once, so perhaps these professionals were relieved that they survived the infection and were protected from reinfection. According to previous studies in Italy and China that identified a relationship between epidemic stages and the prevalence of psychiatric symptoms [17,42], we expected that the variables related to the epidemic moment would have a relevant impact on our results, which did not occur. More studies are needed in different countries at different pandemic times so that we can better understand the influence of pandemic-related factors.

This study has some limitations. First, although RDS is a widely used sampling methodology for surveillance in hidden populations, its use in a visible and well-organized professional population is rare. Compared to other available population sampling methods trade-offs need to be justified. RDS samples networks of relations, in this case professional work and friendship relations, not a traditional sampling population. Results from RDS are more likely to be challenged as unrepresentative of this larger population. Additionally, we contacted the sample remotely,

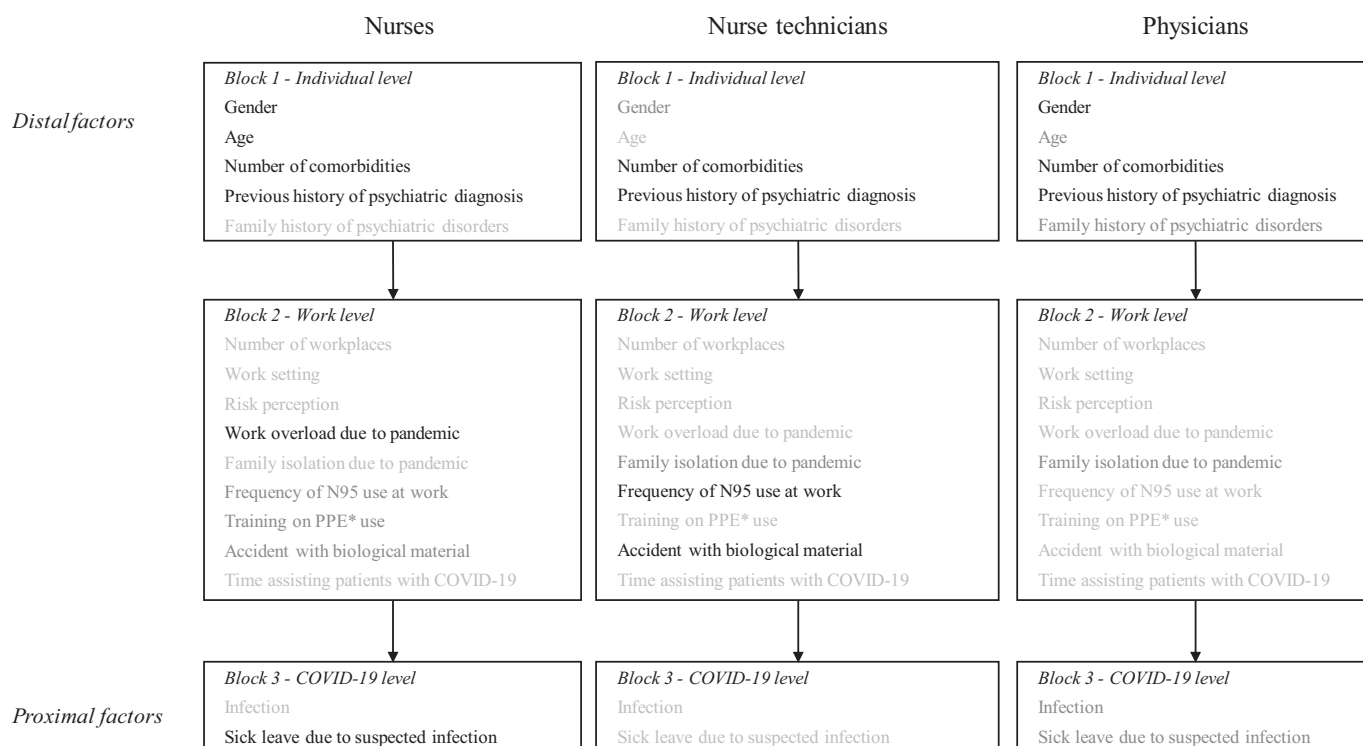


Fig. 2. Factors associated with mental health outcomes in frontline HCWs according to the professional category. In black text are the variables that were significantly associated with more than one mental health outcome, in dark grey text are the variables that were significantly associated with at least one mental health outcome, and in light grey the variables that were not significantly associated with any mental health outcome. *PPE = personal protective equipment.

i.e., we asked participants to provide the names of up to nine contacts and contact them, but also used project staff to contact these participants, request participation and consent, and sent a link via WhatsApp messages to complete the questionnaire. Although there are a number of studies utilizing this approach, our experience is limited. We justify RDS in this project, however, due to the special nature of the pandemic, the need for speed in recruitment and implementation, as well as anticipating resistance to participation. RDS here played a role not dissimilar to Broadhead's peer-driven intervention, presenting an example of a friend who – in this case – completed the questionnaire [53]. Second, those individuals with greater impairment in their mental health may not have participated, so we must consider selection bias. Third, due to the cross-sectional design, it is not possible to establish causal relationships between the factors associated with mental health outcomes. Care should be taken to interpret these results because the purpose of screening instruments is to identify individuals with probable psychiatric disorders, and they do not substitute the need for diagnosis by a specialized professional.

One of the strengths of this study was the representativeness of different geographic regions of the country, which is extremely relevant since Brazilian regions have important cultural, socioeconomic, and health system differences. Furthermore, the research in different epidemic moments allowed a broader analysis of these professionals' mental health conditions, not being limited to the peak moments of the pandemic. The analysis of the three HCW categories independently allowed us to identify factors associated with each mental health outcome in each professional category, identifying particular vulnerabilities for each population.

In May 2020, the Brazilian Ministry of Health launched the "Mental Health Care Project via Teleconsultation for HCWs in the Context of the SARS-CoV-2 Infection". This pilot program was developed in partnership with several universities and teaching hospitals to address mental health issues. The program offered free online psychiatric assessments and psychological interventions, including psychoeducation, cognitive-behavioral therapy, and interpersonal therapy, to healthcare workers

(HCWs) across the country [54]. However, there is a high demand for mental health care, and not all HCWs feel comfortable with teleconsultation or have access to high-quality internet. In addition, some professionals may present chronic symptoms that will require continuous treatment.

Our findings emphasize the urgent need for organizational efforts to implement strategies to prevent and treat HCWs mental distress. Risk factors associated with mental health problems can be potential targets for interventions. Long-term symptom monitoring is essential.

5. Conclusions

Health professionals who worked on the frontline fighting COVID-19 in Brazil showed a high prevalence of CMD symptoms. In our study, individual factors were identified as more relevant than work-related factors. Many of these symptoms can be treated. The incorporation of screening instruments for psychiatric symptoms among staff in health-care institutions could be extremely relevant to identify and providing services primarily to those professionals who are at a higher risk of developing psychiatric disorders, especially in times of sanitary crises.

Ethics approval and consent to participate

This project was approved by the National Research Ethics Committee (CONEP; CAAE: 30629220.8.0000.0008) and the Ethics and Research Committee of the Hospital Moinhos de Vento (CAAE: 33653220.0.1001.5330). This study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Providing electronic informed consent was mandatory to participate and access the questionnaire. Participants gave informed consent to participate in the study before taking part.

Contributors

MC, LC, MA, CM, CK, LK, and SC contributed to the study conception and design. MC, LK, NS, CV, JZ, AC, FJ, MA, LL, and MV participated in the data collection. Material preparation and data analysis were performed by RC, MC, SC, and RA. SC, LC, and LG performed the role of supervisors. SC and LC contributed equally as co-last authors. The first draft of the manuscript was written by MC and all authors critically reviewed the manuscript. All authors read and approved the final manuscript.

Funding

This study was supported by grants from the National Institute of Science and Technology for Health Technology Assessment (IATS) (CNPQ Project: 465518/2014-1), and MCTIC/CNPq/FNDCT/MS/SCTIE/Decit (MCTIC/CNPq/FNDCT/MS/SCTIE/Decit N° 07/2020). The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data and materials are available upon reasonable request. Proposals for the dataset (deidentified participant data, data dictionary) should be directed to the corresponding author: mirian.cohen@22c.com.br. To gain access, data requestors will need to present their plan of analysis and sign a data access agreement.

Acknowledgments

We thank all participants for their important contributions to this project. We acknowledge the National Institute of Science and Technology for Health Technology Assessment (IATS), and MCTIC/CNPq/FNDCT/MS/SCTIE/Decit for funding this study.

References

- [1] De Kock JH, Latham HA, Leslie SJ, Grindle M, Munoz SA, Ellis L, et al. A rapid review of the impact of COVID-19 on the mental health of healthcare workers: implications for supporting psychological well-being. *BMC Public Health* 2021;21:1–18. <https://doi.org/10.1186/s12889-020-10070-3>.
- [2] Xiao X, Zhu X, Fu S, Hu Y, Li X, Xiao J. Psychological impact of healthcare workers in China during COVID-19 pneumonia epidemic: a multi-center cross-sectional survey investigation. *J Affect Disord* 2020;274:405–10. <https://doi.org/10.1016/j.jad.2020.05.081>.
- [3] Giorgi G, Lecca LI, Alessio F, Finstad GL, Bondanini G, Lulli LG, et al. COVID-19-related mental health effects in the workplace: a narrative review. *Int J Environ Res Public Health* 2020;17:1–22. <https://doi.org/10.3390/ijerph17217857>.
- [4] Uphoff EP, Lombardo C, Johnston G, Weeks L, Rodgers M, Dawson S, et al. Mental health among healthcare workers and other vulnerable groups during the COVID-19 pandemic and other coronavirus outbreaks: a rapid systematic review. *PLoS One* 2021;16:1–16. <https://doi.org/10.1371/journal.pone.0254821>.
- [5] Wozniak H, Benzakour L, Moulec G, Buetti N, Nguyen A, Corbass S, et al. Mental health outcomes of ICU and non-ICU healthcare workers during the COVID-19 outbreak: a cross-sectional study. *Ann Intensive Care* 2021;11. <https://doi.org/10.1186/s13613-021-00900-x>.
- [6] Li Y, Scherer N, Felix L, Kuper H. Prevalence of depression, anxiety and posttraumatic stress disorder in health care workers during the COVID-19 pandemic: a systematic review and meta-analysis. *PLoS One* 2021;16:1–19. <https://doi.org/10.1371/journal.pone.0246454>.
- [7] Hao Q, Wang D, Xie M, Tang Y, Dou Y, Zhu L, et al. Prevalence and risk factors of mental health problems among healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. *Front Psych* 2021;12. <https://doi.org/10.3389/fpsy.2021.567381>.
- [8] Cai Q, Feng H, Huang J, Wang M, Wang Q, Lu X, et al. The mental health of frontline and non-frontline medical workers during the coronavirus disease 2019 (COVID-19) outbreak in China: a case-control study. *J Affect Disord* 2020;275:210–5. <https://doi.org/10.1016/j.jad.2020.06.031>.
- [9] World Health Organization. WHO coronavirus (COVID-19) dashboard. <https://covid19.who.int/>; 2022 (accessed August 9, 2022).
- [10] Boschiero MN, Palamim CVC, Ortega MM, Mauch RM, Marson FAL. One year of coronavirus disease 2019 (Covid-19) in Brazil: a political and social overview. *Ann Glob Heal* 2021;87:1–27. <https://doi.org/10.5334/AOGH.3182>.
- [11] Sott MK, Bender MS, da Silva Baum K. Covid-19 outbreak in Brazil: health, social, political, and economic implications. *Int J Heal Serv* 2022;52:442–54. <https://doi.org/10.1177/00207314221122658>.
- [12] Ferigato S, Fernandez M, Amorim M, Ambrogi I, Fernandes LMM, Pacheco R. The Brazilian Government's mistakes in responding to the COVID-19 pandemic. *Lancet* 2020;396:1636. [https://doi.org/10.1016/S0140-6736\(20\)32164-4](https://doi.org/10.1016/S0140-6736(20)32164-4).
- [13] Cotrin P, Moura W, Gambardella-Tkacz CM, Pelloso FC, dos Santos L, de B Carvalho MD, et al. Saúde mental dos profissionais de saúde no Brasil no contexto da pandemia por Covid-19. *Inq (U S)* 2021;25. <https://doi.org/10.1007/s00420-021-01656-4>. e20200160.
- [14] Osório FL, Silveira ILM, Pereira-Lima K, de S Crippa JA, JEC Hallak, Zuairi AW, et al. Risk and protective factors for the mental health of Brazilian healthcare workers in the frontline of COVID-19 pandemic. *Front Psych* 2021;12:1–9. <https://doi.org/10.3389/fpsy.2021.662742>.
- [15] Campos JADB, Martins BG, Campos LA, de Fátima Valadares-Dias F, Marôco J. Symptoms related to mental disorder in healthcare workers during the COVID-19 pandemic in Brazil. *Int Arch Occup Environ Health* 2021;94:1023–32. <https://doi.org/10.1007/s00420-021-01656-4>.
- [16] Fernandez R, Sikhosana N, Green H, Halcomb EJ, Middleton R, Alananzeh I, et al. Anxiety and depression among healthcare workers during the COVID-19 pandemic: a systematic umbrella review of the global evidence. *BMJ Open* 2021;11:1–9. <http://doi.org/10.1136/bmjopen-2021-054528>.
- [17] Carrà G, Crocamo C, Bartoli F, Riboldi I, Sampogna G, Luciano M, et al. Were anxiety, depression and psychological distress associated with local mortality rates during COVID-19 outbreak in Italy? Findings from the COMET study. *J Psychiatr Res* 2022;152:242–9. <https://doi.org/10.1016/j.jpsychires.2022.06.018>.
- [18] Robles R, Morales-Chaíné S, Bosch A, Astudillo-García C, Feria M, Infante S, et al. Mental health problems among covid-19 frontline healthcare workers and the other country-level epidemics: the case of Mexico. *Int J Environ Res Public Health* 2022;19. <https://doi.org/10.3390/ijerph19010421>.
- [19] Marinho PRD, Cordeiro GM, Coelho HFC, Brandão SCS. Covid-19 in Brazil: A sad scenario. *Cytokine Growth Factor Rev* 2021;58:51–4. <https://doi.org/10.1016/j.cytogfr.2020.10.010>.
- [20] David HMSL, Rafael RMR, de M Alves MG, Breda KL, de A Faria MG, Neto M, et al. Infection and mortality of nursing personnel in Brazil from COVID-19: a cross-sectional study. *Int J Nurs Stud* 2021;124. <https://doi.org/10.1016/j.ijnurstu.2021.104089>.
- [21] de FPM de Albuquerque M, de Souza WV, Montarroyos UR, Pereira CR, Braga C, de Araújo TVB, et al. High risk of SARS-CoV-2 infection among frontline healthcare workers in Northeast Brazil: a respondent-driven sampling approach. *MedRxiv* 2021. <https://doi.org/10.1101/2021.10.08.21264755>. 2021.10.08.21264755.
- [22] Heckathorn DD. Respondent-driven sampling: a new approach to the study of hidden populations. *Soc Probl* 1997;44:174–99. <https://doi.org/10.2307/3096941>.
- [23] White RG, Hakim AJ, Salganik MJ, Spiller MW, Johnston LG, Kerr L, et al. Strengthening the reporting of observational studies in epidemiology for respondent-driven sampling studies: “sTROBE-RDS” statement. *J Clin Epidemiol* 2015;68:1463–71. <https://doi.org/10.1016/j.jclinepi.2015.04.002>.
- [24] Gonçalves DM, Stein AT, Kapczinski F. Avaliação de desempenho do Self-Reporting Questionnaire como instrumento de rastreamento psiquiátrico: Um estudo comparativo com o Structured Clinical Interview for DSM-IV-TR. *Cad Saude Publica* 2008;24:380–90. <https://doi.org/10.1590/S0102-311X2008000200017>.
- [25] Meneses-Gaya C, Zuairi AW, Loureiro SR, Hallak JEC, Trzesniak C, De Azevedo Marques JM, et al. Is the full version of the AUDIT really necessary? Study of the validity and internal construct of its abbreviated versions. *Alcohol Clin Exp Res* 2010;34:1417–24. <https://doi.org/10.1111/j.1530-0277.2010.01225.x>.
- [26] Santos IS, Tavares BF, Munhoz TN, de Almeida LSP, da Silva NTB, Tams BD, et al. Sensibilidade e especificidade do Patient Health Questionnaire-9 (PHQ-9) entre adultos da população geral. *Cad Saude Publica* 2013;29:1533–43. <https://doi.org/10.1590/0102-311X00144612>.
- [27] Moreno AL, Desousa DA, De Souza AMFLP, Manfro GG, Salum GA, Koller SH, et al. Factor structure, reliability, and item parameters of the Brazilian-Portuguese version of the GAD-7 questionnaire. *Temas Em Psicol* 2016;24:367–76. <https://doi.org/10.9788/TP2016.1-25>.
- [28] Pereira-Lima K, Loureiro SR, Bolsoni LM, Apolinario da Silva TD, Osório FL. Psychometric properties and diagnostic utility of a Brazilian version of the PCL-5 (complete and abbreviated versions). *Eur J Psychotraumatol* 2019;10. <https://doi.org/10.1080/20008198.2019.1581020>.
- [29] Conselho Federal de Medicina. <https://portal.cfm.org.br/>; 2021 [accessed August 1, 2022].
- [30] Conselho Federal de Enfermagem. <http://www.cofen.gov.br/>; 2021 (accessed January 8, 2022).
- [31] National Cancer Institute. Joinpoint regression program, version 4.9.1.0 - April 2022. Statistical methodology and applications branch, surveillance research program. National Cancer Institute; 2022.
- [32] Kim HJ, Fay MP, Feuer EJ, Midthune DN. Permutation tests for joinpoint regression with applications to cancer rates. *Stat Med* 2000;19:335–51. [https://doi.org/10.1002/\(sici\)1097-0258\(20000215\)19:3<335::aid-sim336>3.0.co;2-z](https://doi.org/10.1002/(sici)1097-0258(20000215)19:3<335::aid-sim336>3.0.co;2-z).

- [33] Clegg LX, Hankey BF, Tiwari R, Feuer EJ, Edwards BK. Estimating average annual per cent change in trend analysis. *Stat Med* 2009;28:3670–82. <https://doi.org/10.1002/sim.3733>.
- [34] CoreTEAM R. R core team. European Environment Agency (EEA); 2020.
- [35] Lumley T. Survey: analysis of complex survey samples. R package version 4.0. 2020.
- [36] Handcock M, Fellows I, KJ G. RDS: Respondent-driven sampling, version 0.9–3. 2022.
- [37] Bonadiman CSC, Malta DC, De Azeredo Passos VM, Naghavi M, Melo APS. Depressive disorders in Brazil: results from the global burden of disease study 2017. *Popul Health Metr* 2020;18:1–13. <https://doi.org/10.1186/s12963-020-00204-5>.
- [38] Munhoz TN, Nunes BP, Wehrmeister FC, Santos IS, Matijasevich A. A nationwide population-based study of depression in Brazil. *J Affect Disord* 2016;192:226–33. <https://doi.org/10.1016/j.jad.2015.12.038>.
- [39] Orellana JDY, Ribeiro MRC, Barbieri MA, da C Saraiva M, Cardoso VC, Bettiol H, et al. Transtornos mentais em adolescentes, jovens e adultos do Consórcio de Coortes de Nascimento brasileiras RPS (Ribeirão Preto, Pelotas e São Luís). *Cad Saude Publica* 2020;36:e00154319. <https://doi.org/10.1590/0102-311X00154319>.
- [40] World Health Organization. Depression and other common mental disorders - Global Health estimates. Geneva. 2017.
- [41] Hennein R, Mew EJ, Lowe SR. Socio-ecological predictors of mental health outcomes among healthcare workers during the COVID-19 pandemic in the United States. *PloS One* 2021;16:1–18. <https://doi.org/10.1371/journal.pone.0246602>.
- [42] Lixia W, Xiaoming X, Lei S, Su H, Wo W, Xin F, et al. A cross-sectional study of the psychological status of 33,706 hospital workers at the late stage of the COVID-19 outbreak. *J Affect Disord* 2022;297:156–68. <https://doi.org/10.1016/j.jad.2021.10.013>.
- [43] Zhang SX, Batra K, Xu W, Liu T, Dong RK, Yin A, et al. Mental disorder symptoms during the COVID-19 pandemic in Latin America – a systematic review and meta-analysis. *Epidemiol Psychiatr Sci* 2022;31. <https://doi.org/10.1017/S2045796021000767>.
- [44] Mongeau-Pérusse V, Rizkallah E, Bruneau J, Chênevert D, Menvielle L, Jutras-Aswad D. Changes in alcohol habits among workers during the confinement of COVID-19: results of a Canadian cross-sectional survey. *Subst Abuse Res Treat* 2021;15. <https://doi.org/10.1177/11782218211033298>.
- [45] Plens JA, Valente JY, Mari JJ, Ferrari G, Sanchez ZM, Rezende LFM. Patterns of alcohol consumption in Brazilian adults. *Sci Rep* 2022;12:1–10. <https://doi.org/10.1038/s41598-022-12127-2>.
- [46] Diniz CFG, Assunção AA, Beinner MA, Pimenta AM. Abuso/dependência de álcool e fatores psicossociais do trabalho em profissionais de saúde/alcohol abuse/dependency and psychosocial factors in the workplace of healthcare professionals. *Ciênc Cuid e Saúde* 2019;18:1–9. <https://doi.org/10.4025/ciencucuidsaude.v18i3.45023>.
- [47] Tobias JSP, da Silva DLF, Ferreira PAM, da Silva AAM, Ribeiro RS, Ferreira ASP. Alcohol use and associated factors among physicians and nurses in Northeast Brazil. *Alcohol* 2019;75:105–12. <https://doi.org/10.1016/j.alcohol.2018.07.002>.
- [48] Yunitri N, Chu H, Kang XL, Jen HJ, Pien LC, Tsai HT, et al. Global prevalence and associated risk factors of posttraumatic stress disorder during COVID-19 pandemic: a meta-analysis. *Int J Nurs Stud* 2022;126:104136. <https://doi.org/10.1016/J.IJNURSTU.2021.104136>.
- [49] Andhavarapu S, Yardi I, Bzhilyanskaya V, Lurie T, Bhinder M, Patel P, et al. Post-traumatic stress in healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. *Psychiatry Res* 2022;317. <https://doi.org/10.1016/j.psychres.2022.114890>.
- [50] Neelam K, Duddu V, Anyim N, Neelam J, Lewis S. Pandemics and pre-existing mental illness: a systematic review and meta-analysis. *Brain Behav Immun Heal* 2021;10. <https://doi.org/10.1016/j.bbih.2020.100177>.
- [51] Kunzler AM, Röthke N, Günthner L, Stoffers-Winterling J, Tüscher O, Coenen M, et al. Mental burden and its risk and protective factors during the early phase of the SARS-CoV-2 pandemic: systematic review and meta-analyses. *Glob Health* 2021;17:1–29. <https://doi.org/10.1186/s12992-021-00670-y>.
- [52] Xiong J, Lipsitz O, Nasri F, Lui LMW, Gill H, Phan L. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J Affect Disord* 2020. <https://doi.org/10.1016/j.jad.2020.08.001>.
- [53] Broadhead RS, Heckathorn DD, Weakliem DL, Anthony DL, Madray H, Mills RJ, et al. Harnessing peer networks as an instrument for AIDS prevention: results from a peer-driven intervention. *Public Health Rep* 1998;113:42–57.
- [54] Projeto TelePsi n.d. <https://telepsi.hcpa.edu.br/> [accessed January 3, 2023].