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THE "HEALTHCARE WORKERS' WELLBEING [BENESSERE OPERATORI]" PROJECT: A THREE-WAVE LONGITUDINAL EVALUATION OF PSYCHOLOGICAL RESPONSES OF ITALIAN HEALTHCARE WORKERS DURING THE COVID-19 PANDEMIC

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ABSTRACT

In December 2019, an outbreak of a novel coronavirus pneumonia hit China, sparking a pandemic crisis around the world. During the last year, the COVID-19 pandemic put all the healthcare workers around the world at risk of physical and psychological sequelae.

The first aim of the present research was to provide quantitative evidence on the psychological impact of epidemic/pandemic outbreaks (i.e., SARS, MERS, COVID-19, ebola, and influenza A) on healthcare workers through a systematic review of the literature. Our findings indicate that between 11% and 73.4% of healthcare workers, primarily physicians, nurses, and auxiliary staff, reported post-traumatic stress symptoms during outbreaks, with symptoms lasting after 1–3 years in 10–40% of cases. Depressive symptoms were reported in 27.5–50.7% of healthcare workers, insomnia symptoms in 34–36.1%, and severe anxiety symptoms in 45%. General psychiatric symptoms and work-related stress were reported in a wide range of cases (17.3-75.3% and 18.1-80.1%, respectively). Several individual and work-related features can be considered risk or protective factors, such as personality characteristics, the level of exposure to affected patients, and organizational support.

The second purpose of the present research was to assess the mental health of Italian healthcare workers during the COVID-19 outbreak to identify high-risk groups, as well as risk and protective factors that could inform data-driven interventions.

The “Healthcare workers’ wellbeing [Benessere Operatori]” project is a web-based longitudinal study administered in three times (i.e., after the first wave of the outbreak, during the second wave, and after the third wave) by means of questions on socio-demographic and work-related information, the Depression Anxiety Stress Scale-21, the Insomnia Severity Index, the Impact of Event Scale-Revised, the State-Trait Anger Expression Inventory-2, the Maslach Burnout Inventory, the Multidimensional Scale of Perceived Social Support, and the Brief Cope. One thousand fifty-five healthcare workers took part in the study.

Our findings highlight that during the first year of the pandemic healthcare workers experienced subclinical depression, anxiety, stress, and insomnia symptoms, as well as medium and high levels of burnout. Throughout the outbreak, these symptoms remained mostly unchanged, with an increase in depression and emotional exhaustion scores at the second follow-up. Nurses and healthcare workers who worked in COVID-19 wards were at higher risk of experiencing psychological distress compared to other groups of healthcare workers.

Specific risk factors have been identified, including higher levels of worry, worse working conditions, working in COVID-19 wards, a previous history of psychiatric illness, being a nurse, and avoidant and emotion-focused coping strategies. Conversely, higher levels of perceived social support, the attendance of an emergency training, problem-focused coping strategies, appreciation from hospital direction and the community, and adequate attention to healthcare workers' wellbeing from hospital direction had a protective role for healthcare workers' mental health.

Despite the subthreshold distress scores obtained by our sample, subsyndromal symptoms can cause distress, impair functioning, and affect the quality of care, necessitating intervention. Recommendations should include the assessment and promotion of coping strategies; programs for the development of self-efficacy in emergency situations; special attention to nurses, healthcare professionals working in COVID-19 wards, healthcare workers with a previous history of psychiatric illness and current high levels of worry; the promotion of adequate working conditions; the expression of appreciation to healthcare workers; and the organization of online support services.

Keywords: COVID-19; pandemic; healthcare workers; mental health; burnout.

1. INTRODUCTION

On December 31, 2019, the Municipal Health Commission of Wuhan, capital of the Hubei province in China, reported to the World Health Organization (WHO) an outbreak of pneumonia cases with acute respiratory syndrome caused by Coronavirus (WHO, 2019). On January 30, 2020, the WHO declared the COVID-19 epidemic in China an international public health emergency (WHO, 2020). On 11 March 2020, due to its intercontinental spread that was no longer confined to specific geographical areas, COVID-19 was declared a pandemic by the WHO general director. To reduce the rapid spread of the infection and in the absence of vaccines or treatments, severe public health measures and non-pharmaceutical interventions, such as lockdown and social distancing, were implemented globally in the spring of 2020. During the summer, the contagion decreased sharply, but in November 2020, the world was hit by a second wave, and numerous countries were subjected to strict measures again, with worrying indices on intensive care unit overload. Vaccine approval and commercialization in December 2020 aided in reducing new infection levels in many areas through the spring of 2021 (Ruta et al., 2021). However, in July 2021, a contagious delta variant began to circulate and eventually became dominant, resulting in another surge. Worldwide, the number of new cases started to rise at the end of July (WHO, 2021a), peaked in August (WHO, 2021b), and began to decline in late September (WHO, 2021c). Meanwhile, starting from September, vaccination rates increased (Our World in Data, 2022), resulting in a reduction in virus transmission (Eyre et al., 2020). Italy's infection rate followed the same trend, escalating during the summer (ISS, 2021a, b, c) and then slowing as autumn approached, while vaccination coverage promptly increased (ISS, 2021d).

On November 26, 2021, the WHO defined a new Variant of Concern, named Omicron. Cases drastically increased at the end of November, both in the general population and among healthcare workers (WHO, 2021d), and this upward curve has stopped neither in December nor in January 2022 (WHO, 2022a). Death rates did not follow this trend, remaining stable from November 2021 to January 2022 (WHO,

2022b). Omicron started to circulate in Italy at the end of November (ISS, 2021f, g) and, by January, it was responsible for 81% of all Italian cases (ISS, 2022).

As of January 21, 2022, over 340,543,962 people have been infected worldwide, with 5,570,163 deaths (WHO, 2022b). In Italy, 9,418,256 confirmed cases of COVID-19 have been reported, with 142,590 deaths (WHO, 2022b).

Indeed, after two years, the COVID-19 pandemic is far from over. Although the emergency was initially medical, we now have to deal with its psychological consequences and implications. The burden caused by the disease itself and the measures taken to control its spread are affecting the global economy and have profoundly changed people's habits and lives, affecting their work, social interactions, and spare time. Everyone dealt with the fear of infection, as well as possible economic difficulties and social isolation. These circumstances, if prolonged, may increase psychological distress levels (e.g., anxiety, depression, and post-traumatic stress symptoms) in the general population (Xiong et al., 2020). Among the population, some categories may be more at risk than others. In particular, healthcare workers represent a group at high risk for psychological distress, as they are on the frontline dealing with the pandemic, bearing the same burdens as the rest of the community (e.g., curfews, activity restrictions), but also facing unique stressors due to their profession (e.g., increased risk of infection, increased workload) (König et al., 2021). Furthermore, healthcare workers bore another challenge when anger erupted in the community in response to the inefficiencies of the national healthcare system. Healthcare workers, despite being victims of these inefficiencies, were mistakenly blamed for the failures in addressing COVID-19, going from heroes to negligent professionals in the public opinion in a matter of weeks, while lawyers and prosecutors began to question their decisions and treatment options in court (d'Aloja, 2020).

In fact, despite healthcare professionals' familiarity with patients' pain and suffering, feelings of helplessness and lack of control in the face of illness and death, and legal responsibilities, their previous

experience cannot be compared to an emergency of this magnitude. In Italy, as of January 23, 2022, a total of 50,762 healthcare workers have been officially infected (Epicentro, 2022), with healthcare workers accounting for 26% of the total deaths reported on work from January 2020 to November 2021 (INAIL, 2021), and 336 physicians having died due to the pandemic (FNOMCeO, 2022).

Consistently, anxiety, depression, and burnout symptoms, as well as high stress levels have been found in healthcare workers in different European countries, such as Italy (e.g., Barello et al., 2020; Magnavita et al., 2020; Rossi et al., 2020), Spain (e.g., Luceño-Moreno et al., 2020), Germany (e.g., Zerbini et al., 2020), and Greece (e.g., Cheristanidis et al., 2021). Similar findings have been reported in countries outside Europe, including the United States (e.g., Hennein et al., 2021; Van Wert et al., 2022), Mexico (e.g., Delgado-Gallegos et al., 2020), India (e.g., Chew et al., 2020a), Singapore (e.g., Chew et al., 2020a), Japan (e.g., Matsuo et al., 2021), China (e.g., Dong et al., 2020; Xiao et al., 2020; Zang et al., 2020), Saudi Arabia (e.g., Mohsin et al., 2021), Ghana (e.g., Afulani et al., 2021), and Uganda (e.g., Kabunga & Okalo, 2021). These results have also been confirmed by systematic reviews, showing the dramatic and deleterious effects of the COVID-19 pandemic on the professionals involved in this unprecedented struggle (da Silva & Neto, 2021; Salazar de Pablo et al., 2020; Sheraton et al., 2020). However, according to two meta-analyses (Pappa et al., 2020; Sun et al., 2021), most healthcare workers appear to have reported subclinical symptoms, with severe symptoms being less common. Thus, despite the strong evidence mentioned above, there is insufficient data to determine whether the prevalence of mental health problems among healthcare workers is currently increasing in comparison to non-pandemic times (Gualano et al., 2021)

Moreover, the cross-sectional design of most studies could not capture the dynamics of the pandemic over time. For this reason, examining healthcare workers' behavior and experiences by using real-time data at different time points might yield more accurate findings (Schwarz, 2007; van Leeuwen et al., 2021).

In addition, many healthcare workers may be able to adapt adequately, with some even performing outstandingly in stressful situations. The variation in response suggests that COVID-19 conditions only account for a portion of the factors leading to psychological distress. Other possible factors may include individual differences in how professionals cope with stress (Crittenden et al., 2021). Thus, there is a need to address both work-related and personal factors to better protect healthcare workers' mental health.

Consistently, the following chapters will analyze the impact of the pandemic on healthcare workers' mental health, focusing on the identification of high-risk groups, risk and protective factors, and short- and long-term mental health outcomes.

First, we aimed at examining evidence from previous epidemics, as well as the first published studies on COVID-19 to conduct a systematic review on the impact of epidemic emergencies on healthcare workers.

Second, we conducted a web-based longitudinal survey to examine the prevalence of psychopathological symptoms and burnout in a sample of Italian healthcare workers involved in the pandemic emergency, and to assess if these symptoms are predicted by specific work-related and personal characteristics, to better understand their specific trajectories, development, and duration in this population.

We assessed participants' working conditions, individual perception of the COVID-19 situation, stress, anxiety, depression, and insomnia symptoms, post-traumatic stress, state anger, and burnout levels. All these factors were evaluated three times at six-month intervals: at baseline or T0 (between May 9 and July 13, 2020, after the main peak of the COVID-19 outbreak in Italy), during the second wave or T1 (between December 5 and December 30, 2020), and after the third wave or T2 (between May 22 and July 9, 2021). Coping strategies and perceived social support were only measured at baseline and were used as possible predictors of mental health outcomes.

Considering the extraordinary circumstances and a lack of relevant literature at the time the study was planned, the research was exploratory in nature, but we expected to find high rates of mental health problems in accordance with our systematic review (Preti et al., 2020).

2. THE PSYCHOLOGICAL IMPACT OF EPIDEMIC AND PANDEMIC OUTBREAKS ON HEALTHCARE WORKERS: A SYSTEMATIC REVIEW[1]

2.1 Introduction

In the last 20 years, several outbreaks of novel infectious diseases occurred all over the world. Recent examples are the outbreak of severe acute respiratory syndrome (SARS) in 2002 and the 2009–2010 A/H1N1 influenza pandemic. Overall, pandemic situations require intense and immediate response in terms of healthcare, with thousands of healthcare workers, either directly (e.g., physicians, nurses) or indirectly (e.g., aides, laboratory technicians, and medical waste handlers) delivering care to patients, fighting at the frontline to address the challenges posed to healthcare systems by millions of patients infected.

Healthcare workers are thus facing critical situations that increase their risk of suffering for the psychological impact of dealing with several unfavorable conditions, with consequences that might span from psychological distress to mental health symptoms.

2.1.1 Why Is This Review Needed?

Healthcare workers responding to a pandemic outbreak are exposed to physical and psychological stressors that may result in severe mental health outcomes. Furthermore, healthcare workforces play a crucial role in successfully responding to a pandemic situation. In this sense, potential psychological negative consequences not only are detrimental to healthcare workers' wellbeing but may also reduce their ability to effectively address the health emergency.

[1] This chapter is based on a paper, published as:
Preti, E., Di Mattei, V., Perego, G., Ferrari, F., Mazzetti, M., Taranto, P., ... & Calati, R. (2020). The psychological impact of epidemic and pandemic outbreaks on healthcare workers: rapid review of the evidence. *Current Psychiatry Reports*, *22*(8), 1-22.

The worldwide spread of COVID-19 is challenging the capacity of response of healthcare systems, and policymakers need evidence to address the issue of psychological distress and mental health of healthcare workers, given their role in responding to the situation. WHO recommends rapid reviews of empirical evidence in these circumstances (WHO, 2017), in order to give recommendations that may help strengthening the response capacity of healthcare systems.

For this reason, we performed a review of empirical studies on the impact of epidemic and pandemic outbreaks on healthcare providers in terms of psychological distress and mental health. The present review aims at providing evidence on maladaptive psychological outcomes in healthcare workers facing epidemic/pandemic situations. Moreover, it aims to identify potential risk and protective factors for such maladaptive consequences.

2.2 Methods

2.2.1 Search Strategy and Selection Criteria

Following PRISMA guidelines, we systematically searched potentially eligible articles on PubMed, PsycINFO, and Web of Science databases on 30 March 2020. We used the following combinations of terms: “infect*”, “COVID*”, “SARS”, “influenza”, “flu”, “MERS”, “ebola”, “Mental”, “Psych*”, “Health Personnel”, “health worker”, “Medical Staff”, “Physician”, and “Nurses”. The full search strategy is available in Appendix A. We developed the following set of inclusion criteria for papers to be included in our review: (a) studies had to report on primary research; (b) studies had to be published in a peer-reviewed journal; (c) studies had to be written in English; (d) studies had to include data on healthcare providers’ mental health or psychological wellbeing or data on factors associated with healthcare providers’ mental health or psychological wellbeing during epidemic/pandemic (i.e., SARS, Middle East respiratory syndrome - MERS-CoV, COVID-19, ebola virus disease - EVD, and influenza A - A/H1N1 and A/H7N9).

Excluding criteria were as follows: (a) qualitative studies; (b) studies focused on distress prevention programs during epidemic/pandemic; (c) studies focused on emergency situations not related to epidemic/pandemic (i.e., wars, natural disasters, and terroristic attacks).

We removed duplicates through Zotero software version 5.0. In the first stage, four independent researchers screened titles and abstracts of the papers we found. In the second stage, the same researchers screened the full texts of all remaining studies to assess their eligibility. In both stages, disagreements were solved through discussion.

2.2.2 Data Extraction

The following data were extracted from each study: publication year, country of study, the type of epidemic/pandemic, participant information (number, occupation), design, assessment scales, time period of study, and main results on psychological outcomes.

To synthesize the data, we performed a qualitative synthesis of findings. We first described psychiatric and psychological difficulties of healthcare workers during and after epidemics/pandemics; then, we summarized risk and protective factors related to these psychological outcomes.

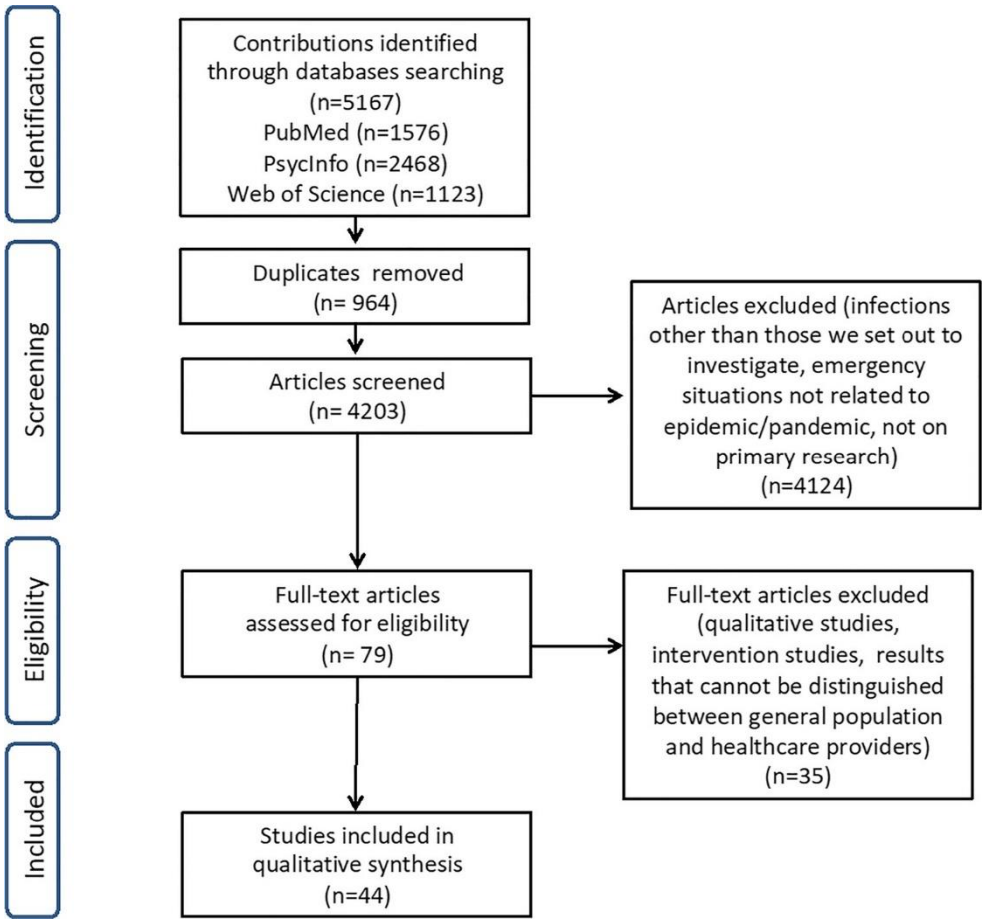
2.3 Results

2.3.1 Study Selection and Characteristics

Database search identified 5167 articles; after duplicate removal, 4203 potentially eligible studies remained. After reading titles and abstracts, we excluded 4124 studies; of the remaining 79 studies, 44 met inclusion criteria and were thus included for qualitative synthesis after full-text reading (see Figure 1 for study selection and Table 1 for a summary of the included studies).

Among the included studies, 27 (62%) referred to the SARS outbreak, 5 (11%) to the MERS-CoV outbreak, 5 (11%) to the COVID-19 outbreak, 3 (7%) to the A/H1N1 influenza outbreak, 3 (7%) to the EVD outbreak, and 1 (2%) to the A/H7N9 influenza outbreak.

Figure 1. Study selection.



The studies were conducted in different countries: China (19 studies), Canada (eight studies), Taiwan (seven studies), South Korea (two studies), Saudi Arabia (two studies), Greece (one study), Nigeria (one study), Sierra Leone (one study), Liberia (one study), Singapore (one study), and Japan (one study).

Thirty-four studies (77%) considered only healthcare workers, namely, physicians, nurses, and auxiliaries, whereas both healthcare workers and other staff members such as clerks and technicians were included in ten studies (23%).

All the studies investigated psychological outcomes by means of both validated questionnaires and interviews and/or study-specific measures.

Table 1. Characteristics of included studies.

Authors, year, country	Epidemic/pandemic	Participants	Design	Measures	Time of measurement	Main results on psychological outcomes
Alsubaie et al., 2019 (SAUDI ARABIA)	MERS-CoV	516 HCWs (284 physicians, 164 nurses, and 68 technicians, respiratory therapists)	Cross-sectional	SSM: Knowledge and HCWs reaction to MERS-CoV; Anxiety (5-point Likert)	During the MERS-CoV outbreak	Non-physicians (vs. physicians): ↑ level of anxiety about contracting MERS-CoV and transmitting it to their family members
Bai et al., 2004 (TAIWAN)	SARS	338 staff members of psychiatric hospital (218 HCWs, 79 administrative personnel)	Cross-sectional	SSM: SARS-related stress reactions questionnaire	During the SARS outbreak	- 5% acute stress disorder symptoms - HCWs (vs.non-HCWS): ↑ insomnia, exhaustion, and uncertainty about the frequent modifications to infection control procedures. - Quarantine → acute stress disorder
Bukhari et al., 2016 (SAUDI ARABIA)	MERS-CoV	386 staff members (293 nurses, 34 physicians, 19 healthcare assistants, 12 medical interns, 12 respiratory therapists, 8 radiology technicians, 2 dieticians, 1 faculty member, 1 pharmacist, 1 secretary, 3 other medical staff)	Cross-sectional	SSM: perception of exposure, perceived risk of infection, impact on personal and work life; IES (subscales)	During the MERS-CoV outbreak	- 56·7% no negative perceptions such as feeling nervous, anxious, or on edge, nor were they unable to stop or control their worrying - Worry about contracting MERS-CoV: 7·8% extremely worried; 20·5% very worried; 34·2% somewhat worried; 27·5% a little worried; 11·9% not worried - Worry about transmitting MERS-CoV to family: 12·2% extremely worried; 21% very worried; 29% somewhat worried; 26·7% a little worried; 11·1% not worried

						- HR HCWs (vs. non-HR HCWs), female (vs. male): ↑ worries and fear of contracting MERS-CoV
Chan et al., 2005 (CHINA)	SARS	1470 nurses (197 HR: SARS ward or ICUs; 135 MR: SARS ward with some contact with SARS; 1138 LR: no contact with SARS)	Cross-sectional	SSM: SARS Nurses' Survey Questionnaire	During the peak period of the SARS outbreak	- 52·6-63·5% good general health - 68·3-80·1% always/often perceived stress from SARS epidemic - Of those who always perceived stress: 50·7% average or poor health (vs. 39% of those who often perceived stress, 28·4% of those who sometimes perceived stress, 18·4% of those who never perceived stress) - MR nurses (vs. HR and LR): ↑ perceived stress; ↓ able to cope with stress
Chen et al., 2005 (TAIWAN)	SARS	128 nurses (65 working in HR units, 21 conscripted from LR units into HR units, 42 control LR)	Cross-sectional and case-control	IES; SCL-90-R	During the peak period of the SARS outbreak	- 11% stress reaction syndrome (IES >35), with the highest prevalence in the HR units - Conscripted nurses (vs. control and HR): ↑ PTS and psychopathological symptoms - HR nurses (vs. control): ↑ PTS (avoidance)

Chen et al., 200 (TAIWAN)	SARS	90 HCWs (66 critical care nurses, 11 physicians, 7 technicians, 6 respiratory care specialists) and 82 control subjects (53 administrators, 29 volunteers, assistants, or part-time workers)	Longitudinal and case-control	MOS SF-36	During the SARS outbreak at 2 time-points: immediately after caring for patients with SARS (t_0) and 4 weeks after self-quarantine and off-duty shifts (t_1)	- HCWs (vs. control) at t_0: ↓ role physical, bodily pain, vitality, role emotional, social functioning, and mental health; - HCWs t_1 (vs. t_0): ↑ social functioning, role emotional and role physical
Chong et al., 2004 (TAIWAN)	SARS	1257 staff members (676 nurses, 139 physicians, 140 health administrative workers, 302 other professionals including pharmacists, technicians, and respiratory therapists)	Cross-sectional	SSM: SARS exposure experience; IES; CHQ-12	6-week period during SARS outbreak: 727 evaluated in the initial phase and 530 in the repair phase	- 75·3% psychiatric morbidity (CHQ-12 cut-off = 2/3); initial phase: 71·3%; repair phase: 80·6% - Repair phase (vs. initial phase): ↑ depression, somatic symptoms, avoidance; ↓ anxiety
Chua et al., 2004 (CHINA)	SARS	271 HCWs, 342 healthy control subjects	Cross-sectional and case-control	SSM: a structured list of putative psychological effects of SARS; PSS-10	During the SARS outbreak	- HCWs (vs. control): ↑ positive psychological effects; LA stress
Fiksenbaum et al., 2006 (CANADA)	SARS	333 nurses	Cross-sectional	SSM: Perceived SARS threat, performance feedback from other HCWs; SPOS; MBI-GS (emotional exhaustion subscale); STAXI (state anger subscale)	During the SARS outbreak	- Nurses-P (vs. NP), quarantine, lower organizational support → perceived SARS threat - Perceived SARS threat, lower organizational support: ↑ emotional exhaustion, state anger

Goulia et al., 2010 (GREECE)	A/H1N1 influenza	469 HCWs (209 nurses, 120 physicians, 59 allied, 81 auxiliary)	Cross-sectional	SSM: concerns and worries about the new pandemic; GHQ-28	During the A/H1N1 second outbreak	- 56·7% worry about the pandemic - 20·7% moderate psychological distress (GHQ-28 >5); 6·8% severe psychological distress (GHQ-28 >11) - Worry about the pandemic → psychological distress
Grace et al., 2005 (CANADA)	SARS	193 physicians	Cross-sectional	SSM: SARS-related attitudes and perception, coping, concerns, effects on personal relationships, changes to work	During the SARS second outbreak	- 18·1% perceived stress related to working during the SARS outbreak - Physicians-P (vs. NP): ↑ perceived stress
Ho et al., 2005 (CHINA)	SARS	- Sample 1: 82 SARS HCWs (26 doctors, 21 nurses, 35 auxiliary staff including anesthetists, medical social workers, and physiotherapists) - Sample 2: 97 HCWs SARS survivors (4 doctors, 51 nurses, 8 allied health professionals, 34 support staff)	Cross-sectional	- Sample 1 - SSM: SARS Fear Scale and Self-Efficacy Scale - Sample 2 - SSM: SARS Fear Scale; CGSE; CIES-R	- Sample 1: at the peak of the SARS outbreak - Sample 2: three months after the peak	- Sample 1 (vs. sample 2): ↑ fear of infection; ↓ fear of health problems and discrimination - Low self-efficacy: ↑ SARS-related fear - In sample 2: SARS-related fear → PTS symptoms
Ji et al., 2017 (SIERRA LEONE)	EVD	143 HCWs (59 SL medical staff, 21 SL logistic staff, 22 SL medical students, 41 Chinese medical staff), 18 survivors	Cross-sectional	SCL-90-R	During EVD outbreak; only for Chinese medical staff: at arrival in SL and before	- Psychopathology from high to low (range 0-4): EVD survivors (2·31 ± 0·57), SL medical staff (1·92 ± 0·62), SL logistic staff (1·88 ± 0·68), SL medical students (1·68 ± 0·73), Chinese medical staff (1·25±0·23)

					departure (5-week period)	- Chinese medical staff at arrival (vs. at departure): LA psychopathology
Lai et al., 2020 (CHINA)	COVID-19	1257 HCWs (493 physicians, 764 nurses, among which 522 HCWs-P, 735 HCWs-NP; 760 HCWs working in Wuhan, 261 in Hubei province, 236 outside Hubei province)	Cross-sectional	PHQ-9, GAD-7, ISI, IES-R	During COVID-19 outbreak	- 50·4% depressive symptoms (PHQ-9 ≥5) - 44·6% anxiety symptoms (GAD-7 ≥5) - 34% insomnia symptoms (ISI ≥8) - 71·5% PTS symptoms (IES-R ≥9) - Nurses (vs. physicians), female (vs. male), HCWs-P (vs. NP), HCWs working in Wuhan (vs. outside Hubei) and in secondary hospital (vs. tertiary): ↑ psychopathological symptoms
Lancee et al., 2008 (CANADA)	SARS	139 HCWs (103 nurses, 15 clerical staff, 21 various hospital staff)	Cross-sectional	SSM: perception of the SARS-related adequacy of training, protection, and support; CAPS; SCID-I (excl. psychosis and PTSD)	One to two years after the Toronto SARS outbreak	- Lifetime prevalence of at least one psychiatric disorder: 30% - Incidence of new episodes of a psychiatric disorder after SARS: 5% - History of psychiatric disorders, less years of experience → new episodes of psychiatric disorders - Perceived adequacy of training and support by the hospital: ↓ new episodes of psychiatric disorders

Lee et al., 2007 (CHINA)	SARS	96 survivors: 63 non-HCWs, 33 HCWs	Cross-sectional and case-control	PSS-10; DASS21; IES-R; GHQ-12	One year after the SARS outbreak	- HCWs (vs. non-HCWs): ↑ stress, anxiety, depressive, and PTS symptoms; ↑ psychiatric morbidity rate (GHQ-12 ≥3: 90% vs. 49%)
Lee et al., 2018 (SOUTH KOREA)	MERS	359 hospital workers (5% doctor, 29·4% technician, 34·6% nurse, 21·7% pharmacist; 17% administrative, 17% others)	Cross-sectional	IES-R	- First survey: during hospital shutdown for MERS outbreak - Second survey: for those who scored >25 on the IES-R, one month after shutdown was cleared	- First survey: 64·1% PTS symptoms (IES-R >18); 51·5% PTSD (IES-R >25) - Second survey (n=77): 54·5% PTS symptoms; 40·3% PTSD - MERS-related tasks (vs. unrelated task) at first survey: ↑ PTS
Li et al., 2015 (LIBERIA)	EVD	52 Liberian HCWs (16 nurses, 36 hygienists)	Cross-sectional	SCL-90-R	During EVD outbreak in Liberia	- Male (vs. female), cleaning and disinfection HCWs (vs. treatment and observation ward HCWs): ↑ psychopathological symptoms
Li et al., 2020 (CHINA)	COVID-19	526 nurses (234 frontline and 292 non-frontline) and 214 general public	Cross-sectional	SSM: vicarious traumatization	During COVID-19 outbreak	- Frontline nurses (vs. non-frontline and general public): ↓ vicarious traumatization - Non-frontline (vs. general public): LA vicarious traumatization
Liang et al., 2020 (CHINA)	COVID-19	59 HCWs (23 doctors, 36 nurses)	Cross-sectional	SDS, SAS	During COVID-19 outbreak	- HR HCWs (vs. LR): LA anxiety and depressive symptoms

Lin et al., 2007 (TAIWAN)	SARS	92 HCWS: - 66 doctors and nurses of the ED (HR); - 26 doctors and nurses of the psychiatric ward (MR).	Cross-sectional	SSM: SARS severity of stress; DTS-C; CHQ-12	During the month after the end of the SARS outbreak	- 93·5% considered SARS "stressful" - 19·3% PTSD symptoms (DTS-C >40) - 47·78% minor psychiatric morbidity (CHQ-12 ≥3) - HR HCWs (vs. MR): ↑ PTSD symptoms; LA minor psychiatric morbidity
Liu et al., 2012 (CHINA)	SARS	549 hospital employees	Cross-sectional	SSM: exposure to SARS, exposure to traumatic events, during-outbreak SARS-related risks perception, current high-stress job; CES-D; IES-R	Three years after SARS outbreak	- 8·8% high depressive symptoms level (CES-D >24) - Younger age, being single, exposure to other traumatic events, during-outbreak quarantine, perceived SARS-related risk: ↑ depressive symptoms - During-outbreak altruistic acceptance of risk: ↓ depressive symptoms
Liu et al., 2020 (CHINA)	COVID-19	1563 HCWs	Cross-sectional	PHQ-9, GAD-7, ISI, IES-R	During the COVID-19 outbreak	- 50·7% depressive symptoms (PHQ-9 ≥5) - 44·7% anxiety symptoms (GAD-7 ≥8) - 36·1% insomnia symptoms (ISI ≥8) - 73·4% PTS symptoms (IES-R ≥9)
Lu et al., 2006 (TAIWAN)	SARS	127 HCWs who had worked with suspected SARS patients (24 physicians, 49 nurses, 54 technicians/attendants)	Cross-sectional	PBI; EPQ; CHQ-12	During the SARS outbreak, but after its main outbreak	- 17·3% psychiatric morbidity (CHQ-12 ≥3) - Dysfunctional maternal attachment, neuroticism: ↑ psychiatric morbidity

Lung et al., 2009 (TAIWAN)	SARS	123 HCWs who had worked with suspected SARS patients (22 physicians, 48 nurses, 53 technicians/attendants)	Longitudinal	Study 1 (Lu et al., 2006): PBI; EPQ; CHQ-12 Study 2 (Lung et al., 2009): CHQ-12 SSM: daily-life stressful events in the past year	One year after the SARS outbreak	- 15·4% psychiatric morbidity (CHQ-12 ≥3) - Psychiatric morbidity at t_0 → psychiatric morbidity at t_1 - Daily-life stressful events in the year following the outbreak, neuroticism: ↑ psychiatric morbidity at t_1
Marjanovic et al., 2007 (CANADA)	SARS	333 nurses	Cross-sectional	SSM: avoidance behavior scale, vigor scale, trust in equipment/infection control, contact with SARS patients, time spent in quarantine; MBI-GS (emotional exhaustion subscale); STAXI; adaptation of SPOS	During the SARS outbreak	- Vigor, organizational support, trust in equipment/infection control: ↓ avoidance behavior, emotional exhaustion, state anger - Quarantine: ↑ avoidance behavior, state anger. - Nurses-P (vs. NP): ↑ emotional exhaustion
Matsuishi et al., 2012 (JAPAN)	A/H1N1 influenza	1625 hospital staff (218 physicians, 864 nurses, 543 other employees)	Cross-sectional	SSM: stress-related questions; IES-R	One month after the peak of the H1N1 outbreak	- HR area (vs. LR): ↑ PTS, infection anxiety, exhaustion - Physicians (vs. other): ↓ PTS, infection anxiety - Nurses (vs. other): ↑ exhaustion

Maunder et al., 2004 (CANADA)	SARS	1557 hospital staff (430 nurses, 117 clerical, 117 research laboratory, 115 physician, 112 administration, 106 clinical laboratory, 48 social work, 45 occupational therapy/physiotherapy, 43 pharmacy, 27 clinical assistant, 26 housekeeping, 32 other clinical jobs, 80 other nonclinical jobs, 259 other jobs)	Cross-sectional	SSM: 76 items probing attitudes toward SARS; IES	During the SARS outbreak	- Nurses (vs other), HCWs-P (vs. NP): ↑ PTS - Fear for one's health and the health of others, social isolation and avoidance, and job-related stress fully mediated the traumatic response to SARS
Maunder et al., 2006 (CANADA)	SARS	587 HR HCWs, 182 LR HCWs Survey A: 769 (73·5% nurses, 8·3% clerical staff, 2·9% physicians, 2·3% respiratory therapists, 12·9% other job types) Both survey A and B: 187	Cross-sectional and case-control	Survey A: SSM: changes in work (hours and face-to-face contact), increase in smoking, drinking alcohol, or "other activities that could interfere with work or relationships", number of missed work shifts; IES; K10; MBI-EE Survey B: SSM: perception of stigma and interpersonal avoidance, adequacy of training, protection, and support, job stress; WCQ	13-26 months after the SARS outbreak	- HR HCWs (vs. LR): ↑ burnout, psychological distress, PTS, substance use, other maladaptive behaviors and days off work; ↓ patient contact and work hours - Maladaptive coping → burnout, psychological distress, PTS - Training, support and protection: ↓ burnout, PTS

				(subscales); ECR-R (anxiety and attachment avoidance scales)		
McAlonan et al., 2007 (CHINA)	SARS	T_0: 106 HR HCWs (who worked in SARS isolation units), 70 LR HCWs (who worked in psychiatric inpatient units) T_1: 71 HR HCWs, 113 LR HCWs	Longitudinal and case-control	T_0: PSS-10 T_1: PSS-10; DASS-21; IES-R	At the peak of the SARS outbreak (t_0) and one year later (t_1)	- HR HCWs (vs. LR) at t_0: ↑ fatigue, poor sleep, worry about health, fear of social contact - HR HCWs (vs. LR) at t_1: ↑ stress, depression, anxiety - Time (t_0 vs. t_1) x risk (HR vs. LR): decrease in stress for LR HCWs and increase in stress for HR HCWs
Mohammed et al., 2015 (NIGERIA)	EVD	117 survivors of EVD, contacts or relatives of a known case of EVD (45 HCWs, 38·5%)	Cross-sectional	GHQ-12; OSS	During the EVD outbreak	- HCWs (vs. non-HCWs): ↓ psychological morbidity (feeling unhappy or depressed)
Nickell et al., 2004 (CANADA)	SARS	1983 hospital staff (173 physicians, 476 nurses, 615 allied HCWs, 593 workers not involved in patient care). Only 510 workers received the GHQ-12	Cross-sectional	SSM: concerns about SARS, use and effects of SARS precautionary measures; GHQ-12	During the peak of the initial phase of the SARS outbreak	- 29% minor psychiatric morbidity (GHQ-12 >3) - 62·7-64·7% SARS-related concern for personal-family health - Stigma, perceived risk of death, lifestyle affected by SARS, reduced trust in precautionary measures →

						concern for personal or family health - Nurses, part-time job, lifestyle affected by SARS, job ability affected by precautionary measure → psychological morbidity
Park et al., 2018 (SOUTH KOREA)	MERS-CoV	187 nurses working in HR areas for the MERS-CoV	Cross-sectional	SSM: MERS-CoV stigma scale; MOS SF-36; PSS-10; DRS-15	During the MERS-CoV outbreak	- Hardiness: ↑ mental health (both directly and indirectly via perceived stress) - Stigma: ↓ mental health (both directly and indirectly via perceived stress)
Phua et al., 2005 (SINGAPORE)	SARS	96 ED HCWs (38 physicians and 58 nurses) who cared for SARS patients	Cross-sectional	COPE; GHQ-28; IES	Six months after the end of the SARS outbreak	- 17·7% PTS symptoms (IES ≥26) - 18·8% psychiatric morbidity (GHQ-28 ≥5) - Less functional coping strategies→ psychiatric morbidity
Son et al., 2019 (CHINA)	MERS	280 hospital workers (153 HCWs, 127 non-HCWs)	Cross-sectional and case-control	IES-R; CD-RISC; SSM (5-point Likert scale): willingness to work; SSM (5-point Likert scale): perceived risk of the disease; SSM (9-point Likert scale): negative emotional experience	One month after the end of the MERS outbreak announced by the public health authority	- 18·6% PTSD (IES-R ≥22) - HCWs (vs. non-HCWs): ↑ PTSD and negative emotional experience - Perceived risk, negative emotional experience: ↑ PTSD
Styra et al., 2008 (CANADA)	SARS	248 HCWs: 160 from HR units (120 ICU, 24 SARS units, 16 ED); 88 from LR units	Cross-sectional and case-control	SSM: personal risk perception, perception of risk to others, confidence in infection control measures, confidence in information about	Three-four months after SARS outbreak in Toronto	- Risk perception, depressive affect, SARS impact on work life, HR units (vs. LR), caring for only one SARS patient → PTS symptoms

				SARS, impact on personal life, impact on work life, depressive affect; IES-R		
Su et al., 2007 (CHINA)	SARS	102 nurses: 70 from SARS units (44 regular units; 26 SARS ICU), 32 from non-SARS units (17 from CCU; 15 from NU)	Longitudinal (one-month study)	Weekly: SSM only for SARS units nurses: attitude scale towards SARS (knowledge and understanding, perceived negative feelings, positive attitudes towards patients); BDI; STAI; DSM-IV insomnia; PSQI Biweekly: DTS-C At baseline and at the end of the study (only for SARS units nurses): SDS; modified Family APGAR index One month after the end of the study: MINI	During SARS outbreak	- SARS-unit nurses (vs. non-SARS): ↑ symptomatic depression (38·5% vs. 6·7%), insomnia (37·1% vs. 9·4%); LA PTSD - Time effect: ↓ depression, PTSD, sleep disturbance, impairment in life, perceived negative feelings of SARS; ↑ positive attitudes towards SARS patients - Time x group effect: decrease in anxiety and sleep disturbance in SARS units (vs. non-SARS units)
Tam et al., 2004 (CHINA)	SARS	652 frontline HCWs (62% nurses; 24% HC assistants; 3% medical professionals)	Cross-sectional	SSM: subjective job-related stress before, during and after the outbreak, coping behaviors, adequacy of various support items, positive and negative	Near the end of SARS outbreak	- 68% significant/severe job-related stress - 56·7% psychiatric morbidity (GHQ-12 ≥3) - Nurse (vs. other), female (vs. male), poor self-rated physical health (vs. fair/good),

				perspectives of the outbreak; GHQ-12		unwillingness to work in SARS units, job-related stress, inadequate support in the workplace → psychiatric morbidity
Tang et al., 2017 (CHINA)	A/H7N9 influenza	102 HCW exposed to H7N9 patients (26 doctors, 62 nurses, 14 interns) from three units: respiratory department (N=20), ED (N=21), ICU (N=61)	Cross-sectional	PCL-C	From 2 to 3 years after the beginning of H7N9 outbreak	- 20·59% PTS symptoms (PCL-C ≥38) - Nurse (vs. doctor), female (vs. male), younger age (21-30 years vs. > 30 years), intermediate and sub-senior titles (vs. primary), work experience < 5 years (vs. > 5 years), HCWs-P (vs. NP), no training (vs. training): ↑ PTS symptoms
Tham et al., 2005 (CHINA)	SARS	96 ED HCWs (38 doctors; 58 nurses)	Cross-sectional	IES-R; GHQ 28	6 months after SARS outbreak	-17·7% PTS symptoms (IES-R ≥26) (doctors: 13·2%; nurses: 20·7%) - 18·8% psychiatric morbidity (GHQ-28 ≥5) (doctors: 15·8%; nurses: 20·7%)
Wong et al., 2005 (CHINA)	SARS	466 ED HCWs (123 doctors, 257 nurses, 82 HCAs) from different public hospitals	Cross-sectional	- SSM (single-item, 10-point Likert scale): level of perceived stress at the time of the survey - SSM (4-point Likert scale): 6 sources of stress (health of self, health of family/others, virus spread, vulnerability/loss of control, changes in work, being isolated)	Immediately after the end of SARS outbreak	- Perceived stress: highest score for nurses (M=6·52), followed by doctors (M=5·91) and HCA (M=5·44) - Nurses (vs. HCAs): ↑ perceived stress - HCAs (vs. doctors): ↑ worries about health of family/others

				- Brief-COPE		
Wong et al., 2010 (CHINA)	A/H1N1 influenza	267 community nurses	Cross-sectional	SSM: clinical services, internal environment and macro-environmental changes as a response H1N1 influenza; professional and public health responsibilities with respect to H1N1 influenza; willingness to continue to work during H1N1 influenza	During H1N1 influenza outbreak	- 33·3% "not willing" and 43·6% "not sure" about caring for H1N1 patients - Perceived stress, infection-related worries, dissatisfaction about hospital management → unwillingness to work
Wu et al., 2009 (CHINA)	SARS	549 hospital employees (20·7% doctors; 37·6% nurses; 22·1% technicians; 19·6% administrative + other hospital staff)	Cross-sectional	SSM: SARS outbreak exposures (work exposure, quarantining, relative or friend got SARS), media exposure, other potentially traumatic events pre-SARS and post-SARS exposure, during-outbreak risk perception; altruistic acceptance of the risk, current fear of future SARS outbreaks; modified IES-R	3 years after SARS outbreak	- 10% PTS symptoms (IES-R ≥20) during the 3 years after SARS (HR units: 46·9%) - SARS exposure (work exposure, quarantining, relative or friend got SARS), during-outbreak perceived risk: ↑ PTS symptoms since SARS - Risk perception partially mediated the relationship SARS exposure-PTS symptoms - Altruistic acceptance of risk: ↓ PTS symptoms since SARS, current fear of SARS

Xiao et al., 2020 (CHINA)	COVID-19	180 medical staff members (82 doctors, 98 nurses)	Cross-sectional	SSRS; SAS; GSES; SASR; PSQI	1-2 months after the beginning of COVID-19 outbreak	- Low sleep quality (PSQI = 8·58 ± 4·567) in the sample - Social support: ↓anxiety, stress; ↑ self-efficacy - Social support: no direct effect on sleep quality > anxiety, stress, self-efficacy mediated the relationship social support-sleep quality

MERS-CoV=Middle East respiratory syndrome coronavirus infection. HCWs=healthcare workers. SSM=study-specific measure. SARS=Severe Acute Respiratory Syndrome. IES=Impact of Event Scale. HR=high-risk. ICUs=intensive care units. MR=moderate-risk. LR=low-risk. SCL-90-R=Symptom Checklist-90-Revised. PTS=post-traumatic stress. MOS SF-36=Medical Outcomes Study Short-Form 36. CHQ-12=Chinese Health Questionnaire-12. PSS-10=Perceived Stress Scale-10. LA=lack of association. SPOS=Survey of Perceived Organizational Support. MBI-GS=Maslach Burnout Inventory-General Survey. STAXI=State-Trait Anger Expression Inventory. P=contact with affected patients. NP=no contact with affected patients. GHQ-28=General Health Questionnaire-28. CGSE=Chinese General Self-Efficacy Scale. CIES-R=Chinese version of Impact of Event Scale-Revised. EVD=Ebola Viral Disease. SL=Sierra Leone. PHQ-9=Patient Health Questionnaire-9. GAD-7=Generalized Anxiety Disorder-7. ISI=Insomnia Severity Index. IES-R=Impact of Event Scale-Revised. CAPS=Clinician Administered PTSD scale. SCID-I=Structured Clinical Interview for DSM-IV Axis I Disorders. PTSD=post-traumatic stress disorder. DASS-21=Depression Anxiety Stress Scales. SDS=Self-Rating Depression Scale. GHQ-12=General Health Questionnaire-12. SAS=Self-Rating Anxiety Scale. ED=emergency department. DTS-C=Davidson Trauma Scale-Chinese version. CES-D=Center for Epidemiologic Studies Depression Scale. PBI=Parental Bonding Instrument. EPQ=Eysenck Personality Questionnaire. K10=Kessler Psychological Distress Scale. MBI-EE=Maslach Burnout Inventory-Emotional Exhaustion scale. WCQ=Ways of Coping Questionnaire. ECR-R=Experiences in Close Relationships-Revised questionnaire. OSS=Oslo Social Support scale. DRS-15=Dispositional Resilience Scale-15. COPE=Coping Orientation to Problems Experienced. CD-RISC=Connor–Davidson Resilience Scale. CCU=coronary care unit. NU=neurology unit. BDI=Beck Depression Inventory. STAI=State-Trait Anxiety Inventory. DSM-IV=Diagnostic and Statistical Manual of Mental Disorders-IV. PSQI=Pittsburgh Sleep Quality Index. MINI=Mini International diagnosis for Neuropsychiatric Interview. PCL-C=PTSD Checklist-Civilian Version. HCAs=healthcare assistants. SSRS=Social Support Rate Scale. GSES=General Self-Efficacy Scale. SASR=Stanford Acute Stress Reaction.

Table 2. Description of studies results classified by psychological outcomes.

Psychological outcomes	Studies	Measures	Prevalence rates	Associations with other psychological outcomes	Case-control studies	Longitudinal studies
PTS symptoms	22 studies (Bai et al., 2004; Chen et al., 2005; Chong et al., 2004*; Ho et al., 2015*; Lai et al., 2019; Lancee et al., 2008*; Lee et al., 2007*; Lee et al., 2018; Lin et al., 2007; Liu et al., 2012*; Liu et al., 2020; Matsuishi et al., 2012; Maunder et al., 2004*; Maunder et al., 2006; McAlonan et al., 2007*;Phua et al., 2005; Son et al., 2019*; Styra et al., 2008; Su et al., 2007; Tang et al., 2017; Tham et al., 2005; Wu et al., 2009)	CAPS, CIES-R, DTS-C, IES, IES-R, PCL-C	- During the outbreak (Chen et al., 2005; Lai et al., 2019; Lee et al., 2018; Liu et al., 2020): 11-73·4% - 1 month after the end of the outbreak (Lin et al., 2007; Son et al., 2019; Su et al., 2007):18·6%-28·4% - 6 months after the end of the outbreak (Phua et al. 2005; Tham et al., 2005): 17·7% - From 1 to 3 years after the end of the outbreak (Maunder et al., 2006; Tang et al.,	Positive association: depressive symptoms (Liu et al., 2012), current fear of SARS (Wu et al., 2009)	- Significant higher PTS symptoms level in HCWs compared to non-HCWs (Su et al., 2007; Son et al., 2019)	- After 1 month: significant reduction in PTS symptoms level (Li et al., 2020)

			2017; Wu et al., 2009): 10-20·59%			
Vicarious traumatization	1 study (Li et al., 2020*)	SSM			- Significantly lower levels of vicarious traumatization in front-line nurses than the control group; no significant difference between non-front-line nurses and controls (Tsai et al., 2015)	
Depressive symptoms	7 studies (Lai et al., 2019; Lee et al., 2007*; Liang et al., 2020; Liu et al., 2012; Liu et al., 2020*; McAlonan et al., 2007; Su et al., 2007*)	BDI, CES-D, DASS-21, PHQ-9, SDS, SSM	- During the outbreak (Lai et al., 2019; Liu et al., 2020; Su et al., 2007): 27·5-50·7% - 3 years after the end of the outbreak (Liu et al., 2012): 8·8%-14%	Positive association: PTS symptoms (Styra et al., 2008)	- Significantly higher depressive symptoms level in HCWs SARS survivors compared to non-HCWs survivors (Lee et al., 2007)	- After 1 month: significant reduction in depression level (Su et al., 2007)
Insomnia symptoms	5 studies **(**Bai et al., 2004*; Lai et al., 2019 ; Liu et al., 2020; Su et al., 2007; Xiao et al., 2020*)	DSM-IV insomnia criteria, ISI, PSQI, SSM	- During the outbreak (Lai et al., 2019; Liu et al., 2020; Su et al., 2007): 28·4-36·1%		- Significantly higher insomnia in HCWs compared to non-HCWs (Bai et al., 2004)	- After 1 month: significant improvement in sleep-quality (Su et al., 2007)
Anxiety symptoms	7 studies (Lai et al., 2019 ; Lee et al., 2007; Liang et al., 2020; Liu et al., 2012*; Liu et al.,2020*; McAlonan et al., 2007; Su et al., 2007*)	DASS-21, GAD-7, STAI, SAS	- During the outbreak (Lai et al., 2019; Liu et al., 2020): 44·6-44·7%	Positive association: distress (Xiao et al.,2020)	- Significantly higher anxiety level in HCWs SARS survivors compared to non-HCWs survivors (Lee et al., 2007)	- After 1 month: significant reduction in anxiety scores (Su et al., 2007)

			- 1 year after the end of the outbreak 17 (Lee et al., 2007): 14-36·7%	Negative association: sleep quality, self-efficacy (Xiao et al., 2020)		
Psychiatric morbidity/general psychological distress	18 studies (Chen et al., 2005*; Chen et al., 2007; Chong et al., 2004; Goulia et al., 2010; Ji et al., 2017; Lancee et al., 2008; Lee et al., 2007; Li et al., 2015; Lin et al., 2007; Lu et al., 2006, Lung et al., 2009*; Maunder et al., 2006*; Mohammed et al., 2015; Nickell et al., 2004; Park et al., 2018*; Phua et al., 2005*; Tam et al., 2004*; Tham et al., 2005)	CHQ-12, GHQ-12, GHQ-28, K10, SF-36, SCID-I, SCL-90-R	- During the outbreak (Chong et al., 2004; Ghoulia et al., 2010; Lu et al., 2006; Nickell et al., 2004; Tam et al., 2004): 17·3-75·3% - 1 month after the end of the outbreak (Lin et al., 2007): 47·7% - 6 months after the end of the outbreak (Phua et al., 2005; Tham et al., 2005): 18·8% - 1 year after the outbreak (Lung et al., 2009): 15·4%		- Significant higher levels of psychiatric morbidity in HCWs SARS survivors compared to non-HCWs survivors (Lee et al., 2007) - Significant lower scores in role physical, bodily pain, vitality, role emotional, social functioning and mental health subscales in HCWs compared to controls (Chen et al., 2007) - Significant lower GHQ-12 scores in HCWs EVD survivors compared to non-HCWs survivors (Mohammed et al., 2015)	- Differences between CHQ first-stage and second-stage scores were not evaluated; first stage CHQ symptoms had a positive direct effect on the second stage results (Lung et al. 2009) - After 1 month: significant improvement in social functioning, role emotional and role physical scores (Chen et al., 2007)

Perceived stress	12 studies (Chan et al., 2005*, Chua et al., 2004*, Grace et al., 2005*, Lee et al., 2007, Lin et al., 2007*, Matsuishi et al., 2012*, McAlonan et al., 2007; Park et al., 2018; Tam et al. 2004*, Wong et al., 2005; Wong et al. 2010; Xiao et al., 2020)	PSS-10, SASR, SSM	- During the outbreak (Chan et al., 2005; Grace et al., 2005; Tam et al., 2004): 18·1%-80·1% - 1 month after the end of the outbreak (Lin et al., 2007): 4·3-47·8%	Positive association: depression (McAlonan et al., 2007), anxiety (McAlonan et al., 2007, Su et al., 2007), PTS symptoms (Lin et al., 2007) Negative association: general health (Chan et al., 2005), sleep quality (Su et al., 2007; Xiao et al., 2019), willingness to work (Wong et al., 2010)	- Significantly higher stress levels in HCWs compared to non-HCWs (Lee et al., 2007) - Nonsignificant differences in stress levels between HCWs and controls (Chua et al., 2004)	- After 1 year: significant decrease in stress for LR-HCWs; significant increase in stress for HR-HCWs (McAlonan et al., 2007)
Infection-related worries	5 studies (Alsubaie et al., 2019; Bukhari et al., 2016; Goulia et al., 2010*; Grace et al., 2005*; Nickell et al., 2004)	SSM	- During the outbreak (Bukhari et al., 2016; Nickell et al., 2004): 7·5%-64·7% - 1 month after the end of the outbreak (Goulia et al., 2010): 56·7%	Negative association: willingness to work (Wong et al., 2010)		
Burnout	3 studies (Fiksenbaum al., 2006; Marjanovic et al., 2007*; Maunder et al., 2006*)	MBI-GS, SSM	- From 1 to 2 years after the end of the outbreak		- Significantly higher exhaustion level in HCWs compared to	

			(Maunder et al., 2006): 30·4%		non-HCWs (Bai et al., 2004)	

* No reported prevalence rates

PTS=post-traumatic stress. CAPS=Clinician Administered PTSD scale. CIES-R=Chinese version of Impact of Event Scale-Revised. IES=Impact of Event Scale. IES-R=Impact of Event Scale-Revised. DTS-C=Davidson Trauma Scale-Chinese version. PCL-C=PTSD Checklist-Civilian Version. SARS=Severe Acute Respiratory Syndrome. HCWs=health-care workers. SSM=study-specific measure. BDI=Beck Depression Inventory. CES-D=Center for Epidemiologic Studies Depression Scale. DASS-21=Depression Anxiety Stress Scales. PHQ-9=Patient Health Questionnaire-9. SDS=Zung Self-Rating Depression Scale. DSM-IV=Diagnostic and Statistical Manual of Mental Disorders-IV. ISI=Insomnia Severity Index. PSQI=Pittsburgh Sleep Quality Index. GAD-7=Generalized Anxiety Disorder-7. STAI=State-Trait Anxiety Inventory. SAS=Self-Rating Anxiety Scale. CHQ-12=Chinese Health Questionnaire-12. GHQ-12=General Health Questionnaire-12. GHQ-28=General Health Questionnaire-28. K10=Kessler Psychological Distress Scale. SF-36=Short-form 36. SCID-I=Structured Clinical Interview for DSM-IV Axis I Disorders. SCL-90-R=Symptom Checklist-90-Revised. EVD=Ebola Viral Disease. PSS-10=Perceived Stress Scale-10. SASR=Stanford Acute Stress Reaction. LR-HCWs=low-risk health-care workers. HR-HCWs=high-risk health-care workers. MBI-GS=Maslach Burnout Inventory-General Survey.

2.3.2 Psychopathological Symptoms

Post-traumatic Stress Symptoms

Post-traumatic stress reactions were examined in 23 studies (Bai et al., 2004; Chen et al., 2005; Chong et al. 2004; Ho et al. 2005; Lai et al., 2019; Lancee et al., 2008; Lee et al., 2007; Lee et al., 2018; Lin et al., 2007; Liu et al., 2012; Liu et al., 2020; Matsuishi et al., 2012; Maunder et al., 2004; Maunder et al., 2006; McAlonan et al., 2007; Phua et al., 2005; Son et al., 2019; Styra et al., 2008; Su et al., 2007; Tang et al., 2017; Tham et al., 2005; Wu et al., 2009).

See Table 2 for a detailed description of psychological outcomes included in each study and their findings.

During outbreaks, the prevalence of PTSD-like symptoms was comprised between 11 and 73.4%. Moreover, 51.5% of healthcare workers scored above the Impact of Event Scale-Revised (IES- R) threshold for a PTSD diagnosis (Chen et al., 2005; Lai et al., 2019; Lee et al., 2018; Liu et al., 2020). Studies on the COVID-19 pandemic (Lai et al., 2019; Liu et al. 2020) reported the highest prevalence rate (71.5–73%). In contrast, only 5% of the staff members of a psychiatric hospital met the DSM-IV criteria for an acute stress disorder during the SARS outbreak (Bai et al., 2004). However, the authors underlined that the specific type of institution they considered limits the generalizability of this result (Bai et al., 2004).

Other studies examined PTSD manifestations after the end of the outbreaks. Findings suggest that from 18.6 to 28.4% of healthcare workers still have significant PTSD symptoms after one month from the end of the pandemic (Lin et al., 2007, Son et al.2019; Su et al.2007), 17.7% after 6 months (Phua et al., 2005; Tham et al., 2005), and 10–40% after 1–3 years (Maunder et al., 2006;

Tang et al., 2017; Wu et al., 2009). Two case-control studies observed that healthcare workers showed a significant higher post-event morbidity to outbreak exposure, compared with non-healthcare workers (Lee et al., 2017; Son et al., 2019).

Depression and Anxiety Symptoms

Depressive symptoms were examined in seven studies (Lai et al., 2019; Lee et al., 2007; Liang et al., 2020; Liu et al., 2012; Liu et al., 2020; McAlonan et al., 2007; Su et al., 2007). During the acute phase of pandemic, the prevalence of depressive symptomatology was between 27.5 and 50.7% in healthcare workers (Lai et al., 2019; Liu et al., 2020; Su et al., 2007), with higher rates during the COVID-19 pandemic (50.4–50.7%), compared with SARS outbreak (27.6%). Three years after the end of the Beijing SARS epidemic, about 14% of the interviewed hospital staff members still showed moderate depressive symptoms, and 8.8% reported high symptom levels (Liu et al., 2012).

Five studies specifically investigated insomnia and sleep quality (Bai et al., 2004; Lai et al. 2019; Liu et al., 2020; Su et al., 2007; Xiao et al., 2019). The DSM-IV criteria for insomnia were met in 28.4% of nurses, with the highest insomnia rate for the regular SARS unit (50%), followed by the SARS intensive care unit (23%), whereas no cases were found in non-SARS units (Su et al., 2007). Significant self-reported insomnia symptoms were observed in 34–36.1% of COVID-19 healthcare workers (Lai et al., 2019; Liu et al., 2020). Moreover, low sleep quality was reported by medical staff members treating COVID-19 patients (Xiao et al., 2019). Five studies investigated anxiety symptoms through standardized self-reported questionnaires during outbreaks (Lai et al., 2019; Liang et al., 2020 21; Liu et al., 2020; Su et al., 2007; Xiao et al., 2019), and two studies examined anxiety symptoms one year after pandemic resolution (Lee et al., 2007; McAlonan et al. 2007). Two extensive studies conducted during the peak phase of COVID-19 pandemic reported that about 45%

of healthcare workers presented severe anxiety symptoms (Lai et al., 2019; Liu et al., 2020). Among medical staff members treating COVID-19 patients, anxiety levels affected psychological wellbeing, by increasing levels of distress and decreasing sleep quality and self-efficacy (Xiao et al., 2019).

One study prospectively evaluated changes in anxiety symptoms in a sample of SARS nurses over time (Su et al., 2007). Findings suggest a significant reduction in both depressive and anxiety symptoms at one-month follow-up, as well as significant improvement in sleep quality.

In a case-control study, Lee and colleagues (2007) found significantly higher depressive and anxiety symptom levels among healthcare workers survivors compared with non- healthcare workers survivors one year after the end of the SARS epidemic.

Psychiatric Morbidity and General Psychological Distress

Eighteen studies investigated healthcare workers' mental health using screening measures of psychiatric symptoms and psychological distress and questionnaires of general health status (Chen et al., 2005; Chen et al., 2007; Chong et al. 2004; Goulia et al., 2010; Ji et al., 2017; Lancee et al. 2008; Lee et al., 2007; Li et al. 2015; Lin et al., 2007; Lu et al., 2006; Lung et al., 2009; Maunder et al., 2006; Mohammed et al., 2015; Nickell et al., 2004; Park et al., 2018; Phua et al., 2005; Tam et al., 2004, 2005).

Specifically, five studies investigated psychiatric symptoms during outbreaks through the General Health Questionnaire, reporting a considerable variability in prevalence rates, with a range comprised between 17.3 and 75.3% (Chong et al., 2004; Goulia et al., 2010; Lu et al., 2006; Nickell et al., 2004; Tam et al., 2004).

One month after the end of the SARS outbreak, 47.8% of hospital staff members showed psychiatric symptoms (Lin et al., 2007). Six months after the SARS epidemic, 18.8% of healthcare workers presented psychiatric symptoms (Phua et al., 2005; Tham et al., 2005).

Between one and two years after SARS resolution, the incidence of new episodes of psychiatric disorders (diagnosed with the SCID-I, excluding the psychotic disorders and PTSD) was of 5% in healthcare workers in Toronto (Lancee et al., 2008). Similarly, one year after the end of the SARS epidemic, 15.4% of the respondents still showed significant mental health symptoms (Lung et al., 2009).

One year after the end of the SARS outbreak, healthcare workers survivors had a sixfold increased risk for psychiatric symptoms, compared with non-healthcare workers survivors, even after controlling for age, sex, and education level (Lee et al., 2007). Conversely, in a study on EVD survivors, Mohammed and colleagues (2015) found that being a healthcare worker was a protective factor for depressive feelings.

2.3.3 Psychological Impact

Perceived Stress

Twelve studies investigated healthcare workers' perceived stress during outbreaks (Chan et al., 2005; Chua et al., 2004; Grace et al., 2005; Lee et al., 2007; Lin et al., 2007; Matsuishi et al., 2012; McAlonan et al., 2007; Park et al., 2018; Tam et al., 2004; Wong et al., 2005, 2010; Xiao et al., 2020). From 18.1 to 80.1% of healthcare workers reported high levels of work-related stress during the SARS outbreak (Chan et al., 2005; Grace et al., 2005; Tam et al., 2004).

Moreover, healthcare workers survivors reported higher perceived stress than survivors from the general population one year after the end of the SARS outbreak (Lee et al., 2007). Conversely, Chua and colleagues (2004) found no significant differences in perceived stress between healthcare workers and healthy control subjects after the SARS outbreak.

One prospective study (McAlonan et al., 2007) examined changes in perceived stress among high-risk and low-risk healthcare workers over time, from the peak of the SARS outbreak to one year after resolution. The authors observed a significant time x risk interaction effect, with a general trend toward a decrease of perceived stress for low-risk healthcare workers and an increase of perceived stress for high-risk healthcare workers.

Infection-Related Worries

Five studies specifically investigated healthcare workers' infection-related worries through non-standardized ad hoc measures (Alsubaie et al., 2019; Bukhari et al., 2016; Goulia et al., 2010; Grace et al., 2005; Nickell et al., 2004).

Nickell and colleagues (2004), in a study on a large sample of hospital staff members, found that 64.7% of the respondents expressed SARS-related concerns for personal health and 62.7% for family health during the peak phase of the outbreak. Bukhari and colleagues (2016) examined fears related to contracting and transmitting MERS-CoV in a sample of Saudi Arabian healthcare workers working during the outbreak. The authors found that from 7.8 to 20.5% of the respondents were extremely-very worried about contracting MERS-CoV over the past four weeks; from 12.2 to 21% of the sample reported to be extremely-very worried about transmitting the infection to family members or friends. One month after the end of the A/ H1N1 pandemic, Goulia and colleagues (Goulia et al.,

2010) found that 56.7% of their sample still expressed a moderately high level of concern about the disease.

Burnout

Three studies investigated healthcare workers' burnout reactions to outbreaks, specifically examining its emotional exhaustion component (Fiksenbaum et al., 2006; Marjanovic et al., 2007; Maunder et al., 2006). One to two years after the SARS outbreak, 30.4% of healthcare workers who had direct contact with infected patients still reported a high level of emotional exhaustion (Maunder et al., 2006)

Bai and colleagues (2004) found a significantly higher level of emotional exhaustion among SARS healthcare workers compared with non-healthcare workers. However, the authors measured emotional exhaustion through a single item.

2.3.4 Risk and Protective Factors

Detailed results regarding risk and protective factors for the aforementioned mental health outcomes are reported in Table 3. As shown, sociodemographic factors, such as gender, age, education, marital status, and having children, as well as their association with mental health outcomes, were extensively investigated. However, results are mixed (see Table 3).

Some studies investigated the role of personal variables, such as personality, attachment styles, coping strategies, and clinical features, on mental health outcomes. Specifically, neuroticism (Lu et al., 2006; Lung et al., 2009), dysfunctional attachment (Lu et al., 2006; Maunder et al., 2006), and maladaptive coping (Maunder et al., 2006; Phua et al., 2003) were found to be risk factors for mental

health outcomes. Additionally, resilience indicators (i.e., hardiness, vigor) (Marjanovic et al., 2007, Park et al., 2018) and self-efficacy (Ho et al., 2005, Xiao et al., 2020) were protective factors for mental health outcomes.

Few retrospective studies found that having a past psychiatric history (Lancee et al., 2008; Su et al., 2007) and reporting traumatic and stressful life events (Liu et al., 2012; Lung et al., 2009; Wu et al., 2009) were risk factors for psychiatric disorders or symptoms, respectively.

Several work-related features were investigated as factors associated with mental health outcomes: occupation, years of professional experience, working in high-risk units, direct contact with affected patients, being quarantined, being infected, or having relatives/friends get infected, confidence in equipment and protective measures, perceived organizational support, perceived adequacy of training, disease-related risk perception, work-related stress, and confidence in disease-related information.

Four studies found that physicians were less worried and anxious about the infection, compared with other healthcare workers (Alsubaie et al., 2019; Goulia et al., 2010; Matsuishi et al., 2012; Wong et al., 2005). Also, nurses reported higher perceived stress levels (Matsuishi et al., 2012; Maunder et al., 2006; Tam et al., 2004; Wong et al., 2005), psychopathological symptoms (Lai et al., 2019), and higher PTSD symptoms, compared with other healthcare workers (Lai et al., 2019; Maunder et al., 2004; Phua et al., 2005; Tang et al., 2017).

The level of exposure to infection seems to affect psychological outcomes. Studies showed that healthcare workers in units at high risk of infection present more severe mental health outcomes, compared with healthcare workers in units at low risk of infection (Bukhari et al., 2016; Chen et al., 2005; Lin et al., 2007; Liu et al., 2012; Matsuishi et al., 2012; Maunder et al., 2006; McAlonan et al., 2007; Styra et al., 2008; Su et al., 2007; Wu et al., 2009). Interestingly, two studies found that being

conscripted from a unit at low risk of infection to one at high risk of infection during an epidemic is a specific risk factor for worse mental health (Chen et al., 2005; Tam et al., 2004). Conversely, altruistically accepting the risk of infection is a protective factor (Liu et al., 2012; Wu et al., 2009). Similarly, direct contact with affected patients is a significant risk factor for all mental health outcomes (Chong et al., 2004; Grace et al., 2005; Lai et al., 2019; Lee et al., 2018; Marjanovic et al., 2007; Maunder et al., 2004; Tam et al., 2004; Tang et al., 2017).

With reference to more personal levels of exposure, studies show a trend for higher PTS and infection-related worries in healthcare workers who have been quarantined (Bai et al., 2004; Fiksenbaum et al., 2006; Wu et al., 2009).

Two important organizational variables that emerge as protective factors for mental health outcomes are organizational support (Fiksenbaum et al., 2006; Lancee et al., 2008; Maunder et al., 2006; Tam et al., 2004) and perceived adequacy of training (Lancee et al., 2008; Maunder et al., 2006; Tang et al., 2017).

Confidence in equipment and infection control measures appears to be a protective factor for mental health outcomes related to daily stress, namely, burnout (Marjanovic et al., 2007; Maunder et al., 2006), perceived stress (Chua et al., 2004), and infection-related worries (Nickell et al., 2004), but not for general mental health (Maunder et al., 2004, Maunder et al., 2006; Styra et al., 2008).

Moreover, disease-related risk perception was associated with worse mental health outcomes (Goulia et al., 2010; Khang et al., 2020, Liu et al., 2012; Maunder et al., 2004; Nickell et al., 2004; Son et al., 2019; Styra et al., 2008; Wong et al., 2005; Wu et al., 2009).

Table 3. Risk and protective factors.

Variables	PTS	General psychological distress/psychiatric morbidity	Depressive symptoms	Insomnia symptoms	Anxiety symptoms	Perceived stress	Infection-related worries	Burnout
Socio-demographic features								
Female gender	**+** (Lai et al., 2019; Maunder et al., 2006; Tang et al., 2017) **-** (Chong et al., 2004) **LA** (Lin et al., 2007; Styra et al., 2008; Tham et al., 2005; Wu et al., 2009)	**-** (Li et al., 2015) **+** (Tam et al., 2004) **LA** (Grace et al., 2005; Lin et al., 2007; Lung et al., 2009; Maunder et al., 2006; Park et al., 2018; Tham et al., 2005)	**+** (Lai et al., 2019)		**+** (Lai et al., 2019)	**-** (McAlonan et al., 2007) **LA** (Wong et al., 2005)	**+** (Bukhari et al., 2016; Wu et al., 2009)	**LA** (Maunder et al., 2006)
Age	**-** (Wu et al., 2009) **+** (Tang et al., 2017) **LA** (Lin et al., 2007; Styra et al., 2008; Tham et al., 2005)	**LA** (Chong et al., 2004; Lin et al., 2007; Lu et al., 2006; Lung et al., 2009; Park et al., 2018; Tham et al., 2005)	**-** (Liu et al., 2012; Su et al., 2007) **LA** (Liang et al., 2020)		**LA** (Liang et al., 2020; Lung et al., 2009)	**+** (Matsuishi et al., 2012) **-** (McAlonan et al., 2007 ; Tam et al., 2004) **LA** (Wong et al., 2005)	**-** (Matsuishi et al., 2012; Nickell et al., 2004) **LA** (Wu et al., 2009)	
Education	**LA** (Wu et al., 2009)	**-** (Ji et al., 2017; Lung et al., 2009) **LA** (Lu et al., 2006)				**LA** (McAlonan et al., 2007)	**+** (Wu et al., 2009)	
Being married	**LA** (Chong et al., 2004; Lin et al., 2007; Styra et al., 2008; Tham et al., 2005; Wu et al., 2009)	**LA** (Chong et al., 2004; Lin et al., 2007; Lu et al., 2006; Lung et al., 2009; Park et al., 2018; Tham et al., 2005)	**-** (Liu et al., 2012)				**+** (Wu et al., 2009)	

Having children	**LA** (Lin et al., 2007; Styra et al., 2008)	**LA** (Lin et al., 2007)						
Living with family/children	**-** (Lee et al., 2018) **LA** (Lin et al., 2007)	**-** (Nickell et al., 2004) **LA** (Chong et al., 2004; Lin et al., 2007)						
Personality, coping strategies and clinical features								
Neuroticism		**+** (Lu et al., 2006; Lung et al., 2009)						
Dysfunctional attachment		**+** (Lu et al., 2006; Maunder et al., 2006)						
Maladaptive coping	**+** (Maunder et al., 2006)	**+** (Maunder et al., 2006; Phua et al., 2005)						**+** (Maunder et al., 2006)
Resilience indicators		**-** (Park et al., 2018)						- (Marjanovic et al., 2007)
Self-efficacy				- (Xiao et al., 2020)			- (Ho et al., 2005)	
Psychiatric history		**+** (Lancee et al., 2008)	**+** (Su et al., 2007)	**+** (Su et al., 2007)				
Traumatic and stressful life events	**LA** (Wu et al., 2009)	**+** (Lung et al., 2009)	**+** (Goulia et al., 2010)					
Work-related features								
Occupation	**LA** (Lee et al., 2007)	**LA** (Li et al., 2015; Maunder et al., 2006; Phua et al., 2005)				**LA** (McAlonan et al., 2007)		
Physicians	**-** (Matsuishi et al., 2012)	**-** (Goulia et al., 2010)					- (Alsubaie et al., 2019; Goulia et al., 2010; Matsuishi et al., 2012; Wong et al., 2005)	

Nurses	**+** (Lai et al., 2019; Maunder et al., 2004; Phua et al., 2005; Tang et al., 2017)	**-** (Lu et al., 2006) **+** (Nickell et al., 2004; Tam et al., 2004)	**+** (Lai et al., 2019)	**+** (Lai et al., 2019)	**+** (Lai et al., 2019)	**+** (Matsuishi et al., 2012; Tam et al., 2004; Wong et al., 2005)		**+** (Maunder et al., 2006)
Other HCWs							**+** (Goulia et al., 2010)	
Years of experience	**-** (Chong et al., 2004; Tang et al., 2017) **LA** (Maunder et al., 2006; Styra et al., 2008; Tham et al., 2005)	**-** (Lancee et al., 2008; Maunder et al., 2006) **LA** (Park et al., 2018; Tham et al., 2005)				**LA** (Wong et al., 2005)		**LA** (Maunder et al., 2006)
High-risk units	**+** (Chen et al., 2005; Lin et al., 2007; Matsuishi et al., 2012; Styra et al., 2008; Wu et al., 2009) **LA** (Su et al., 2007)	**+** (Maunder et al., 2006) **LA** (Lin et al., 2007)	**+** (Liu et al., 2012; McAlonan et al., 2007; Su et al., 2007) **LA** (Liang et al., 2020)	**+** (Liu et al., 2012; McAlonan et al., 2007; Su et al., 2007)	**+** (McAlonan et al., 2007) **LA** (Liang et al., 2020)	**LA** (McAlonan et al., 2007)	**+** (Matsuishi et al., 2012; McAlonan et al., 2007; Wong et al., 2010)	**+** (Matsuishi et al., 2012)
Conscription to HR units	**+** (Chen et al., 2005)	**+** (Chen et al., 2005; Tam et al., 2004)	**+** (Chen et al., 2005)					
Altruistic acceptance of risk	**-** (Wu et al., 2009)		**-** (Liu et al., 2012)				**-** (Wu et al., 2009)	
Contact with affected patients	**+** (Chong et al., 2004; Lai et al., 2019; Lee et al., 2018; Maunder et al., 2004; Tang et al., 2017)	**-** (Chen et al., 2007; Chong et al., 2004) **+** (Chong et al., 2004)	**+** (Lai et al., 2019)	**+** (Lai et al., 2019)	**+** (Lai et al., 2019)	**+** (Grace et al., 2005; Tam et al., 2004)	**+** (Fiksenbaum et al., 2006) **LA** (Bukhari et al., 2016)	**+** (Marjanovic et al., 2007)

Quarantine	**+** (Bai et al., 2004; Wu et al., 2009) **LA** (Lee et al., 2018)	**+** (Maunder et al., 2006) **LA** (Chong et al., 2004; Lin et al., 2007)	**+** (Liu et al., 2012)				**+** (Fiksenbaum et al., 2006)	
Being infected/ relative or friend infected	**+** (Wu et al., 2009)		**LA** (Liu et al., 2012)			**LA** (Wong et al., 2005)	**-** (Ho et al., 2005)	
Confidence in protective measures	**-** (Maunder et al., 2006) **LA** (Maunder et al., 2004; Styra et al., 2008)	**LA** (Maunder et al., 2006)				**-** (Chua et al., 2004)	**-** (Nickell et al., 2004)	**-** (Marjanovic et al., 2007; Maunder et al., 2006)
Organizational support	**-** (Maunder et al., 2006)	**-** (Lancee et al., 2008; Tam et al., 2004) **LA** (Maunder et al., 2006)					**-** (Fiksenbaum et al., 2006)	**-** (Fiksenbaum et al., 2006; Maunder et al., 2006)
Training	**-** (Maunder et al., 2006; Tang et al., 2017)	**-** (Lancee et al., 2008) **LA** (Maunder et al., 2006)						**-** (Maunder et al., 2006)
Confidence in disease-related info	**LA** (Styra et al., 2008)						**-** (Goulia et al., 2010)	
Job-related stress	**+** (Maunder et al., 2004) **LA** (Maunder et al., 2006)	**+** (Tam et al., 2004) **LA** (Maunder et al., 2006)						**LA** (Maunder et al., 2006)
Risk perception	**+** (Maunder et al., 2004; Son et al., 2019; Styra et al., 2008; Wu et al., 2009)		**+** (Liu et al., 2012)			**+** (Wong et al., 2005)	**+** (Goulia et al., 2010; Nickell et al., 2004; Wu et al., 2009)	**+** (Fiksenbaum et al., 2006)
Stigma	**LA** (Maunder et al., 2006)	**+** (Park et al., 2018) **LA** (Maunder et al., 2006)					**+** (Nickell et al., 2004)	**LA** (Maunder et al., 2006)

+ = positive association; - = negative association; LA lack of association.

2.4 Discussion

This systematic review aimed to provide quantitative evidence on the potential maladaptive psychological outcomes in healthcare workers facing epidemic and pandemic situations and to identify potential risk and protective factors.

In describing the issues faced by healthcare workers responding to the COVID-19 pandemic, Kang et al. (2020) refer to "a high risk of infection and inadequate protection from contamination, over-work, frustration, discrimination, isolation, patients with negative emotions, a lack of contact with their families, and exhaustion". The evidence reviewed here, both related to the COVID-19 pandemic and to other previous epidemic/pandemic outbreaks, clearly confirms that facing such issues has a relevant psychological impact on healthcare workers responding to outbreaks.

In particular, during outbreaks, healthcare workers reported post-traumatic stress symptoms (11–73.4%), depressive symptoms (27.5–50.7%), insomnia (34–36.1%), severe anxiety symptoms (45%), general psychiatric symptoms (17.3–75.3%), and high levels of work-related stress (18.1–80.1%) (Chan et al., 2005; Chen et al., 2005; Chong et al., 2004; Goulia et al., 2010; Grace et al., 2005; Lai et al., 2019; Liu et al., 2020; Lu et al., 2006; Nickell et al., 2004; Su et al., 2007; Tam et al., 2004). Among these psychopathological outcomes, anxious and post-traumatic reactions were the most extensively investigated, and results pointed to the high prevalence of such areas of symptomatology in healthcare workers facing epidemic/pandemic outbreaks. This is not surprising, given the traumatic nature of the situations to which healthcare workers are exposed in their everyday work during epidemic/pandemic outbreaks. Furthermore, concerning mental health suffering, healthcare workers are considered a high-risk group even in non-pandemic times (Dutheil et al., 2019).

Evidence related to psychopathological outcomes also shows that these maladaptive reactions can be long-lasting. In fact, post-traumatic and depressive symptoms, as well as general psychological

distress, were reported even after periods ranging from six months up to three years after the epidemic/pandemic outbreak (Liu et al., 2012; Munder et al., 2006; Phua et al., 2005; Tang et al., 2017; Tham et al. 2005; Wu et al., 2009).

At a psychological level, the evidence reviewed shows that general stress, specific infection-related worries, and work-related stress are reported by healthcare workers facing epidemic/pandemic outbreaks. While stress and worries seem to be limited to the period of exposure to the outbreak, effects in terms of burnout can be long-lasting.

What can we do to reduce the negative impact of outbreaks in terms of psychological distress?

During epidemic/pandemic outbreaks, healthcare workers are, of necessity, exposed to a situation that causes maladaptive psychological responses. However, in this review, we also provide evidence synthesis about personal and situational factors that showed to have an impact in determining the level of such maladaptive psychological responses.

In reviewing findings related to the role of sociodemographic factors, we did not find strong evidence suggesting that these personal factors make the difference in maladaptive psychological responses reported by healthcare workers. Instead, other personal factors are more consistently associated with poorer outcomes. healthcare workers with less effective coping abilities were more likely to report psychopathological responses, whereas those showing resilience were relatively less affected by the situation (Marjanovic et al., 2007; Maunder et al., 2006; Park et al., 2018; Phua et al., 2005). Previous psychiatric history was also a predictor of higher maladaptive responses (Lancee et al., 2008; Su et al., 2007).

Several work-related features were associated with the level of maladaptive responses in healthcare workers. Results are particularly consistent in indicating that physicians are less psychologically affected than nurses in facing an epidemic/pandemic outbreak (Alsubaie et al., 2019, Goulia et al.,

2010; Matsuishi et al., 2012; Wong et al., 2005). This could be due to a higher physical contact with patients for nurses, as compared with physicians. Also, physicians could be more protected from these kinds of negative outcomes as a result of their longer training. Another situational factor that clearly emerges is the level of exposure to the epidemic/pandemic situation, with healthcare workers working in high-risk units (or being in contact with infected patients) reporting poorer psychological adjustment (Bukhari et al., 2016; Chen et al., 2005; Lin et al., 2007; Liu et al., 2012; Matsuishi et al., 2012; Maunder et al., 2006; McAlonan et al., 2007; Styra et al., 2008; Su et al., 2007; Wu et al., 2009). This is also consistent with results showing that higher risk perception is associated with higher maladaptive responses (Fiksenbaum et al., 2006; Goulia et al., 2010; Liu et al., 2012; Maunder et al., 2004; Nickell et al., 2004; Son et al., 2019; Styra et al., 2008; Wong et al., 2005; Wu et al., 2009). Considering work organization, confidence in protective measures, training, and organizational support were all related to less severe psychological outcomes (Chua et al., 2004; Fiksenbaum et al., 2006; Lancee et al., 2008; Marjanovic et al., 2007; Maunder et al., 2006; Nickell et al., 2004; Tam et al., 2004; Tang et al., 2017).

With these personal and situational factors in mind, the following suggestions can help reduce negative psychological responses of healthcare workers confronted with epidemic/pandemic outbreaks. These suggestions have the double aim of reducing the individual psychological burden of healthcare workers and strengthening the response capacity of healthcare systems.

Know your healthcare workers' workforce to support and enhance resilience and coping strategies

Primary prevention should take place regularly, so that personal factors (e.g., past psychiatric history and difficulties in coping strategies) could be addressed. Such preventive interventions will result in a healthier workforce that will likely show better psychological responses in emergency situations, such as epidemic/pandemic outbreaks.

Training programs related to coping and resilience should be a regular part of healthcare workers' training and continuing education programs. Resilience trainings for healthcare workers have shown to be of benefit to health professionals (for a review, see Cleary et al., 2018). Training courses designed to build resilience to the stress of working during a pandemic are available also in online formats (e.g., Maunder et al., 2010). Furthermore, a recent review (Brooks et al., 2017) provided evidence that pre-disaster training and education can improve employees' confidence in their ability to cope with disasters. The need for training to enhance medical staff psychological skills was also recently underlined in relation to the ongoing COVID-19 pandemic outbreak (Chen et al., 2020).

Reserve a special attention to healthcare workers working on the frontline

During the COVID-19 outbreak, frontline medical staff was included in the priority category identified by the Chinese Society of Psychiatry to deliver psychological crisis intervention and provide technical guidance (Jiang et al., 2020).

In China, on the one hand, psychological intervention teams, comprising psychological assistance hotline teams, and group activities to release stress were implemented for medical staff. On the other hand, the shift system and online platforms with medical advice were offered to help workers (Chen et al., 2020; Kang et al., 2020). In a situation in which resources are limited, interventions should be focused, on a first stage, on frontline healthcare workers, since they are more likely to undergo maladaptive psychological consequences. Particular attention should be reserved to nurses, since results show that they are especially affected by a more intense physical exposure to infected patients.

Provide adequate protective measures to healthcare workers

The evidence synthesized in our review leads to hypothesize that when healthcare workers are provided with protective measures that are perceived as adequate, their risk perception is lower, and this could result in lower adverse psychological outcomes.

An essential factor to improve collaboration seems to be trust between organizations and workers (Imai et al., 2020; Okello et al., 2015). The feeling of being protected is associated with higher work motivation (Imai et al., 2010). Hence, physical protective materials (Imai et al., 2020), together with frequent provision of information, should be provided.

Organize support services that can be delivered online

In comparison to previous epidemics, during the COVID-19 pandemic, internet and smartphones are widely available (Liu et al., 2020); hence, online mental health education, online psychological counseling services, and online psychological self-help intervention systems may and should be developed.

The major strength of the present review is that, to the best of our knowledge, this is the first attempt to provide quantitative evidence of the mental health impact in healthcare workers facing epidemic and pandemic outbreaks as well as to identify potential related risk and protective factors. Some limitations are related to the characteristics of the included studies: (1) the number of longitudinal studies was limited, and the majority were retrospective ones; (2) we found a great variability in the prevalence estimates, probably due to different cut-off scores used to identify cases (e.g., IES- R) and to the use of heterogeneous instruments (e.g., stress perception); (3) it is possible that cultural differences in health beliefs, display of mental symptoms, and different healthcare systems have influenced the results of the studies included in this review; and (4) some risk and protective factors are still understudied in relation to psychological responses to

epidemic/pandemic outbreaks; for example, perceived social support was investigated only by one recent study on COVID-19 (Xiao et al., 2020), despite evidence highlighting its protective role for mental health outcomes (Tsai et al., 2015). Finally, the rapid nature of the study did not allow us to perform a quality check of the included studies.

2.4.1 Conclusions

The present review confirms that healthcare workers responding to epidemic/pandemic outbreaks show a number of negative mental health and psychological consequences. Such sequelae are particularly alarming when considering their long-lasting nature and their plausible association with impaired decision-making capacities. As a matter of fact, we cannot avoid the exposure of healthcare workers to critical situations that could be detrimental for their mental health, since their rapid and effective deployment is critical in confronting epidemic/pandemic outbreaks. However, failing to consider the negative psychological impact that these workers suffer would result in consequences both at the individual level and in the healthcare response capacity at a systemic level.

The literature reviewed points to several personal and situational factors that play a role in mitigating or exacerbating the maladaptive consequences suffered by healthcare workers. Following empirical evidence, the assessment and promotion of coping strategies and resilience, special attention to frontline healthcare workers, the provision of adequate protective supplies, and the organization of online support services could be ways to mitigate the negative psychological responses of healthcare workers responding to epidemic/pandemic outbreaks.

3. THE PSYCHOLOGICAL IMPACT OF THE COVID-19 PANDEMIC ON ITALIAN HEALTHCARE WORKERS: BASELINE FINDINGS[2]

3.1 Introduction

During the rapid spread of the pandemic, millions of healthcare workers around the world have been employed on the front line to save lives and reduce the risk of virus transmission. All of them have been working in a challenging situation and experiencing great psychological distress (Cipolotti et al., 2020; Greenberg et al., 2020; Vindegaard et al., 2020).

Increasing evidence suggests that COVID-19 may be the most common independent risk factor for stress, psychological distress, and post-traumatic stress disorder (PTSD) in healthcare workers (Carmassi et al., 2020; Evanoff et al., 2020; Sanghera et al., 2020; Spoorthy et al., 2020).

Notably, COVID-19 put healthcare professionals in an unprecedented condition, forcing them to make difficult decisions and work under extreme pressure. These decisions entail distributing scarce resources to similarly vulnerable patients, reconciling their own physical and mental health needs with those of patients, matching their desire and responsibility to patients with those of family and friends, and treating all seriously ill patients with limited or inadequate resources (Greenberg et al., 2020). Moreover, the non-quantifiable numbers of patients with critical conditions, the unpredictable course of the disease, the high morbidity and mortality rates, and the lack of defined therapies have generated feelings of fear and helplessness in healthcare workers, severely affecting their mental health conditions (Carmassi et al., 2020; Sanghera et al., 2020) and causing feelings of irritability, frustration, and anger (García-Fernández et al., 2021).

Therefore, healthcare workers are at risk not only of detrimental physical effects from COVID-19, but also of harmful psychological sequelae (Neto et al., 2021; Gold, 2020).

On the one hand, the literature reports several risk factors for healthcare workers' mental health, including female gender, age <40, low income, a higher number of family/home stressors, isolation

[2] This chapter is based on a paper, published as:
Di Mattei, V. E., Perego, G., Milano, F., Mazzetti, M., Taranto, P., Di Pierro, R., ... & Preti, E. (2021). The "Healthcare Workers' Wellbeing (Benessere Operatori)" Project: A Picture of the Mental Health Conditions of Italian Healthcare Workers during the First Wave of the COVID-19 Pandemic. *International Journal of Environmental Research and Public Health*, *18*(10), 5267.

from family, poor supervisor and organizational support, high workload, working in unsafe settings, time pressure, working with COVID-19 patients, being part of the nursing staff, fewer years of working experience, history of organic and mental illness, higher avoidance strategies, and lower positive attitude (Carmassi et al., 2020; Evanoff et al., 2020; Sanghera et al., 2020; D'Ettorre et al., 2021; De Kock et al., 2021; Young et al., 2021). On the other hand, the presence of children, a strong social and family network, team cohesion and shared responsibility among colleagues, adequate personal protective equipment, the use of humor and planning as coping strategies, and the ability to talk to someone about their experiences seem to be protective factors for healthcare workers' mental health (Carmassi et al., 2020; Evanoff et al., 2020; D'Ettorre et al., 2021; De Kock et al., 2021; Young et al., 2021). Similar findings have been reported in Italian samples (Babore et al., 2020; Di Tella et al., 2020; Gorini et al., 2020; Morgantini et al., 2020; Rossi et al., 2020; Trumello et al., 2020.

Furthermore, the literature extensively highlights differences in mental health among different categories of healthcare workers, both during previous epidemics (Preti et al., 2020; Carmassi et al., 2020) and during the COVID-19 outbreak (Sanghera et al., 2020; De Kock et al., 2021; Tan et al., 2020; Vizheh et al., 2020). In particular, nurses reported higher levels of anxiety, depression, and PTSD symptoms than did other groups of healthcare workers and clerical staff (Carmassi et al., 2020; Sanghera et al., 2020; De Kock et al., 2021; Vizheh et al., 2020). These differences are probably related to the amount of time spent in contact with patients (Lasalvia et al., 2021).

In light of the extreme importance of this topic, we conducted a web-based longitudinal survey to examine the psychological impact of the COVID-19 pandemic on a sample of Italian healthcare workers involved in the management of the pandemic. In this chapter, baseline findings of the "Healthcare workers' wellbeing (Benessere Operatori)" project will be presented. The first baseline assessment, conducted between 9 May 2020 and 13 July 2020, aimed at collecting data on levels

of psychological distress, as well as on related socio-demographic, situational, and personal factors that can affect individuals' psychological response to the COVID-19 pandemic to identify high-risk groups.

3. 2 Methods

3.2.1 Participants and Procedure

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the University of Milan-Bicocca (protocol n. 0024531/20), the Ethics Committee of the IRCCS San Raffaele Scientific Institute (protocol n. 109/2020), and the Ethics Committee of the Parma Local Health Authority (protocol n. PG0019826_2020).

We conducted a baseline assessment between 9 May and 13 July 2020, after the main peak of COVID-19 outbreak in Italy. We spread information about the study (www.benessereoperatori.com) by contacting national healthcare workers' professional boards and associations, posting pamphlets inside hospitals, and through campaigns on social networks. After reading the informed consent, participants voluntarily completed an online survey administered through Qualtrics. We assessed participants' socio-demographic characteristics, working conditions, individual perception of the COVID-19 situation, anxiety, depression, and insomnia symptoms, post-traumatic stress, state anger, and burnout levels. The baseline battery also included a measure of coping strategies and perceived social support, both of which were investigated as potential predictors of mental health outcomes during study follow-ups.

The initial dataset included 1090 participants. Thirty-five participants declared that they had not been working during the past three months; therefore, they were excluded from the analyses, resulting in a final sample of 1055 participants (75.70% females, *n* = 799) with an overall mean age of 44.74 years (*SD* = 11.30, range = 20–79). Forty-nine percent (*n* = 517) of them were married and

57.10% (*n*=602) had children. Only 16.70% (*n* = 176) were living alone. Most of the participants (*n* = 1033, 98.10%) were located in one of the four regions most affected by the COVID-19 outbreak (i.e., Lombardy, Emilia-Romagna, Piedmont, and Veneto), while the remaining participants (*n* = 22, 1.90%) were located in other regions. About 22.40% (*n* = 236) of the sample reported a mental health disorder in the past. Although 18% (*n* = 189) of the sample reported being at least somewhat likely to need psychological or psychiatric support, only 5.10% (*n* = 54) reported being at least somewhat likely to seek psychological or psychiatric support during the next week.

Concerning their occupation, 28.20% (*n* = 298) of our participants were physicians, 34.30% (*n* = 362) were nurses, 24.70% (*n* = 261) were other healthcare workers (i.e., psychologists, physiotherapists, healthcare assistants, midwives, radiology technicians, laboratory technicians, psychiatric rehabilitation technicians, speech therapists, social workers, and biologists), and 12.70% (*n* = 134) were clerks. About 45.60% (*n* = 481) of them had more than 20 years of professional experience and 23.60% (*n* = 249) reported having felt very likely or extremely likely at risk of making mistakes during the previous three months. Among healthcare workers, 35.20% (*n* = 332) worked in COVID-19 wards.

Finally, 25.90% (*n* = 273) of our participants reported having symptoms of COVID-19, and 21% (*n* = 222) and 81.40% (*n* = 859) reported having relatives and colleagues with symptoms of COVID-19, respectively.

3.2.2 Measures

The Depression Anxiety Stress Scale-21 (DASS-21 - Lovibond & Lovibond, 1995; Bottesi et al., 2015) is a 21-item measure, evaluating general distress on a tripartite model of psychopathology. This questionnaire is divided into three subscales: depression, anxiety, and stress. Each subscale contains seven items rated on a 4-level Likert scale (0 = never; 3 = almost always). The total score

is estimated by adding together the response values of each item. Higher scores indicate severe levels of depression, anxiety, and stress symptoms. The score at the depression subscale (e.g., "I felt I wasn't worth much as a person") is grouped into normal (0–9), mild (10–12), moderate (13–20), severe (21–27), and extremely severe depression (28–42). The score at the anxiety subscale (e.g., "I felt scared without any good reason") is split up into normal (0–6), mild (7–9), moderate (10–14), severe (15–19), and extremely severe anxiety (20–42). The score at the stress subscale (e.g., "I found it difficult to relax") is divided into normal (0–10), mild (11–18), moderate (19–26), severe (27–34), and extremely severe stress (35–42) (Lovibond & Lovibond, 1995). The original version of the questionnaire showed an internal reliability with Cronbach's alpha coefficient of .91 for the depression scale, .84 for the anxiety scale, and .90 for the stress scale (Lovibond & Lovibond, 1995). The total score of the Italian version reported a Cronbach's alpha value of .90, with subscales values ranging from .74 to .85 (Bottesi et al., 2015). In our sample, Cronbach's alpha values range from .85 to .95.

The Insomnia Severity Index (ISI - Morin, 1993; Castronovo et al., 2016) is a self-report questionnaire evaluating the nature, severity, and impact of insomnia through seven items rated on a 5-level Likert scale (0 = "no problem"; 4 = "very severe problem"). Scores range from 0 to 28 and can be classified into absence of insomnia (0–7); sub-threshold insomnia (8–14); moderate insomnia (15–21); and severe insomnia (22–28). The dimensions assessed include severity of sleep onset, sleep maintenance, early morning awakening problems, sleep dissatisfaction, interference of sleep difficulties with daytime functioning, noticeability of sleep problems by others, and distress caused by the sleep difficulties. The original version of the ISI reported a Cronbach's alpha coefficient of .74 (Morin, 1993). The Italian version showed a Cronbach's alpha coefficient of .75 (Castronovo et al., 2016). In our sample, Cronbach's alpha value is .62.

The Impact of Event Scale-Revised (IES-R - Weiss & Marmar, 1997; Pietrantonio et al., 2003) is a 22-item self-report questionnaire assessing the frequency of intrusive and avoidant thoughts and behaviors associated with a traumatic event. Items are rated on a 5-points Likert scale (0 = "not at all"; 4 = "extremely"). The IES-R is composed of three subscales. Intrusion (8 items) measures intrusive thoughts, nightmares, intrusive feelings, and imagery associated with the traumatic event; avoidance (8 items) measures avoidance of feelings, situations, and ideas; hyperarousal (6 items) measures difficulty in concentrating, anger and irritability, psychophysiological arousal upon exposure to reminders, and hypervigilance. The original version showed high levels of internal consistency (Intrusion: α=.87-.94, Avoidance: α=.84-.87, Hyperarousal: α=.79-.91; Weiss & Marmar, 1997). The Italian version shows good (.84) and acceptable (.71) internal consistency for the intrusion subscale and the avoidance subscale, respectively (Pietrantonio et al., 2003). In our sample, Cronbach's alpha values range from .85 to .95.

The State-Trait Anger Expression Inventory-2 (STAXI-2 - Spielberger, 1999, 2004) is a 57-item self-report questionnaire measuring five domains of anger: State-Anger, Trait-Anger, Anger Expression-In, Anger Expression-Out, and Anger-Control. Responses are rated on a 4-point Likert scale, ranging from 1 (not at all) to 4 (almost always). Cronbach's alpha coefficients range from .73 to .76, indicating high internal reliability for all the subscales except for the Trait Anger Scale/Angry Reaction (Spielberger, 1999). In the present study, we only used the State-Anger subscale to assess healthcare workers' acute reaction to the pandemic. The State-Anger subscale is composed of three subscales: Feeling Angry (5 items), Verbal Expression (5 items), and Physical Expression (5 items) (α range = .89–.94).

The Maslach Burnout Inventory (MBI - Maslach & Jackson, 1981; Sirigatti & Stefanile, 1993) is composed of 22 items divided into three subscales assessing the three components of the burnout syndrome: emotional exhaustion (9 items), depersonalization (5 items), and personal accomplishment (8 items). Each item is rated on a 7-point Likert scale (0 = “never”; 6 = “every day”). For Italian healthcare workers, subscales scores can be classified as follows: the emotional exhaustion subscale scores are divided into low (≤14), medium (15–23), and high (≥24); the depersonalization subscale scores are grouped into low (≤3), medium (4-8), and high (≥9); and the personal accomplishment subscale scores are classified into low (≥37), medium (30-36), and high (≤29) (Sirigatti & Stefanile, 1993). The subscales showed good internal consistency both for the original version (emotional exhaustion: α=.90, depersonalization: α=.79, personal accomplishment: α=.71; Maslach & Jackson, 1981) and for the Italian version (emotional exhaustion: α=.87, depersonalization: α=.68, personal accomplishment: α=.76; Sirigatti & Stefanile, 1993). In our sample, Cronbach’s alpha values range from .75 to .93.

Moreover, we measured how much participants were worried about the possibility that they, their relatives, and their colleagues could become infected by COVID-19. Four items were rated on a 5-point Likert scale (1 = “not at all”; 5 = “extremely”). A total score of worry was obtained by averaging items scores. Higher scores indicate higher levels of worry (α = .86).

Finally, we measured participants’ working conditions during the past three months in several areas, including eating, sleeping, working shifts, being isolated, and wearing adequate protective equipment. Seven items were rated on a 5-point Likert scale (1 = “not at all”; 5 = “very much”). A total score of working conditions was obtained by averaging items scores. Higher scores indicate worse working conditions (α = .69).

3.2.3 Statistical Analysis

Psychological scales were summarized using median and interquartile range (IQR), while categorical variables were reported by means of frequency distribution and percentages. Since psychological scales showed skewed distributions, the Kruskal–Wallis test was applied for comparing scores obtained by different working categories. In the presence of a significant Kruskal–Wallis result ($p < 0.05$), a post-hoc analysis was performed to examine specific categories of interest taken in pairs (Dunn's test was performed followed by Bonferroni's correction for adjusting for multiple testing). The following comparisons were considered relevant for the study: COVID physicians vs. non-COVID physicians; COVID nurses vs. non-COVID nurses; COVID other vs. non-COVID other; COVID physicians vs. COVID nurses; COVID physicians vs. COVID other; non-COVID physicians vs. non-COVID nurses; non-COVID physicians vs. non-COVID other; and clerks were compared with all the aforementioned groups.

3.3 Results

As listed in Table 1, the Kruskal–Wallis test showed a significant difference in the distribution of scores for the different groups in the following variables: Anxiety ($p < 0.0001$) and Stress ($p = 0.0275$) subscales of the DASS-21; ISI total score ($p < 0.0001$); Intrusion ($p < 0.0001$), Avoidance ($p < 0.0001$), and Hyperarousal ($p = 0.0003$) subscales of the IES-R; State-Anger ($p = 0.0012$), Feel like expressing Anger Verbally ($p < 0.0001$), and Feel like expressing Anger Physically ($p < 0.0001$) subscales of the STAXI-2; Emotional Exhaustion ($p < 0.0001$), Depersonalization ($p < 0.0001$), and Personal Accomplishment ($p < 0.0001$) subscales of the MBI; Working conditions ($p < 0.0001$); and Worry ($p = 0.0403$).

Table 1. Kruskal-Wallis test.

	non-COVID physicians		COVID physicians		non-COVID nurses		COVID nurses		non-COVID other		COVID other		Clerks		p-value
	Median	iqr	median	iqr	median	iqr	median	iqr	median	iqr	median	iqr	median	iqr	
DASS_Depression	6	(2,14)	8	(2,14)	8	(2,14)	8	(2,14)	6	(2,12)	6	(2,12)	5	(2,14)	0.1381
DASS_Anxiety	2	(0,6.5)	2	(0,8)	5	(2,10)	6	(2,12)	3	(0,6)	4	(2,12)	4	(2,8)	<0.0001
DASS_Stress	14	(8,20)	14	(10,22)	16	(6,22)	16	(8,22)	12	(8,18)	14	(8,21)	14	(6,20)	0.0275
ISI_Total score	7	(5,10)	8	(5,10)	8.5	(6,11.25)	10	(7,12)	7	(5,10)	9	(5.5,11)	7.5	(6,11)	<0.0001
IES_Intrusion	0.5	(0.12,1.03)	1	(0.38,1.38)	0.88	(0.38,1.75)	1	(0.5,2)	0.5	(0.25,1.12)	0.88	(0.5,1.69)	0.62	(0.25,1.25)	<0.0001
IES_Avoidance	0.5	(0.12,1)	0.75	(0.38,1.12)	0.88	(0.38,1.53)	0.88	(0.38,1.59)	0.62	(0.12,1.12)	0.88	(0.25,1.12)	0.62	(0.38,1.22)	<0.0001
IES_Hyperarousal	0.67	(0.29,1.17)	0.67	(0.33,1.17)	0.83	(0.5,1.83)	0.92	(0.5,2)	0.67	(0.33,1.17)	0.83	(0.25,1.58)	0.67	(0.33,1.33)	0.0003
STAXI_State Anger	16	(15,19)	18	(16,21)	16.5	(15,22)	18	(15,24)	17	(15,21)	17	(16,22)	17	(15,22)	0.0012
STAXI_Feeling Angry	6	(5,8)	7	(6,9)	6	(5,8)	7	(5,9)	6	(5,8)	7	(5,8)	7	(5,8.75)	0.0558
STAXI_Verbal Exp.	5	(5,6)	5	(5,7)	5	(5,8)	6	(5,9)	5	(5,7)	5	(5,7)	5	(5,7)	<0.0001
STAXI_Physical Exp.	5	(5,5)	5	(5,5)	5	(5,5)	5	(5,6)	5	(5,5)	5	(5,5)	5	(5,5.75)	<0.0001
MBI_Emotional Exhaustion	17	(8,29)	19	(12,29)	14	(8,31.25)	17.5	(9,30)	11	(6,19)	13	(6,25)	15	(7,29.75)	<0.0001
MBI_Depersonalization	4	(1,8.25)	5.5	(3,11.75)	3	(0,8)	6	(2,10)	1	(0,4)	3	(0,7)	2	(0,6.75)	<0.0001
MBI_Personal Accomplishment	39	(31,44)	38.5	(32.25,42.75)	39	(34,44)	39	(35,43.75)	35	(26,42)	41	(36,45)	25	(11.25,36.75)	<0.0001
Working conditions	2.5	(2,3.14)	3.14	(2.6,3.64)	2.67	(2.17,3.3)	3.17	(2.67,3.64)	2.33	(1.86,2.83)	2.5	(2.15,3.17)	2.71	(2.21,3.33)	<0.0001
Worry	4.17	(3.83,4.5)	4.33	(4,4.57)	4.33	(4,4.67)	4.33	(4,4.67)	4.33	(4,4.5)	4.17	(3.83,4.5)	4.17	(4,4.67)	0.0403

Depression, Anxiety, and Stress Symptoms

With reference to the cut-off values reported in the literature (Lovibond & Lovibond, 1995) (see Table 2), more than 65% of the sample reported normal or mild scores of depression, anxiety, and stress symptoms. However, 12.21% of non-COVID nurses, 12.63% of COVID nurses, and 16.28% of other COVID healthcare workers reported extremely severe anxiety symptoms. Only 1.5% of non-COVID physicians, 4.08% of COVID physicians, 4.13% of other non-COVID healthcare workers, and 4.48% of clerks reported extremely severe anxiety symptoms.

Considering the whole set of scores (see Supplementary Material, Figure S1 for a graphical representation), there was a significant difference in the distribution of anxiety scores between non-COVID nurses and non-COVID physicians (Dunn's test $p = 0.0019$); between non-COVID nurses and other non-COVID healthcare workers (Dunn's test $p = 0.0017$); between COVID nurses and COVID physicians (Dunn's test $p = 0.0003$); and between COVID nurses and clerks (Dunn's test $p = 0.0328$).

Insomnia Symptoms

With reference to the cut-off values reported in the literature (Castronovo et al., 2016), more than 85% of the sample reported absent or sub-threshold insomnia; however, 12.21% of non-COVID nurses and 13.16% of COVID nurses showed moderate insomnia. Only one COVID nurse reported a severe level of insomnia. A total of 1.5% of non-COVID physicians reported moderate insomnia while 5.1% of COVID physicians reported moderate insomnia. None in the "physician" category reported severe levels of insomnia. Considering the whole set of scores, there was a significant difference in the distribution of insomnia scores (see Figure S2) between non-COVID nurses and non-COVID physicians (Dunn's test $p = 0.0051$); between COVID nurses and COVID physicians (Dunn's test $p = 0.0148$); and between COVID nurses and clerks (Dunn's test $p = 0.0129$).

Post-Traumatic Stress Symptoms

Considering the whole set of scores, there was a significant difference in the distribution of intrusion, avoidance, and hyperarousal (see Figures S3–S5 respectively) scores between non-COVID nurses and non-COVID physicians (p = 0.0009; p = 0.0001; p = 0.0216, respectively); and between non-COVID nurses and other non-COVID healthcare workers (Dunn's test p = 0.0011; p = 0.0083; p = 0.0363, respectively). Moreover, there was a significant difference in the distribution of intrusion scores between COVID physicians and non-COVID physicians (Dunn's test p = 0.0047); and between COVID nurses and clerks (Dunn's test p = 0.0004). From a purely descriptive perspective, the highest percentage of extremely severe scores was recorded for COVID nurses (5.79%), followed by COVID physicians (5.1%).

State-Anger

Considering the whole set of scores, there was a significant difference in the distribution of State-Anger scores (see Figure S6) between COVID physicians and non-COVID physicians (Dunn's test p = 0.0471). Moreover, there was a significant difference in the distribution of verbal expression of anger (see Figure S7) between COVID nurses and clerks (Dunn's test p = 0.0473). There was also a significant difference in the distribution of physical expression of anger (see Figure S8) between COVID nurses and non-COVID nurses (Dunn's test p = 0.0167).

Burnout Symptoms

With reference to the cut-off values reported in the literature (Sirigatti & Stefanile, 1993), more than 28% of the sample reported high levels of emotional exhaustion, except for other non-COVID

healthcare workers (19.27%). Actually, post-hoc analysis highlighted a significant difference in the distribution of emotional exhaustion scores (see Figure S9) when comparing other non-COVID healthcare workers to both non-COVID physicians (Dunn's test $p = 0.0003$) and non-COVID nurses (Dunn's test $p = 0.0021$).

More than 50% of the sample reported low levels of depersonalization, except for COVID nurses and physicians, who reported high levels of depersonalization, respectively, in 31.05% and 36.73% of the cases. From the post-hoc analysis, significant differences in the distribution of depersonalization scores (see Figure S10) emerged when comparing COVID physicians to non-COVID physicians (Dunn's test $p = 0.0061$), other COVID healthcare workers (Dunn's test $p = 0.0101$), and clerks (Dunn's test $p < 0.0001$). Moreover, non-COVID physicians differed from other non-COVID healthcare workers (Dunn's test $p < 0.0001$); COVID nurses reported different levels of depersonalization compared to non-COVID nurses (Dunn's test $p = 0.0273$) and clerks; and finally non-COVID nurses differed from other non-COVID healthcare workers (Dunn's test $p = 0.0024$).

More than 58% of the sample reported low levels of reduced personal accomplishment, except for other non-COVID healthcare workers and clerks, who reported high levels of reduced personal accomplishment, respectively, in 32.11% and 56.72% of the cases.

Finally, significant differences in the distribution of personal accomplishment scores (see Figure S11) emerged when comparing clerks to all other categories. Moreover, other non-COVID healthcare workers differed from other COVID healthcare workers (Dunn's test $p = 0.0011$), non-COVID physicians (Dunn's test $p = 0.0050$), and non-COVID nurses (Dunn's test $p = 0.0022$).

Table 2. Distress levels distribution according to the cut-off values reported in the literature.

	non-COVID physicians	COVID physicians	non-COVID nurses	COVID nurses	non-COVID other	COVID other	Clerks
DASS_Depression							
normal (0–9)	130(65%)	56(57.14%)	100(58.14%)	102(53.68%)	142(65.14%)	26(60.47%)	80(59.7%)
mild (10–12)	19(9.5%)	13(13.27%)	18(10.47%)	32(16.84%)	28(12.84%)	10(23.26%)	19(14.18%)
moderate (13–20)	33(16.5%)	15(15.31%)	33(19.19%)	29(15.26%)	31(14.22%)	3(6.98%)	22(16.42%)
severe (21–27)	7(3.5%)	7(7.14%)	14(8.14%)	12(6.32%)	12(5.5%)	1(2.33%)	7(5.22%)
extremely severe depression (28–42)	11(5.5%)	7(7.14%)	7(4.07%)	15(7.89%)	5(2.29%)	3(6.98%)	6(4.48%)
DASS_Anxiety							
normal (0–6)	150(75%)	71(72.45%)	102(59.3%)	107(56.32%)	168(77.06%)	27(62.79%)	92(68.66%)
mild (7–9)	15(7.5%)	8(8.16%)	9(5.23%)	19(10%)	15(6.88%)	2(4.65%)	11(8.21%)
moderate (10–14)	22(11%)	13(13.27%)	27(15.7%)	25(13.16%)	16(7.34%)	5(11.63%)	18(13.43%)
severe (15–19)	10(5%)	2(2.04%)	13(7.56%)	15(7.89%)	10(4.59%)	2(4.65%)	7(5.22%)
extremely severe anxiety (20–42)	3(1.5%)	4(4.08%)	21(12.21%)	24(12.63%)	9(4.13%)	7(16.28%)	6(4.48%)
DASS_Stress							
normal (0–10)	72(36%)	31(31.63%)	66(38.37%)	65(34.21%)	103(47.25%)	19(44.19%)	56(41.79%)
mild (11–18)	77(38.5%)	34(34.69%)	51(29.65%)	60(31.58%)	61(27.98%)	10(23.26%)	41(30.6%)
moderate (19–26)	35(17.5%)	21(21.43%)	32(18.6%)	32(16.84%)	38(17.43%)	10(23.26%)	24(17.91%)
severe (27–34)	13(6.5%)	7(7.14%)	16(9.3%)	22(11.58%)	15(6.88%)	2(4.65%)	9(6.72%)
extremely severe stress (35–42)	3(1.5%)	5(5.1%)	7(4.07%)	11(5.79%)	1(0.46%)	2(4.65%)	4(2.99%)
ISI_Total score							
absence of insomnia (0–7)	119(59.5%)	48(48.98%)	76(44.19%)	58(30.53%)	118(54.13%)	17(39.53%)	67(50%)
sub-threshold insomnia (8–14)	78(39%)	45(45.92%)	75(43.6%)	106(55.79%)	84(38.53%)	22(51.16%)	58(43.28%)
moderate insomnia (15–21)	3(1.5%)	5(5.1%)	21(12.21%)	25(13.16%)	16(7.34%)	3(6.98%)	9(6.72%)
severe insomnia (22–28)	0(0%)	0(0%)	0(0%)	1(0.53%)	0(0%)	1(2.33%)	0(0%)

MBI_Emotional Exhaustion							
low (<=14)	85(42.5%)	36(36.73%)	88(51.16%)	71(37.37%)	143(65.6%)	22(51.16%)	65(48.51%)
medium (15-23)	46(23%)	25(25.51%)	21(12.21%)	52(27.37%)	33(15.14%)	9(20.93%)	28(20.9%)
high (>=24)	69(34.5%)	37(37.76%)	63(36.63%)	67(35.26%)	42(19.27%)	12(27.91%)	41(30.6%)
MBI_Depersonalization							
low (<=4)	99(49.5%)	29(29.59%)	88(51.16%)	69(36.32%)	151(69.27%)	23(53.49%)	79(58.96%)
medium (4-8)	51(25.5%)	33(33.67%)	44(25.58%)	62(32.63%)	47(21.56%)	13(30.23%)	27(20.15%)
high (>=9)	50(25%)	36(36.73%)	40(23.26%)	59(31.05%)	20(9.17%)	7(16.28%)	28(20.9%)
MBI_Personal Accomplishment							
low (>=37)	117(58.5%)	58(59.18%)	104(60.47%)	122(64.21%)	101(46.33%)	30(69.77%)	34(25.37%)
medium (30-36)	45(22.5%)	24(24.49%)	37(21.51%)	42(22.11%)	47(21.56%)	10(23.26%)	24(17.91%)
high (<=29)	38(19%)	16(16.33%)	31(18.02%)	26(13.68%)	70(32.11%)	3(6.98%)	76(56.72%)

Working Conditions and Worry

Considering the whole set of scores, significant differences emerged in the distribution of working conditions scores (see Figure S12) when comparing COVID physicians respectively to non-COVID physicians (Dunn's test $p < 0.0001$), other COVID healthcare workers (Dunn's test $p = 0.0141$), and clerks (Dunn's test $p = 0.0118$); moreover COVID nurses reported different working condition scores compared to non-COVID nurses (Dunn's test $p < 0.0001$) and other COVID healthcare workers (Dunn's test $p = 0.0036$); finally differences emerged between non-COVID nurses and other non-COVID healthcare workers (Dunn's test $p = 0.0011$), and between other non-COVID healthcare workers and clerks (Dunn's test $p = 0.0010$). Finally, there was a significant difference in the distribution of worry scores (see Figure S13) between non-COVID nurses and non-COVID physicians (Dunn's test $p = 0.0250$).

3.4 Discussion

The present study investigated short-term psychological consequences of the COVID- 19 outbreak in a large sample of Italian healthcare workers. To the best of our knowledge, this is the first study to compare specific subgroups of healthcare workers involved in pandemic management, taking into account both their profession and ward (i.e., COVID ward vs. non-COVID ward).

In general, the scores obtained by our sample in depression, anxiety, stress, and insomnia scales can be classified as low according to the cut-off values identified in the literature (Lovibond & Lovibond, 1995; Castronovo et al., 2016). However, their burnout levels can be classified as medium and high, especially concerning physicians' and nurses' scores (Sirigatti & Stefanile, 1993). Our findings highlight significant differences among the different groups of healthcare workers. In general, healthcare workers in COVID wards experienced higher levels of anger, anxiety, insomnia, burnout, and PTSD symptoms compared to those of healthcare workers in non-COVID wards. Moreover, nurses were the group at higher risk, as nurses who worked both in COVID and non-COVID wards experienced higher levels of distress than did the other groups of healthcare workers.

Specifically, both physicians and nurses who worked in COVID wards reported worse working conditions, higher depersonalization symptoms, greater states of anger, and a higher tendency to express it compared to those reported by physicians and nurses who worked in non-COVID wards. Moreover, physicians and nurses who worked in COVID wards reported worse working conditions even compared to other healthcare workers who worked in COVID wards. These results are in line with the literature showing that working in COVID wards is an independent risk factor for higher levels of anxiety, burnout, insomnia, and PTSD symptoms (Di Tella et al., 2020; Gorini et al., 2020; Lasalvia et al., 2021; Sanghera et al., 2020; Trumello et al., 2020). Indeed, working in COVID wards entails the risk of contracting the infection and spending several hours under uncomfortable working conditions without taking a break (Sanghera et al., 2020). Moreover, healthcare workers had to treat a large number of patients with limited resources and little knowledge of the disease, which may have resulted in a sense of helplessness among the professionals.

Furthermore, our results showed that non-COVID nurses reported higher levels of worry and PTSD symptoms than did physicians, but in COVID wards these differences were no longer significant. In general, nurses displayed higher insomnia and anxiety symptoms than did physicians in COVID and non-COVID wards. Furthermore, nurses who worked in non-COVID wards had greater anxiety and PTSD symptoms than did other healthcare workers who worked in non-COVID wards. Consistently, the literature underlines working in nursing staff as a risk factor for higher levels of anxiety, insomnia, and PTSD symptoms (Carmassi et al., 2020; Gorini et al., 2020; Rossi et al., 2020; Song et al., 2020).

The greater distress levels found in nurses can be explained by the longer time spent taking care of patients compared to any other group of healthcare workers. Moreover, they are more frequently exposed to death and patients' pain. This is even accentuated by the absence of their relatives, who are not allowed in the hospital due to COVID-19 restrictions (Gorini et al., 2020; Maunder et al., 2004; Mok et al., 2005).

Concerning other healthcare workers, working in COVID wards was associated with higher levels of personal accomplishment compared to working in non-COVID wards, probably because all the healthcare worker who worked in COVID wards felt useful and actively contributing to the health emergency, as also shown in Barello and colleagues' study (2020). Although other non-COVID healthcare workers seemed to feel less accomplished, they were at lower risk of burnout compared to non-COVID physicians and nurses, probably because they had better working conditions, at least compared to those of nurses.

As far as clerks are concerned, their distress levels did not significantly differ from those of the other groups of healthcare workers who worked in non-COVID wards. Moreover, clerks reported better working conditions, lower distress levels, and lower personal accomplishment compared to the healthcare workers who worked in COVID wards. This is in contrast with a study conducted during the main peak of COVID-19 showing higher levels of anxiety symptoms in nonmedical healthcare workers compared to medical healthcare workers (Tan et al., 2020). However, this difference could be due to the fact that their sample of nonmedical healthcare workers included both allied healthcare professionals and clerical staff.

3.4.1 Conclusions

In conclusion, the baseline findings of the "Healthcare workers' wellbeing (Benessere Operatori)" project identified nurses in general and healthcare workers operating in COVID wards as vulnerable categories. Despite the sub-threshold distress scores obtained by our sample, the pandemic placed a heavy burden on healthcare workers and the healthcare system in general. Thus, it is essential to keep their distress levels monitored over time, paying particular attention to high-risk individuals. Consistently, policymakers should allocate funds for preventative interventions for these workers' mental health and reduce mental health stigma in clinical workplaces (Galbraith et al., 2020).

The present study illustrated a first profile of psychological responses to the COVID-19 situation in Italian healthcare workers. With the analyses of data derived from the next phases of the project, we will link socio-demographic characteristics, job-related variables, perceived social support, and coping strategies with psychological distress in response to the COVID-19 situation to identify risk and protective factors.

Our findings may assist government advisors and hospitals in providing targeted interventions for healthcare professionals in the face of the COVID-19 outbreak in Italy and other countries.

4. THE PSYCHOLOGICAL IMPACT OF THE COVID-19 PANDEMIC ON ITALIAN HEALTHCARE WORKERS: SIX-MONTH FOLLOW-UP[3]

4.1 Introduction

Healthcare settings may represent a challenging workplace, characterized by long and undefined working hours, excessive workloads, competitiveness of training, high responsibility, and constant exposure to suffering, illness, and mourning (Gray et al., 2019; Petrie et al., 2019). However, lack of time, stigma, and concerns around confidentiality may prevent seeking psychological support (Petrie et al., 2019; Wallace, 2012).

Consistently, increasing evidence shows that healthcare workers around the world report high levels of depression, anxiety, stress, burnout, and post-traumatic stress disorder (PTSD) (Gray et al., 2019; Mark & Smith, 2012). However, the literature is limited and the samples analyzed are heterogeneous, resulting in a prevalence of psychiatric symptoms ranging from 30% to 60% for physicians (Lacy & Chan, 2018; Mihailescu & Neiterman, 2019; West et al., 2018) and from 11% to 73% for nurses (Maharaj, Lees & Lal, 2018).

In turn, neglected mental health issues in healthcare workers can affect both team and individual work performance, resulting in reduced quality of care (Hall et al., 2016), lower patient satisfaction, and higher rates of medical errors and staff turnover (Fahrenkopf et al., 2008; Marvaldi et al., 2021; Hall et al., 2016), with a remarkable impact on the healthcare economy (Kim et al., 2018; Gray et al., 2019; Marvaldi et al., 2021).

This topic is currently of critical importance, given the detrimental consequences of the COVID-19 pandemic on the entire population (e.g., Xiong et al., 2020) and healthcare workers in particular (da Silva Neto et al., 2021), worsening already problematic and stressful workplace conditions. Indeed, frontline healthcare workers have been working for more than a year in unprecedented and critical circumstances to cope with the COVID-19 pandemic, while being exposed to potentially traumatic or stressful factors such as fear of contagion, a lack of personal protection equipment, longer

[3] This chapter is based on a paper, published as:
Perego, G., Cugnata, F., Brombin, C., Milano, F., Preti, E., Di Pierro, R., De Panfilis, C., Madeddu, F., & Di Mattei, V. E. (2022). The "Healthcare workers' wellbeing [Benessere Operatori]" project: a longitudinal evaluation of psychological responses of Italian healthcare workers during the COVID-19 pandemic. *J. of Clinical Medicine, 11*.

working hours, countless patient deaths and numerous critical patients, and continuous updates to hospital procedures (Marvaldi et al., 2021; Sahebi, 2021).

Although healthcare workers faced the second wave of the pandemic with more therapeutic knowledge than the first, they still had limited resources to care for COVID-19 patients. In fact, the unpredictability of the disease and the pandemic's course, the extremely high number of deaths and critical patients, and the necessity to make difficult choices about prioritizing care remained serious concerns about COVID-19 (Sahebi, 2021).

Several reviews and meta-analyses show that working in COVID-19 wards in such stressful and critical conditions affected healthcare workers' mental health, in terms of high rates of depression, anxiety, insomnia, burnout, and PTSD symptoms (Busch et al., 2021; d'Ettorre et al., 2021; da Silva Neto et al., 2021; Labrague, 2021; Luo et al., 2020; Sahebi, 2021; Sanghera et al., 2020). A recent meta-analysis (Marvaldi et al., 2021) found the following pooled prevalence of psychiatric outcomes among healthcare workers: 30% for anxiety, 31.1% for depression, 56.5% for acute stress, 20.2% for post-traumatic stress, and 44% for sleep disorders. However, as other two meta-analyses pointed out (Pappa et al., 2020; Sun et al., 2021), the majority of healthcare workers actually experienced mild psychiatric symptoms, with moderate and severe symptoms being less common.

This is in line with our baseline findings, which point to low or mild mental health issues among healthcare workers after the main peak of the outbreak's first phase (Di Mattei et al., 2021). Notwithstanding, the pandemic has evolved quickly, and early studies were unable to capture post-traumatic stress disorders and the mental health outcomes associated with a state of prolonged stress. Longitudinal studies are thus required to analyze the effect of time on these psychiatric outcomes (Marvaldi et al., 2021) and to differentiate the effect of the pandemic from all other pre-existing stressors in the hospital work environment (Magnavita et al., 2021).

In this chapter, findings of the "Healthcare workers' wellbeing [Benessere Operatori]" project will be illustrated to evaluate psychological distress, as well as socio-demographic, situational, and personal factors that may affect individuals' psychological response to the COVID-19 pandemic. All

these factors have been assessed twice: at baseline or T0 (between May 9 and July 13, 2020, after the main peak of the COVID-19 outbreak in Italy) and during the second wave or T1 (between December 5 and December 30, 2020). Along with more traditional mixed effects modelling approaches, an alternative advanced data mining approach, extending regression trees methodology to repeated measures data, has been applied. The applied procedure is extremely flexible and appealing since it allows for the identification of the best variables with the best cut-off values for discriminating among different outcome responses, while uncovering complex relationships among predictors. It thus provides an effective tool to be used in clinical practice to support decision making process.

4.2 Methods

4.2.1 Participants and Procedure

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the University of Milano-Bicocca (protocol n. 0024531/20), the Ethics Committee of the IRCCS San Raffaele Scientific Institute (protocol n. 109/2020), and the Ethics Committee of the Parma Local Health Authority (protocol n. PG0019826_2020).

After reading the informed consent, participants voluntarily completed an online survey administered through Qualtrics and sent to the e-mail address provided during the baseline assessment. We assessed participants' working conditions, individual perception of the COVID-19 situation, anxiety, depression, and insomnia symptoms, post-traumatic stress, state anger, and burnout levels. In the present study, we will also analyze coping strategies and perceived social support, measured during the baseline study.

In total, 344 healthcare workers participated in the second survey, ten of whom stated that they had not worked in the previous three months and were thus excluded from the analysis. Finally, statistical analyses have been carried out on a sample of 291 respondents with complete records on both demographic and psychological variables.

4.2.2 Measures

A self-report questionnaire was used to collect socio-demographic and work-related information from participants, including their age, gender, psychological/psychiatric history, ward in which they worked, and whether they had received emergency training.

The Depression Anxiety Stress Scale-21 (DASS-21 - Lovibond & Lovibond, 1995; Bottesi et al., 2015) is a 21-item scale that assesses general distress using a tripartite model of psychopathology. This questionnaire includes three subscales: depression, anxiety, and stress. Each item is rated on a 4-level Likert scale (0=never; 3=almost always). The total score is calculated by adding together the response values for each item. Higher scores suggest severe levels of depressive, anxiety, and stress symptoms. The depression subscale score (e.g., "I felt I wasn't worth much as a person") is classified as normal (0–9), mild (10–12), moderate (13–20), severe (21–27), and extremely severe depression (28–42). The anxiety subscale score (e.g., "I felt scared without any good reason") is divided into normal (0–6), mild (7–9), moderate (10–14), severe (15–19), and extremely severe anxiety (20–42). The stress subscale score (e.g., "I found it difficult to relax") is grouped into normal (0–10), mild (11–18), moderate (19–26), severe (27–34), and extremely severe stress (35–42). The original version of the questionnaire showed an internal reliability with Cronbach's alpha coefficient of .91 for the depression scale, .84 for the anxiety scale, and .90 for the stress scale (Lovibond & Lovibond, 1995). The total score of the Italian version reported a Cronbach's alpha value of .90, with subscales values ranging from .74 to .85 (Bottesi et al., 2015).

The Insomnia Severity Index (ISI - Morin, 1993; Castronovo et al., 2016) is a self-report questionnaire that assesses the nature, severity and impact of insomnia using 7 items rated on a 5-level Likert scale (0="no problem"; 4="very severe problem"). Scores range from 0 to 28 and are divided into four categories: absence of insomnia (0–7); sub-threshold insomnia (8–14); moderate insomnia (15–

21); and severe insomnia (22–28). The dimensions evaluated are severity of sleep onset, sleep maintenance, early morning awakening problems, sleep dissatisfaction, interference of sleep difficulties with daytime functioning, noticeability of sleep problems by others, and distress caused by the sleep difficulties. The original version of the ISI reported a Cronbach's alpha coefficient of .74 (Morin, 1993). The Italian version showed a Cronbach's alpha coefficient of .75 (Castronovo et al., 2016).

The Impact of Event Scale – Revised (IES-R - Weiss & Marmar, 1997; Pietrantonio et al., 2003) is a 22-item self-report questionnaire evaluating the frequency of intrusive and avoidant thoughts and behaviors associated with a traumatic event. Items are rated on a 5-points Likert scale (0="not at all"; 4="extremely"). The IES-R is divided into three subscales. Intrusion (8 items) assesses intrusive thoughts, nightmares, intrusive feelings, and imagery related to the traumatic event; Avoidance (8 items) evaluates avoidance of feelings, situations, and ideas; Hyperarousal (6 items) measures difficulty in concentrating, anger and irritability, psychophysiological arousal in response to reminders, and hypervigilance. The original version showed high levels of internal consistency (Intrusion: α=.87-.94, Avoidance: α=.84-.87, Hyperarousal: α=.79-.91; Weiss & Marmar, 1997). The Italian version shows good (.84) and acceptable (.71) internal consistency for the intrusion subscale and the avoidance subscale, respectively (Pietrantonio et al., 2003).

The State-Trait Anger Expression Inventory-2 (STAXI-2 - Spielberger, 1999, 2004) is a 57-item self-report questionnaire that measures five domains of anger: State-Anger, Trait-Anger, Anger Expression-In, Anger Expression-Out, and Anger-Control. Responses are rated on a 4-point Likert scale, ranging from 1 (not at all) to 4 (almost always). Cronbach's α coefficients range from .73 to .76, indicating high internal reliability for all the subscales except for the Trait Anger Scale/Angry Reaction (Spielberger, 1999). In the present study, we only used the State-Anger subscale to assess healthcare workers' acute reaction to the pandemic.

The Maslach Burnout Inventory (MBI - Maslach & Jackson, 1981; Sirigatti & Stefanile, 1993) consists of 22 items divided into three subscales that assess the three components of the burnout syndrome: emotional exhaustion (9 items), depersonalization (5 items) and personal accomplishment (8 items). Each item is rated on a 7-point Likert scale (0="never"; 6="every day"). Subscales scores for Italian healthcare workers are classified as follows: for the emotional exhaustion subscale scores are split up into low (≤14), medium (15-23), and high (≥24), for the depersonalization subscale scores are divided into low (≤3), medium (4-8), and high (≥9), and for the personal accomplishment subscale scores are grouped into low (≥37), medium (30-36), and high (≤29) (Sirigatti & Stefanile, 1993). The subscales showed good internal consistency both for the original version (emotional exhaustion: α=.90, depersonalization: α=.79, personal accomplishment: α=.71; Maslach & Jackson, 1981) and for the Italian version (emotional exhaustion: α=.87, depersonalization: α=.68, personal accomplishment: α=.76; Sirigatti & Stefanile, 1993).

The Brief Cope (Carver, 1997; Monzani et al., 2015) is a 28-item questionnaire, divided into 14 subscales, measuring coping responses. Each item is rated on a 4-level Likert scale (0="I have not been doing this at all"; 3="I have been doing this a lot"). Coping strategies can be grouped into problem-focused (strategies aimed at changing a stressful situation: Active coping, Use of instrumental support, Positive reframing, and Planning), emotion-focused (strategies to regulate emotions associated with a stressful situation: Use of emotional support, Venting, Humor, Acceptance, Self-blame, and Religion), and avoidance coping strategies (physical or cognitive efforts to disengage from the stressor: Self-distraction, Denial, Substance use, and Behavioral disengagement) (Dias et al., 2012; Poulus et al., 2020). The original version of the questionnaire showed Cronbach's alpha coefficients ranging from .50 to .90 (Carver, 1997), while the Italian version of the questionnaire revealed omega coefficients for reliability ranging from .439 to .959 (Monzani et al., 2015).

The Multidimensional Scale of Perceived Social Support (MSPSS - Zimet et al., 1988; Di Fabio & Busoni, 2008) is a 12-item self-administered questionnaire evaluating social support perceived by family, friends, and significant others, rated on a 7-point Likert scale (1="very strongly disagree"; 7="very strongly agree"). Higher scores indicate higher perceived social support. The internal reliability of the questionnaire is good, with Cronbach's alpha coefficients ranging from .85 to .91 (Zimet et al., 1990). The Italian version shows good indices of reliability with Cronbach's alpha coefficients ranging from .81 to .98 (Di Fabio & Palazzeschi, 2015).

Furthermore, we assessed how worried participants were about the possibility that themselves, their relatives, their friends, and their colleagues could contract COVID-19. Four items were rated on a 5-point Likert scale (1="not at all"; 5="extremely"). A total score of worry was obtained by averaging items scores.

Finally, we evaluated participants' working conditions over the previous three months in several areas, including eating, sleeping, working shifts, isolation, and wearing appropriate protective equipment. Seven items were rated on a 5-point Likert scale (1="not at all"; 5="very much"). A total score of working conditions was obtained by averaging items scores. Higher scores indicate worse working conditions.

Table S1 reports Cronbach's alpha values calculated for this sample at T0 and T1.

4.2.3 Statistical Analysis

Median and interquartile range (IQR) were used as summary statistics to describe continuous variables, while categorical variables were expressed as frequencies and percentages. Moreover, radar plots were used to allow for an effective comparison at a descriptive and visual level between

measurements collected during the two evaluations, as well as to highlight differences in the psychological profiles of different healthcare worker categories.

Linear mixed-effects (LME) models (Pinheiro & Bates, 2000) were applied to evaluate the changes in the selected psychological outcomes over time while accounting for respondent-specific heterogeneity through random effects specification. The variables included in the models were: time (categorical with two levels, T0 and T1, respectively at baseline and during the second wave), gender, occupation, working or having worked in COVID-19 wards (time dependent variable), worry scores and the evaluation of working conditions, the presence of psychological or psychiatric symptoms in the past, having attended an emergency training, perceived social support as measured by the MSPSS, the three Brief COPE subscales (problem-focused, emotion-focused, and avoidant coping strategies). To highlight specific differences in the outcome variables over time for the different healthcare workers categories, we also entered in the model the interaction between occupation and time.

To examine psychological measures dynamics over time within a data mining framework, an extension of regression trees methodology accounting for correlation structure among observations was considered. This approach is suited for studies with repeated measures and longitudinal data. In particular, the tree-based estimation method proposed and implemented in the R RE-EMtree package by Sela and Simonoff (2011) was considered.

The algorithm underlying the estimation of a Random Effects/Expectation Maximization (RE-EM) Tree is iterative and combines regression tree methodology with linear mixed modelling. In the initial tree building phase, the correlation structure among observations is disregarded. The resulting tree structure is then used to estimate a linear mixed effects model. In the derived final tree, predicted responses at each terminal node account also for the random effects (Sela and Simonoff, 2011).

A regression tree, as proposed by Breiman et al. (1984), implements a binary recursive partitioning in which predictor variables that best discriminate among response profiles, along with the optimal

cut-points, are automatically chosen. The splitting criterion is based on maximizing the reduction in sum of squares for the node until convergence is reached. The approach is very flexible in handling missing values and both quantitative and qualitative predictors.

Following the branches of the resulting tree, hence considering rules derived from variables' best cut-off values, it is possible to derive different patterns of longitudinal responses. Regression trees provide an effective tool to be used in clinical practice for supporting decision making process, since they allow to identify relevant variables associated with different outcomes while uncovering complex relationships among predictors. Trees were estimated using the same covariates included in the mixed effects models.

4.3 Results

Participants' characteristics are shown in Table 1. The final sample included 291 participants. The median age was 46 years (IQR=[35.00, 54.00]) ranging from 23 to 72 years; 239 (82.1%) were female. 23% (n = 67) of the sample reported having a psychological/psychiatric history, and only 16.8% (n=49) reported having undergone an emergency training.

Concerning their occupation, 31.3% (n = 91) of the participants were physicians, 33.3% (n = 97) were nurses, 27.9% (n = 81) were other healthcare workers (i.e., psychologists, physiotherapists, healthcare assistants, midwives, radiology technicians, laboratory technicians, psychiatric rehabilitation technicians, speech therapists, social workers, and biologists), and 7.6% (n = 22) were clerks. At T0, 33.3% (n = 97) of the participants worked in a COVID-19 ward, and 15.5% (n = 45) worked in a COVID-19 ward at T1.

Table 1. Demographic, clinical, and occupational characteristics (n=291).

Age (median [IQR]) – *years*	46.00 [35.00, 54.00]
Gender = Female - no. (%)	239 (82.1%)
Psych history = Yes - no. (%)	67 (23.0%)
Emergency training = Yes - no. (%)	49 (16.8%)
Occupation	

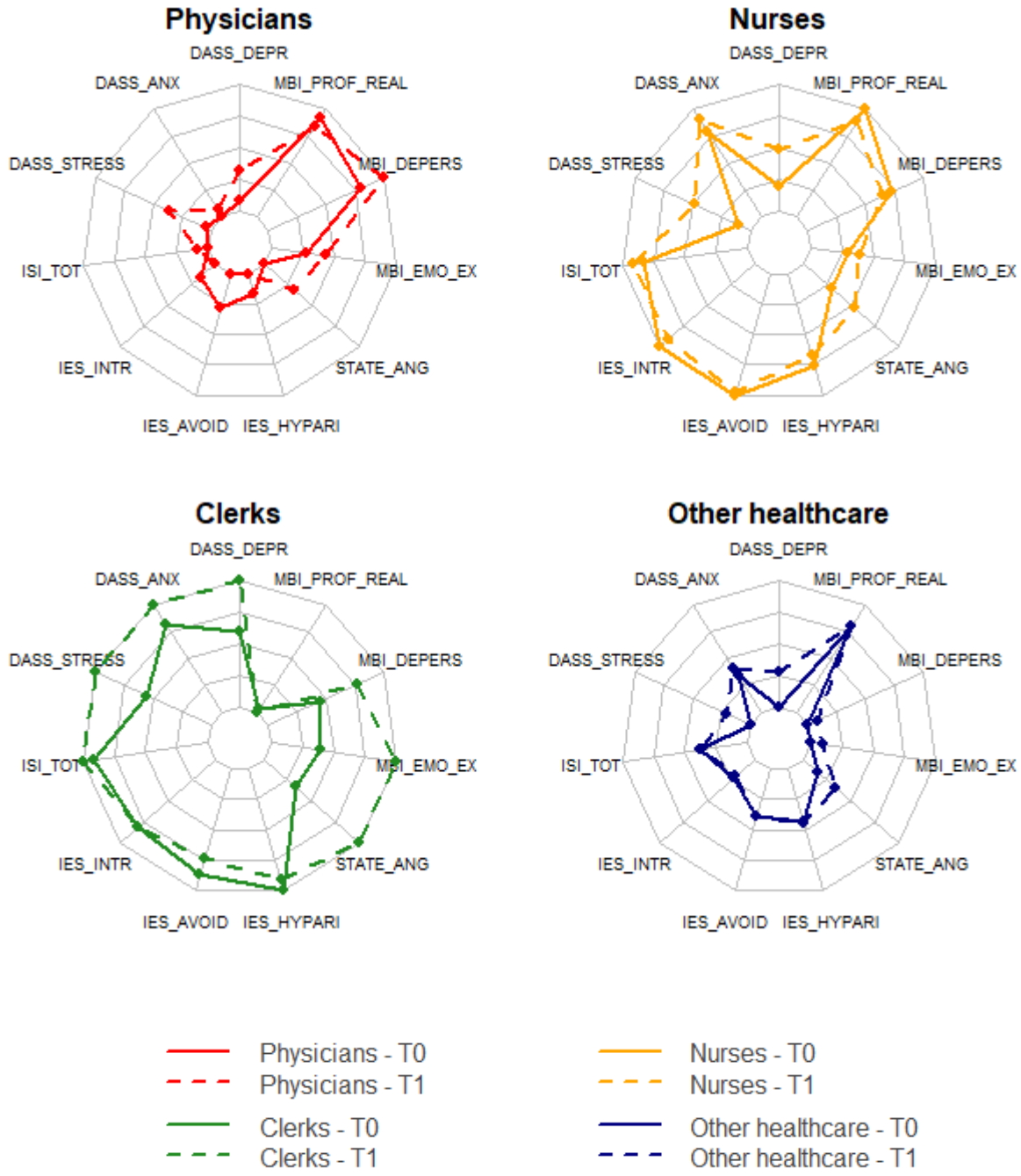
Physicians - no. (%)	91 (31.3%)
Nurses - no. (%)	97 (33.3%)
Clerks - no. (%)	22 (7.6%)
Other healthcare - no. (%)	81 (27.8%)
T0 - Ward COVID-19 = Yes - no. (%)	97 (33.3%)
T1 - Ward COVID-19 = Yes - no. (%)	45 (15.5%)

Table 2 shows the characteristics of the participants stratified by occupation, and radar plots in Figure 1 display the average score of the psychological constructs of interest for each occupation group at each time point. Overall clerks reported higher average scores on almost all the scales and their psychological condition seems to worsen at least at a descriptive level at the second time point. State-anger, DASS-21 scales and emotional exhaustion subscale are on average higher for all the healthcare workers at the second time point (for the sake of completeness, summary statistics of psychological constructs at T0 and T1 for each healthcare worker category are reported in Table S2).

Table 2. Demographic, clinical, and occupational characteristics stratified by occupation (n=291).

	Physicians (n=91)	**Nurses (n=97)**	**Clerks (n=22)**	**Other healthcare (n=81)**
Age (median [IQR]) – *years*	46.00 [36.00, 56.50]	45.00 [34.00, 51.00]	46.50 [38.00, 53.00]	46.00 [34.00, 54.00]
Gender = Female – no. (%)	60 (65.9%)	88 (90.7%)	17 (77.3%)	74 (91.4%)
Psych history = Yes – no. (%)	28 (30.8%)	15 (15.5%)	4 (18.2%)	20 (24.7%)
Emergency training = Yes – no. (%)	16 (17.6%)	26 (26.8%)	-	7 (8.6%)
T0 – Ward COVID-19 = Yes – no. (%)	27 (29.7%)	54 (55.7%)	-	16 (19.8%)
T1 – Ward COVID-19 = Yes – no. (%)	13 (14.3%)	24 (24.7%)	-	8 (9.9%)
MSPSS (median [IQR])	72.00 [62.00, 77.00]	71.00 [61.00, 79.00]	67.00 [57.25, 75.75]	71.00 [62.00, 78.00]
COPE – Problem-Focused (median [IQR])	2.88 [2.50, 3.25]	3.00 [2.62, 3.38]	2.94 [2.75, 3.22]	3.00 [2.50, 3.38]
COPE –_Emotion-Focused (median [IQR])	2.25 [2.00, 2.50]	2.33 [2.17, 2.67]	2.25 [1.88, 2.40]	2.33 [2.08, 2.58]
COPE – Avoidant (median [IQR])	1.38 [1.19, 1.75]	1.62 [1.38, 1.88]	1.62 [1.38, 1.97]	1.50 [1.38, 1.75]
T0 – WORRY (median [IQR])	3.00 [2.50, 3.25]	3.25 [2.75, 3.75]	3.25 [2.81, 4.00]	3.25 [3.00, 3.75]
T0 – CONDWORK (median [IQR])	2.71 [2.41, 3.23]	2.86 [2.29, 3.50]	2.90 [2.45, 3.55]	2.43 [2.00, 2.83]
T1 – WORRY (median [IQR])	3.25 [3.00, 3.75]	3.25 [3.00, 4.00]	3.50 [3.06, 4.00]	3.25 [3.00, 4.00]
T1 – CONDWORK (median [IQR])	2.43 [2.00, 3.07]	2.43 [2.00, 2.86]	2.57 [2.18, 2.86]	2.14 [1.71, 2.57]

Figure 1. Radar charts displaying average scores of the investigated psychometric variables at T0 and T1 stratified by occupation (see Table S3 for summary statistics).



DASS-21 – depression, anxiety, and stress

Table 3 displays the estimated models for the DASS-21 subscales. The results show that all the DASS-21 subscales are not significantly different at T1 with respect to the baseline values (T0). Moreover, we found a significant positive effect of worry, working condition, and psychological/psychiatric

history in all models. Higher levels of worry, worse working conditions and having a psychological/psychiatric history significantly increase anxiety, depression, and stress levels. Having undergone an emergency training significantly decreases all DASS-21 subscales. Higher levels of perceived social support decrease only participants' depression levels. Considering the effects of coping strategies, we found that the use of problem-focused coping significantly decreases all DASS-21 subscales, avoidant coping significantly increases all DASS-21 subscales, and emotional-focused coping significantly increases only depression and stress levels. Finally, nurses show higher anxiety levels than physicians.

Figure 2 shows the estimated regression trees for the prediction of the DASS-21 subscales scores. For depression, among all the variables, the algorithm selected both avoidant coping and working conditions as the variables best discriminating among participants' response profiles. High levels of avoidant coping and worse working conditions predict the highest levels of depression, whereas low levels of avoidant coping and better working conditions predict lower levels of depression symptoms. For subjects with avoidant coping ≥ 2.2, the mean depression level is 4.4. Among subjects who have avoidant coping scores < 2.2, also working conditions do affect the depression level. In particular, for subjects with avoidant coping scores < 2.2 and working conditions ≥ 2.4, the predicted depression level is 2.9. For subjects having working conditions < 2.4 and avoidant coping scores between 1.7 and 2.2, the predicted depression level is 2.7, whereas for subjects having working conditions score < 2.4 and avoidant coping scores lower than 1.7, the predicted depression level is 2.

When anxiety is considered as an outcome, in addition to avoidant coping and working conditions, the algorithm selected the worry scale.

In particular, following the tree branches, participants with higher scores on worry scale (≥ 3.4) and avoidant coping scores greater than or equal to 2.2 show the highest average value equal to 3.9. Conversely, participants with scores on worry scale lower than 3.4 and showing avoidant coping scores lower than 1.9 show the lowest average value equal to 1.5. In the tree for stress,

psychiatric/psychological history and problem-focused coping strategy were selected, in addition to splitting variables characterizing the other two trees, to best discriminate among different response profiles.

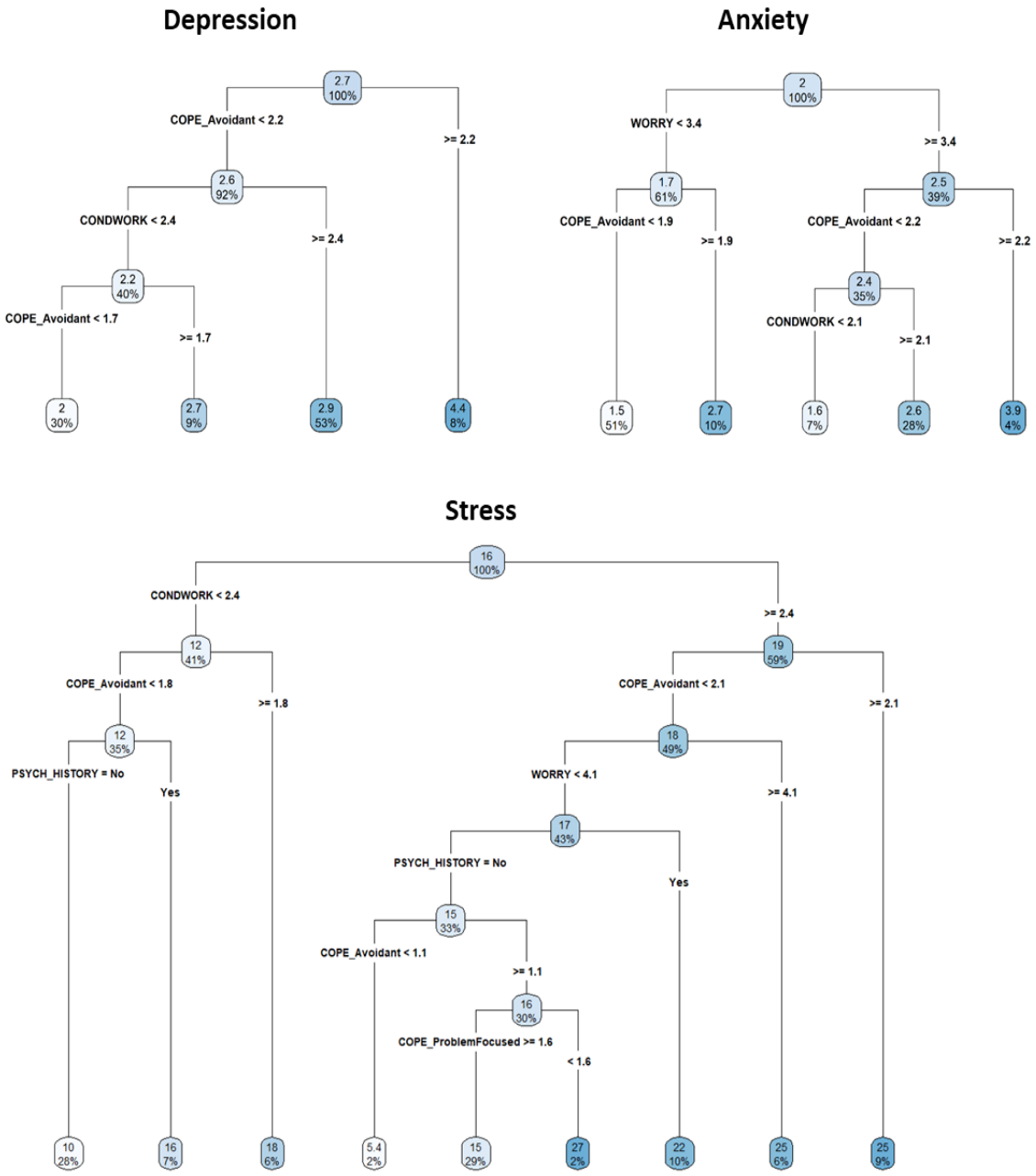
Table 3. Estimates (standard-errors) of the models for the DASS-21 subscales.

Parameter	Depression	Anxiety	Stress
Intercept	-0.69(0.73)	-2.14(0.67)**	-10.96(4.05)**
Time (T1 vs T0)	0.11(0.15)	-0.1(0.15)	1.68(0.96)
AGE	0(0.01)	0(0.01)	-0.03(0.04)
GENDER (Female vs Male)	0.18(0.19)	0.19(0.18)	0.02(1.05)
Occupation (Ref= Physicians)			
Nurses	-0.1(0.21)	0.58(0.2)**	-0.84(1.22)
Clerks	-0.05(0.34)	0.2(0.31)	-0.53(1.92)
Other healthcare	-0.16(0.22)	0.22(0.21)	-0.14(1.26)
WARD COVID (Yes vs No)	-0.11(0.14)	-0.1(0.14)	-1.6(0.85)
WORRY	0.39(0.09)***	0.54(0.09)***	2.41(0.53)***
CONDWORK	0.51(0.09)***	0.36(0.08)***	4.59(0.5)***
PSYCH HISTORY (Yes vs No)	0.63(0.17)***	0.64(0.16)***	4.88(0.93)***
EMERGENCY TRAINING (Yes vs No)	-0.44(0.2)*	-0.43(0.18)*	-2.42(1.07)*
MSPSS	-0.02(0.01)**	-0.003(0.005)	-0.05(0.03)
COPE – Problem-Focused	-0.47(0.16)**	-0.34(0.14)*	-2.64(0.85)**
COPE – Emotion-Focused	0.55(0.23)*	0.38(0.21)	3.98(1.24)**
COPE – Avoidant	1.03(0.19)***	0.93(0.17)***	5.88(1.02)***
T1 : Occupation = Nurses	0.33(0.21)	0.25(0.2)	1.5(1.29)
T1 : Occupation = Clerks	0.56(0.34)	0.37(0.32)	2.78(2.1)
T1 : Occupation = Other healthcare	0.19(0.22)	0.14(0.21)	0.06(1.35)

*** p<0.0001; ** p<0.01; * p<0.05

Figure 2. RE-EM tree for the DASS-21 subscales. Each tree represents a series of splits starting at the top of the tree. Starting from the top node, a series of questions are presented based on the splitting variables and corresponding cut-off values. Depending on the answer, other branches may appear till the final node, which displays the average predicted outcome value for participants satisfying all the conditions leading to that node and the proportion of subjects falling in the node itself. For example, in the first tree for depression scale, the top split assigns observations having avoidant coping scores greater than or equal to 2.2 to the right branch. The predicted depression level for these subjects is given by the mean response value for the individuals in the data set with avoidant coping ≥ 2.2. For such subjects, the mean depression level is 4.4. Among subjects who have avoidant coping scores < 2.2, also the working conditions does affect depression level. For subjects with avoidant coping score < 2.2 and working conditions ≥ 2.4, the predicted depression level is 2.9. For

subjects having working conditions < 2.4 and avoidant coping scores between 1.7 and 2.2, the predicted depression level is 2.7, whereas for subjects having working conditions score < 2.4 and avoidant coping scores lower than 1.7, the predicted depression level is 2. The same logic applies to all the other trees.



MBI emotional exhaustion, Insomnia, IES-R Intrusion, and State anger

Table 4 shows the estimated models for the MBI emotional exhaustion scale, the ISI score, the IES-R Intrusion score, and the State anger score. When comparing the two time points, the state anger score significantly increases at T1 with respect to the baseline values (T0). Only for clerks, also the MBI emotional exhaustions score significantly increases at T1 compared to T0. Focusing on the occupation, overall nurses report higher ISI levels and IES-R Intrusion levels than physicians. Higher levels of worry and worse working conditions significantly increase all the considered scales. A previous history of psychological or psychiatric symptoms significantly increases the MBI emotional exhaustion score, the ISI score, and the IES-R Intrusion score but not the State anger score. Older age significantly increases the ISI score and the IES-R Intrusion score. Having undergone an emergency training significantly decreases the ISI and IES-R Intrusion scores. Higher levels of perceived social support decrease the MBI emotional exhaustion score. Finally, we found that using avoidant coping significantly increases all considered scales and the use of problem-focused and emotion-focused coping strategies significantly influence the MBI emotional exhaustion scale and State anger scale.

Figure 3 shows the estimated regression trees for predicting emotional exhaustion, insomnia, intrusion, and state anger scores.

For emotional exhaustion, among all the variables, the algorithm selected working conditions, avoidant coping strategies, and survey administration time as those variables best discriminating among patients' profiles of response. In particular, worse working conditions and higher use of avoidant coping strategies will lead to the highest predicted levels of emotional exhaustion, whereas the lowest outcome score is predicted for participants with better working conditions (i.e., working conditions score lower than 2.4). Moreover, worse working conditions and avoidant coping scores lower than the cut-point value of 2.3, depending on the survey administration time, will lead to different predicted outcome scores, with higher predicted values at the time of the second survey (average emotional exhaustion is predicted to be 4.7 at time 1 vs. 4.2 at time 0).

For insomnia, among all the variables, the algorithm selected working conditions and the worry scale as the variables best discriminating among patients' profiles of response. In particular, worse working conditions and higher levels of worry will lead to the highest predicted levels of insomnia, whereas the lowest outcome score is predicted for participants with better working conditions (i.e., working conditions score lower than 2.4). Participants with worse working conditions and a level of worry lower than the cut-off value of 3.4 will have predicted values lying in the middle between those found in the previous two scenarios.

With reference to intrusion, working conditions, avoidant coping strategies, and scores on the worry scale are selected as best splitting variables to identify different response profiles. Higher use of avoidant coping strategies (i.e., at least greater than 1.8) will lead to higher predicted levels of intrusion.

When avoidant coping strategies are lower than the cut-off level of 1.8 and associated with better working conditions and lower levels of worry, the lowest levels of intrusion are predicted.

When avoidant coping strategies are lower than the cut-off level of 1.8 and associated with worse working conditions (i.e., score at least higher than 2.7), participant profiles with levels of intrusion lying in the middle between the best and the worst scenarios are identified.

For state anger, out of all the variables, only the worry scale plays a role in discriminating among participants' response profiles, with higher levels of worry leading to the highest predicted state anger score.

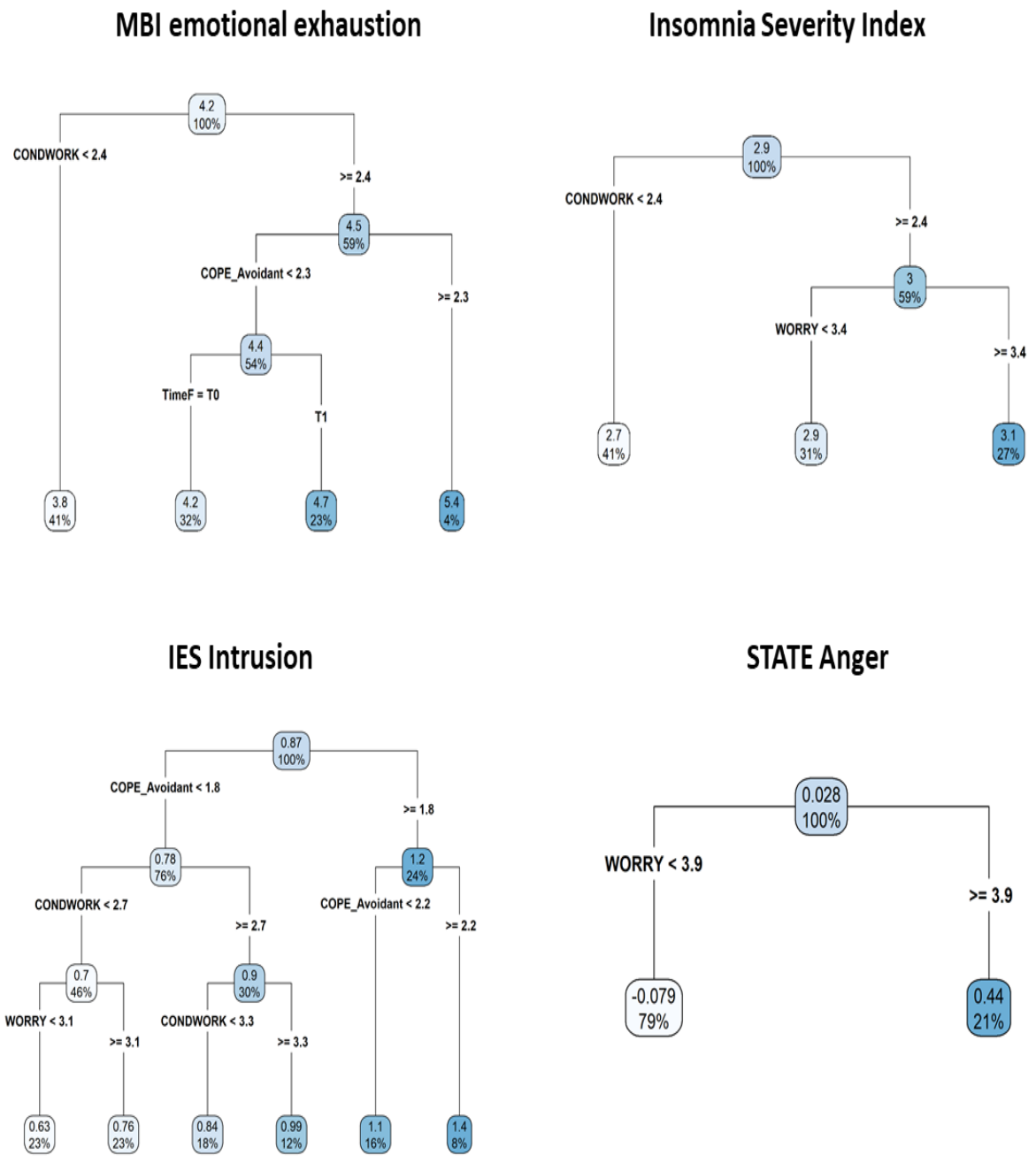
To provide a complete depiction of healthcare workers psychological conditions, estimated linear mixed models for depersonalization and personal accomplishment MBI subscales are reported in Table S4. In Table S5, linear estimated mixed models for the IES-R subscales of avoidance and hyperarousal are reported.

Table 4. Estimates (standard-errors) of the models for the MBI Emotional Exhaustion, ISI total score, IES-R Intrusion and State Anger.

Parameter	MBI EMO EX	ISI TOT	IES Intrusion	STATE Anger
Intercept	0.85(0.74)	0.44(0.28)	-1.01(0.19)***	-2.26(0.44)***
Time (T1 vs T0)	0.07(0.13)	0.02(0.06)	-0.02(0.03)	0.3(0.09)**
AGE	0.01(0.01)	0.01(0.003)***	0.005(0.002)*	0.002(0.004)
GENDER (Female vs Male)	0.37(0.2)	0.08(0.08)	0.07(0.05)	-0.21(0.12)
Occupation (Ref= Physicians)				
Nurses	-0.32(0.21)	0.28(0.08)***	0.16(0.06)**	0.06(0.13)
Clerks	-0.26(0.33)	0.12(0.13)	-0.03(0.09)	0.06(0.2)
Other healthcare	-0.52(0.22)	0.16(0.09)	-0.03(0.06)	0.23(0.13)
WARD COVID (Yes vs No)	-0.1(0.13)	-0.1(0.05)	-0.02(0.03)	0.16(0.09)
WORRY	0.32(0.09)***	0.19(0.04)***	0.13(0.02)***	0.23(0.06)***
CONDWORK	0.55(0.08)***	0.29(0.03)***	0.15(0.02)***	0.19(0.05)***
PSYCH HISTORY (Yes vs No)	0.74(0.18)***	0.23(0.07)***	0.17(0.05)***	0.2(0.1)
EMERGENCY TRAINING (Yes vs No)	-0.35(0.2)	-0.22(0.08)**	-0.14(0.05)**	-0.15(0.12)
MSPSS	-0.02(0.01)**	-0.002(0.002)	-0.002(0.001)	-0.002(0.003)
COPE – Problem-Focused	-0.51(0.16)**	-0.09(0.06)	-0.02(0.04)	-0.22(0.09)*
COPE – Emotion-Focused	0.79(0.23)***	0.07(0.09)	0.15(0.06)	0.34(0.14)*
COPE – Avoidant	0.84(0.19)***	0.35(0.07)***	0.37(0.05)***	0.54(0.11)***
T1 : Occupation = Nurses	0.21(0.18)	0.09(0.08)	0.04(0.04)	0.0003(0.12)
T1 : Occupation = Clerks	0.74(0.29)*	0.15(0.12)	0.09(0.07)	0.32(0.2)
T1 : Occupation = Other healthcare	0.13(0.18)	0.003(0.08)	0.04(0.05)	-0.25(0.13)

*** p<0.0001; ** p<0.01; * p<0.05

Figure 2. Estimated regression trees for Emotional exhaustion, Insomnia, Intrusion, and State anger.



4.4 Discussion

The present study is the second phase of a longitudinal study investigating the psychological consequences of the COVID-19 outbreak and their predictive factors in a sample of Italian healthcare workers. To our knowledge, this is one of the few longitudinal studies that monitored the mental health of healthcare workers during the COVID-19 outbreak (Dufour et al., 2021; Magnavita et al., 2021; Sasaki et al., 2021).

In general, the scores obtained by our sample on the psychological scales during the second phase do not significantly differ from the scores obtained during the first phase. Overall, regardless of the category of healthcare workers, our sample only showed an increase in state anger levels. Furthermore, during the second wave, clerks seemed to experience higher levels of burnout.

These results are in line with the scant literature, showing a substantial invariance of psychiatric symptoms among healthcare workers throughout the epidemic (Dufour et al., 2021; Magnavita et al., 2021; Sasaki et al., 2021).

However, working under chronic stress conditions and experiencing a poor quality of sleep both contribute to increased feelings of anger among healthcare workers during the COVID-19 outbreak (Albott et al., 2020; Lee et al., 2021). Moreover, during the second wave of the pandemic, public opinion appears to have shifted, and healthcare workers now feel less support, appreciation, and trust from the general population, and they are viewed less favorably than in the past (Magnavita et al., 2021). Consistently, during previous epidemics, feelings of anger seemed to be frequent among healthcare workers, caused by both long-term stressful working conditions and poor adherence to infection control guidelines, as well as rejection and stigma experienced from relatives and public opinion (Chew et al., 2020b).

Furthermore, the increasing levels of burnout experienced by clerks during the second phase may be explained by the end of smart-working and the subsequent return to work in hospitals.

Concerning predictive factors, our results highlight that higher levels of worry, worse working conditions, a previous history of psychiatric illness, being a nurse, older age, and avoidant and

emotion-focused coping strategies seem to be risk factors for healthcare workers' mental health. Conversely, high levels of perceived social support, the attendance of an emergency training, and problem-focused coping strategies seem to be protective factors for healthcare workers' mental health.

Specifically, worse working conditions and worry about the infection represent risk factors for higher levels of depression, anxiety, stress, burnout, PTSD, insomnia, and state anger. Considering the regression trees, a score greater than or equal to 2.4 in working conditions is a cut-off for higher scores of depression (for participants showing avoidant coping scores lower than 2.2), stress, burnout, and insomnia; a high worry score (≥ 3.9) is the only factor that distinguishes between the highest and lowest levels of state anger, whereas a score greater than or equal to 3.4 discriminates among participants with more extreme levels of anxiety and insomnia.

These findings are in line with the literature showing that difficult working environments, including poor supervision and organizational support, intense workload, a lack of personal protective equipment or its continuous use for many hours, and fear and concern about becoming infected or infecting relatives or colleagues, increase the psychological distress' levels of healthcare workers (Muller et al., 2020; Yuan et al., 2021- Varghese et al., 2021; Zhou et al., 2020).

Concerning demographic variables, older age seems a risk factor for higher levels of insomnia and intrusion symptoms. This result is consistent with the literature, which shows an association between increasing age and a physiological decline in sleep quality (Dzierzewski et al., 2018). Additionally, the literature identifies older age as a risk factor for PTSD symptoms during the COVID-19 pandemic, probably due to the elderly being a high-risk category for infection and death (Li et al., 2020; Qiu et al., 2020).

Moreover, a previous history of psychiatric illness seems to be a risk factor for higher levels of depression, anxiety, stress, burnout, PTSD, and insomnia symptoms. The current literature highlights that a history of psychiatric symptoms seems to make healthcare workers more

vulnerable and more likely to experience psychological distress during the COVID-19 emergency (Şahin et al., 2020; Dobson et al., 2021).

Furthermore, considering specific subgroups of healthcare workers, being a nurse seems to be a risk factor for higher levels of anxiety, PTSD intrusion symptoms, and insomnia. This result is consistent with the literature showing that being a nurse represents a risk factor for worse mental health, probably due to the longer time spent with patients in contact with their fears, suffering, and death (Sanghera et al., 2020; Shaukat et al., 2020; Vizheh et al., 2020; Yuan et al., 2021).

Concerning protective factors, having undergone emergency training predicts lower levels of depression, anxiety, stress, PTSD, and insomnia. This result is in line with the literature showing perceived adequacy of training as a protective factor for long-term psychiatric morbidity (Lancee et al., 2008), post-traumatic stress (Maunder et al., 2006; Tang et al., 2016), and burnout (Maunder et al., 2006) in previous epidemics. This is understandable given that the goal of emergency training is to improve healthcare workers' skills and abilities in order to increase their sense of control and avoid being overwhelmed during a real emergency (World Health Organization, 2018).

Additionally, high levels of perceived social support from family and friends seem to be a protective factor for lower depression and burnout symptoms. This result is consistent with the literature highlighting the role of high perceived social support from family, colleagues, and friends in helping healthcare workers to deal with work-related stress and increase self-confidence in their skills (Sanghera et al., 2020; Muller et al., 2020).

Concerning coping strategies, the use of avoidant strategies seems to be a risk factor for general mental health, as it predicts higher symptoms across all psychological subscales. Considering the regression trees, higher avoidant coping scores lead to the highest scores in the depression, anxiety, stress, burnout, and PTSD subscales.

The detrimental role of avoidant coping strategies is consistent with current literature as well as previous epidemic literature (Besirli et al., 2021; Tahara et al., 2020; Labrague, 2020; Marjanovic et al., 2007). Avoidance strategies, such as denial or self-distraction, may be helpful for short periods

of time to allow the person to continue with their tasks while also giving them some time to think. However, in the long-term, these coping strategies are dangerous for mental health, provoking dysfunctional detachment and distance from the problem while changing neither the situation nor the associated psychological distress (Carver et al., 1989; Ben-Zur, 2009).

Conversely, the use of problem-focused coping strategies seems to be a protective factor for lower levels of depression, anxiety, stress, burnout, and state anger. This result is in accordance with the literature showing that these strategies can increase feelings of autonomy and self-efficacy while reducing psychological distress (Besirli et al., 2021; Chew et al., 2020c; Labrague, 2021). These coping strategies may help in changing the meaning of the event and focusing on a specific goal, thereby increasing the perception of control, and avoiding being overwhelmed by the stressful situation (Ben-Zur, 2009; Carver et al., 1989).

Finally, the use of emotion-focused coping strategies seems to be a risk factor for higher levels of depression, stress, burnout, and state anger. The literature concerning emotion-focused coping strategies is contradictory (Ben-Zur, 2009; Labrague 2021), probably due to the heterogeneous nature of the strategies included in this subscale (e.g., use of emotional support and self-blaming). Moreover, during an emergency, problem-focused strategies appear more effective and adaptive than emotion-focused strategies (Di Monte et al., 2020). Probably, making difficult decisions in a stressful and extraordinary situation, with little knowledge about the disease and poor support from family and friends due to isolation, may be overwhelming if emotions are prioritized over the problem. Indeed, because of the governments' social restrictions policy in response to the COVID-19 emergency, a typically positive and protective coping strategy, such as the use of emotional support (Martinez et al., 2020; Chew et al., 2020c), could be a risk factor for poor mental health among healthcare workers (Babore et al., 2020; Di Monte et al., 2020; Chew et al., 2020c; Tahara et al., 2020).

4.4.1 Conclusions

Along with traditional modelling approach, the proposed data mining methodology allowed to derive classification rules and to identify risk and protective factors for healthcare workers psychological wellbeing, which should be monitored during emergency situations. Hence, this innovative statistical analysis strategy could provide more insight into the psychological aspects on which leverage when implementing training/intervention, programs, thereby helping healthcare workers to effectively deal with stressful situations. In the current context, much can be offered, such as virtual clinics and remotely delivered psychological therapies and psychoeducation. However, it is also necessary to reduce mental health stigma, as physicians appear generally reluctant to disclose their problems, even when they are experiencing significant psychological distress (Galbraith et al., 2021).

5. THE PSYCHOLOGICAL IMPACT OF THE COVID-19 PANDEMIC ON ITALIAN HEALTHCARE WORKERS: ONE-YEAR FOLLOW-UP[4]

5.1 Introduction

The COVID-19 pandemic started as a medical emergency, but quickly evolved into a psychological emergency (Xiong et al., 2020; Wu et al., 2021), highlighting the importance of mental health as a high public health priority (Latoo et al., 2021). Since the beginning of the outbreak, public attention focused on healthcare workers and their mental health. Indeed, healthcare workers all over the world have been working under stressful conditions with increased workloads to combat the epidemic for nearly two years (Th'ng, et al., 2021).

However, despite several reviews and meta-analyses indicating high levels of depression, anxiety, burnout, insomnia, and post-traumatic stress symptoms among healthcare workers during the pandemic (Busch et al., 2021; d'Ettorre et al., 2021; da Silva Neto et al., 2021; Labrague, 2021; Luo et al., 2020; Sahebi, 2021; Sanghera et al., 2020), a lack of longitudinal studies and literature on this topic prior to the COVID-19 outbreak makes it difficult to understand the global impact of the emergency on healthcare workers' mental health (Gualano et al., 2021; Marvaldi et al., 2021).

Although it may seem counterintuitive, the few longitudinal studies conducted reveal that most healthcare workers are coping with the health emergency experiencing mild psychiatric symptoms (Dufour et al., 2021; Th'ng, et al., 2021). The public outpouring of support and appreciation, particularly during the early stages of the outbreak, most likely increased feelings of pride and accomplishment, allowing healthcare workers to continue working without feeling completely overwhelmed (El Ouni et al., 2021; van Leeuwen et al., 2021).

Several socio-demographic and work-related factors have been identified as protective elements for mental health, including being married (Varghese et al., 2021), having children (Babore et al., 2020; Evanoff et al., 2020; Th'ng et al., 2021), having social support from relatives and colleagues (Babore et al., 2020; Evanoff et al., 2020; Muller et al, 2020), working with adequate personal

[4] This chapter is based on a paper, currently proposed for publication as:
Perego, G., Cugnata, F., Brombin, C., Milano, F., Mazzetti, M., Taranto, P., Preti, E., Di Pierro, R., De Panfilis, C., Madeddu, F., & Di Mattei, V. (under review). Analysis of healthcare workers' mental health during the COVID-19 Pandemic: Evidence from a Three-Wave Longitudinal Study. *Journal of Health Psychology*.

protective equipment (Varghese et al., 2021), and perceiving support and appreciation from supervisors and the community (El Ouni et al., 2021; Th'ng et al., 2021; Gualano et al., 2021).

Similarly, risk factors for psychiatric symptoms include both personal (i.e., female gender, living with elderly parents, worrying about being infected, and worrying about family members being infected) and work-related characteristics (i.e., being a nurse, having fewer years of working experience, a heavy workload, working in unsafe settings, a lack of training, working on the frontline at direct contact with COVID-19 patients, and working in areas with a high incidence of infection) (d'Ettore et al., 2021; Muller et al., 2020; da Silva Neto et al., 2021; Sanghera et al., 2020; Shaukat et al., 2020; Vizheh, 2020). Moreover, among the coping strategies used by healthcare workers during the COVID-19 outbreak, humor seems to be a protective factor (Besirli, 2020; Canestrari et al., 2021), whereas avoidance strategies (i.e., denial and substance use) seem to be risk factors for their mental health (Besirli, 2020; Halayem et al., 2020; Canestrari et al., 2021).

Notwithstanding, the impact of the pandemic on the mental health of healthcare workers may vary depending on the stage of the outbreak (van Leeuwen et al., 2021). Indeed, several waves of infection have occurred since March 2020, with high peaks of contagions and a high number of deaths. Moreover, in the last two years, to combat the spread of contagions, the government has alternated months characterized by strong restrictions (e.g., lockdown, closure of shops and restaurants, and curfew) with months marked by few or no restrictions. As a result, a longitudinal approach in which experiences are measured at multiple time points is more appropriate for studying possible changes in healthcare workers' mental health (Gualano et al., 2021; Marvaldi et al., 2021).

In this chapter, findings from the third phase of the "Healthcare workers' wellbeing [Benessere Operatori]" project will be presented. The third phase of the study, which took place between May 22 and July 9, 2021, sought to investigate the long-term psychological consequences of the COVID-19 pandemic on healthcare workers, as well as to evaluate the predictive role of socio-demographic and work-related factors on mental health. Since data were collected after the third wave, when

the majority of COVID wards in Italy were closed, the hospitals were not overloaded, and there were few restrictions, we did not expect an increase in psychiatric symptoms throughout the sample.

5.2 Methods

5.2.1 Participants and Procedure

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the University of Milano-Bicocca (protocol n. 0024531/20), the Ethics Committee of the IRCCS San Raffaele Scientific Institute (protocol n. 109/2020), and the Ethics Committee of the Parma Local Health Authority (protocol n. PG0019826_2020).

After reading the informed consent, participants voluntarily completed an online survey administered through Qualtrics and sent to the e-mail address provided during the baseline assessment. We assessed participants' working conditions, individual perception of the COVID-19 situation, anxiety, depression, and insomnia symptoms, post-traumatic stress, state anger, and burnout levels. All these factors were evaluated three times at six-month intervals: at baseline or T0 (between May 9 and July 13, 2020, after the main peak of the COVID-19 outbreak in Italy), during the second wave or T1 (between December 5 and December 30, 2020), and after the third wave or T2 (between May 22 and July 9, 2021). In the present study, we will also analyze coping strategies and perceived social support, measured during the baseline study.

In total, 407 healthcare workers participated both in the first survey and in the second or in the third one.

5.2.2 Measures

A self-report questionnaire was used to collect socio-demographic and work-related information from participants, including their age, gender, whether they lived alone or with someone else,

psychological/psychiatric history, ward in which they worked, and whether they had received emergency training.

The Depression Anxiety Stress Scale-21 (DASS-21 - Lovibond & Lovibond, 1995; Bottesi et al., 2015) is a 21-item scale that assesses general distress using a tripartite model of psychopathology. This questionnaire includes three subscales: depression, anxiety, and stress. Each item is rated on a 4-level Likert scale (0=never; 3=almost always). The total score is calculated by adding together the response values for each item. Higher scores suggest severe levels of depressive, anxiety, and stress symptoms. The depression subscale score (e.g., "I felt I wasn't worth much as a person") is classified as normal (0–9), mild (10–12), moderate (13–20), severe (21–27), and extremely severe depression (28–42). The anxiety subscale score (e.g., "I felt scared without any good reason") is divided into normal (0–6), mild (7–9), moderate (10–14), severe (15–19), and extremely severe anxiety (20–42). The stress subscale score (e.g., "I found it difficult to relax") is grouped into normal (0–10), mild (11–18), moderate (19–26), severe (27–34), and extremely severe stress (35–42). The original version of the questionnaire showed an internal reliability with Cronbach's alpha coefficient of .91 for the depression scale, .84 for the anxiety scale, and .90 for the stress scale (Lovibond & Lovibond, 1995). The total score of the Italian version reported a Cronbach's alpha value of .90, with subscales values ranging from .74 to .85 (Bottesi et al., 2015).

The Insomnia Severity Index (ISI - Morin, 1993; Castronovo et al., 2016) is a self-report questionnaire that assesses the nature, severity and impact of insomnia using 7 items rated on a 5-level Likert scale (0="no problem"; 4="very severe problem"). Scores range from 0 to 28 and are divided into four categories: absence of insomnia (0–7); sub-threshold insomnia (8–14); moderate insomnia (15–21); and severe insomnia (22–28). The dimensions evaluated are severity of sleep onset, sleep maintenance, early morning awakening problems, sleep dissatisfaction, interference of sleep difficulties with daytime functioning, noticeability of sleep problems by others, and distress caused

by the sleep difficulties. The original version of the ISI reported a Cronbach's alpha coefficient of .74 (Morin, 1993). The Italian version showed a Cronbach's alpha coefficient of .75 (Castronovo et al., 2016).

The Impact of Event Scale – Revised (IES-R - Weiss & Marmar, 1997; Pietrantonio et al., 2003) is a 22-item self-report questionnaire evaluating the frequency of intrusive and avoidant thoughts and behaviors associated with a traumatic event. Items are rated on a 5-points Likert scale (0="not at all"; 4="extremely"). The IES-R is divided into three subscales. Intrusion (8 items) assesses intrusive thoughts, nightmares, intrusive feelings, and imagery related to the traumatic event; Avoidance (8 items) evaluates avoidance of feelings, situations, and ideas; Hyperarousal (6 items) measures difficulty in concentrating, anger and irritability, psychophysiological arousal in response to reminders, and hypervigilance. The original version showed high levels of internal consistency (Intrusion: α=.87-.94, Avoidance: α=.84-.87, Hyperarousal: α=.79-.91; Weiss & Marmar, 1997). The Italian version shows good (.84) and acceptable (.71) internal consistency for the intrusion subscale and the avoidance subscale, respectively (Pietrantonio et al., 2003).

The State-Trait Anger Expression Inventory-2 (STAXI-2 – Spielberger, 1999, 2004) is a 57-item self-report questionnaire that measures five domains of anger: State-Anger, Trait-Anger, Anger Expression-In, Anger Expression-Out, and Anger-Control. Responses are rated on a 4-point Likert scale, ranging from 1 (not at all) to 4 (almost always). Cronbach's α coefficients range from .73 to .76, indicating high internal reliability for all the subscales except for the Trait Anger Scale/Angry Reaction (Spielberger, 1999). In the present study, we only used the State-Anger subscale to assess healthcare workers' acute reaction to the pandemic.

The Maslach Burnout Inventory (MBI – Maslach & Jackson, 1981; Sirigatti & Stefanile, 1993) consists of 22 items divided into three subscales that assess the three components of the burnout syndrome: emotional exhaustion (9 items), depersonalization (5 items) and personal accomplishment (8 items).

Each item is rated on a 7-point Likert scale (0="never"; 6="every day"). Subscales scores for Italian healthcare workers are classified as follows: for the emotional exhaustion subscale scores are split up into low (≤14), medium (15-23), and high (≥24), for the depersonalization subscale scores are divided into low (≤3), medium (4-8), and high (≥9), and for the personal accomplishment subscale scores are grouped into low (≥37), medium (30-36), and high (≤29) (Sirigatti & Stefanile, 1993). The subscales showed good internal consistency both for the original version (emotional exhaustion: α=.90, depersonalization: α=.79, personal accomplishment: α=.71; Maslach & Jackson, 1981) and for the Italian version (emotional exhaustion: α=.87, depersonalization: α=.68, personal accomplishment: α=.76; Sirigatti & Stefanile, 1993).

The Brief Cope (Carver, 1997; Monzani et al., 2015) is a 28-item questionnaire, divided into 14 subscales, measuring coping responses. Each item is rated on a 4-level Likert scale (0="I have not been doing this at all"; 3="I have been doing this a lot"). Coping strategies can be grouped into problem-focused (strategies aimed at changing a stressful situation: Active coping, Use of instrumental support, Positive reframing, and Planning), emotion-focused (strategies to regulate emotions associated with a stressful situation: Use of emotional support, Venting, Humor, Acceptance, Self-blame, and Religion), and avoidance coping strategies (physical or cognitive efforts to disengage from the stressor: Self-distraction, Denial, Substance use, and Behavioral disengagement) (Dias et al., 2012; Poulus et al., 2020). The original version of the questionnaire showed Cronbach's alpha coefficients ranging from .50 to .90 (Carver, 1997), while the Italian version of the questionnaire revealed omega coefficients for reliability ranging from .439 to .959 (Monzani et al., 2015).

The Multidimensional Scale of Perceived Social Support (MSPSS - Zimet et al., 1988; Di Fabio & Busoni, 2008) is a 12-item self-administered questionnaire evaluating social support perceived by family, friends, and significant others, rated on a 7-point Likert scale (1="very strongly disagree";

7="very strongly agree"). Higher scores indicate higher perceived social support. The internal reliability of the questionnaire is good, with Cronbach's alpha coefficients ranging from .85 to .91 (Zimet et al., 1990). The Italian version shows good indices of reliability with Cronbach's alpha coefficients ranging from .81 to .98 (Di Fabio & Busoni, 2008).

Furthermore, we assessed how worried participants were about the possibility that themselves, their relatives, their friends, and their colleagues could contract COVID-19. Four items were rated on a 5-point Likert scale (1="not at all"; 5="extremely"). A total score of worry was obtained by averaging items scores.

Moreover, we evaluated participants' working conditions over the previous three months in several areas, including eating, sleeping, working shifts, isolation, and wearing appropriate protective equipment. Seven items were rated on a 5-point Likert scale (1="not at all"; 5="very much"). A total score of working conditions was obtained by averaging items scores. Higher scores indicate worse working conditions.

In addition, we asked healthcare workers how much they felt they were at risk of making mistakes over the previous three months. One item was rated on a 5-point Likert scale (1="not at all"; 5="very much"), with a higher score indicating a higher risk perception.

Finally, we assessed how much participants thought they needed psychological or psychiatric support. One item was rated on a 5-point Likert scale (1="not at all"; 5="very much"), with a higher score indicating a greater need.

Only at T1 and T2, we measured how much participants felt appreciated by hospital direction and the community. Moreover, we asked how much they felt that hospital direction was doing

something for their protection and/or wellbeing. Three items were independently rated on a 5-point Likert scale (1="not at all"; 5="very much"), with higher scores indicating a greater sense of satisfaction.

Table S6 reports Cronbach's alpha values calculated for this sample at T0, T1, and T2.

5.2.3 Statistical Analysis

Median and interquartile range (IQR) were used to describe continuous variables, while categorical variables were summarized in terms of frequencies and percentages. Radar plots were used to effectively display and compare the scores obtained by the different healthcare worker categories on the psychological variables collected in the survey's three administrations.

Linear mixed-effects (LME) models (Pinheiro & Bates, 2000) were applied to evaluate the changes in the psychological outcomes of interest over time while accounting for respondent-specific heterogeneity through random effects specification. A first set of models were estimated including the following independent variables: time (categorical with three levels, T0, T1, and T2 corresponding to the three survey administration's times), gender, occupation, working or having worked in COVID-19 wards, worry scores and the evaluation of working conditions, the presence of psychological or psychiatric symptoms in the past, having attended an emergency training, perceived social support as measured by the MSPSS, and the three Brief COPE subscales (problem-focused, emotion-focused, and avoidant coping strategies). To highlight specific differences in the outcome variables over time for the different healthcare workers categories, we also entered in the model an interaction between occupation and time.

Within the same framework, we also estimated LME models to evaluate the impact of feeling appreciated by the hospital direction and the community, as measured by the three Likert items, on all the psychological scales of interest, while adjusting for time and working category. Standard

transformations (square root, power, ordered quantile normalization) were applied to outcome variables before entering in the LME model to satisfy model regression assumptions.

Generalized mixed-effects (GLMER) models for binary data were also estimated to evaluate the effect of psychological scales (entered in the model one by one) on how much respondents felt at risk of making mistakes over the previous three months, and on how they thought to need psychological or psychiatric support, while adjusting for time and working category. In particular, "much" and "very much" response categories (i.e., 4 and 5 ratings) were aggregated in one category to be compared to all the other response categories, thus generating a binary outcome.

5.3 Results

Statistical analyses have been carried out on a sample of 325 respondents with complete records on both demographic and psychological variables. Specifically, 189 subjects took part in all three surveys, with 88 taking part in the first and second surveys and 48 taking part in the first and third surveys.

Participants' characteristics are shown in Table 1. The median age was 46 years (IQR=[35.00, 54.00]), ranging from 23 to 79 years; 264 (81.2%) were female. 23.7% (n= 77) of the sample reported having a psychological/psychiatric history, and only 17.2% (n=56) reported having undergone an emergency training.

Concerning their occupation, 32.3% (n = 105) of the participants were physicians, 32.3% (n = 105) were nurses, 27.7% (n = 90) were other healthcare workers (i.e., psychologists, physiotherapists, healthcare assistants, midwives, radiology technicians, laboratory technicians, psychiatric rehabilitation technicians, speech therapists, social workers, and biologists), and 7.7% (n = 25) were clerks.

Table 1. Demographic, clinical, and occupational characteristics (n=325).

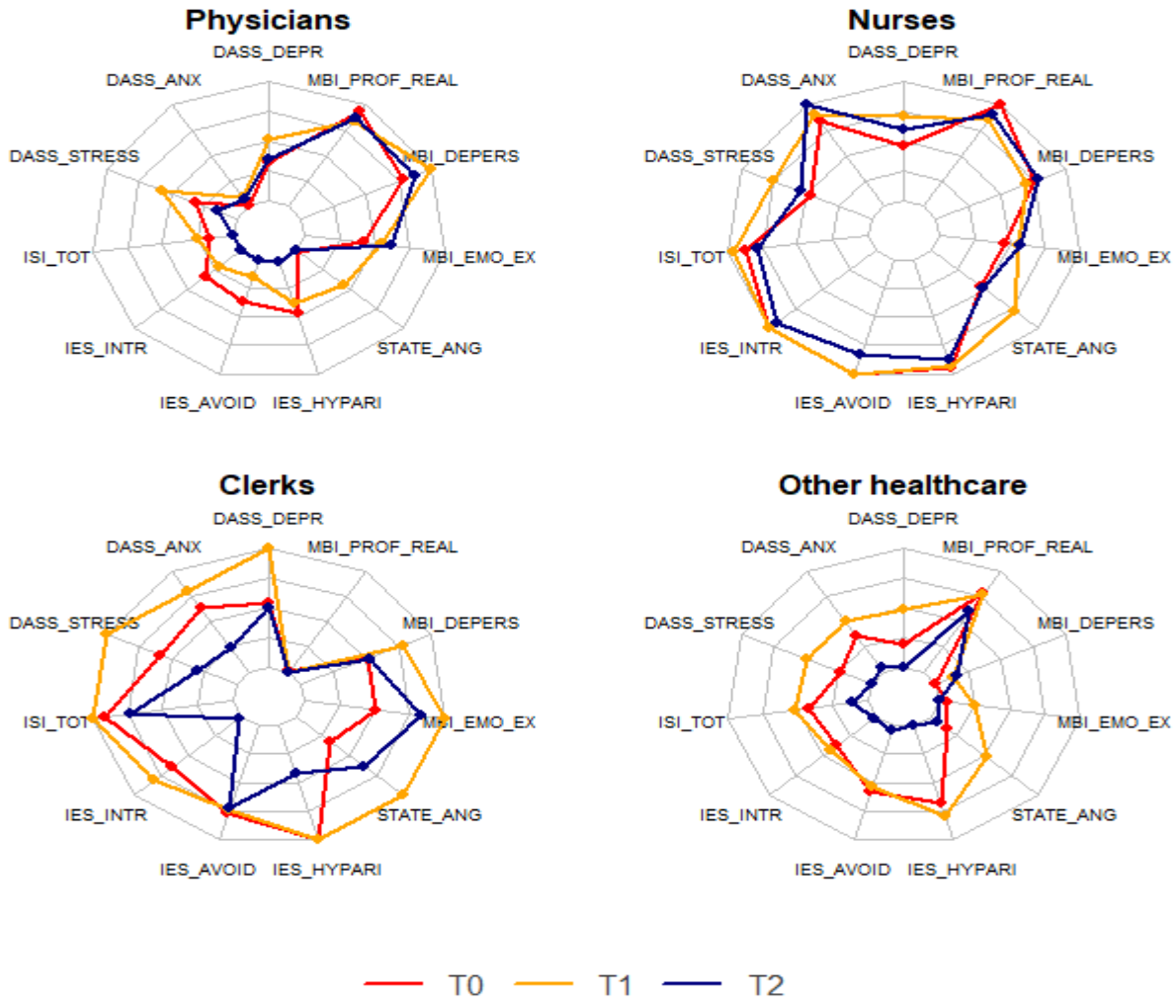
Age (median [IQR]) – *years*	46.00 [35.00, 54.00]
Gender = Female - no. (%)	264 (81.2)
Psych history = Yes - no. (%)	77 (23.7)
Emergency training = Yes - no. (%)	56 (17.2)
Occupation	
Physicians - no. (%)	105 (32.3)
Nurses - no. (%)	105 (32.3)
Clerks - no. (%)	25 (7.7)
Other healthcare - no. (%)	90 (27.7)
Live alone = Yes - no. (%)	49 (15.1)
T0 - Ward COVID-19 = Yes - no. (%)	107/325 (32.9)
T1 - Ward COVID-19 = Yes - no. (%)	43/277 (15.5)
T2 - Ward COVID-19 = Yes - no. (%)	14/237 (5.9)

Table 2 shows participants' characteristics stratified by occupation, and radar plots in Figure 1 display the average score of the psychological constructs of interest for each healthcare worker category at each time point. The same data are shown as mean and standard error in Table S7.

Table 2. Clinical, and occupational characteristics stratified by occupation (median [IQR]).

	Physicians	**Nurses**	**Clerks**	**Other healthcare**
MSPSS	70 [61, 77]	71 [61, 80]	68 [57, 78]	71.50 [62, 78]
COPE – Problem-Focused	2.88 [2.50, 3.25]	3.00 [2.62, 3.38]	2.88 [2.38, 3.12]	3.00 [2.50, 3.38]
COPE –_Emotion-Focused	2.25 [2.00, 2.50]	2.33 [2.08, 2.58]	2.17 [1.83, 2.33]	2.33 [2.00, 2.58]
COPE – Avoidant	1.50 [1.25, 1.75]	1.62 [1.38, 1.88]	1.62 [1.38, 2.00]	1.50 [1.38, 1.75]
T0 – WORRY	3.00 [2.50, 3.25]	3.25 [2.75, 3.75]	3.25 [2.75, 4.00]	3.25 [3.00, 3.50]
T1 – WORRY	3.25 [3.00, 3.75]	3.25 [3.00, 3.94]	3.50 [3.00, 4.00]	3.25 [3.00, 4.00]
T2 – WORRY	2.50 [2.25, 3.00]	2.75 [2.50, 3.50]	2.75 [2.25, 3.25]	2.75 [2.25, 3.25]
T0 – CONDWORK	2.67 [2.20, 3.17]	3.14 [2.57, 3.57]	3.00 [2.25, 3.60]	2.40 [1.88, 2.83]
T1 – CONDWORK	2.43 [2.00, 3.11]	2.43 [2.00, 2.96]	2.57 [2.14, 2.86]	2.14 [1.71, 2.57]
T2 – CONDWORK	2.14 [1.86, 2.86]	2.29 [1.86, 2.86]	2.29 [1.93, 2.64]	2.00 [1.57, 2.29]

Figure 1. Radar charts displaying average scores of the investigated psychometric variables at T0, T1 and T2 stratified by occupation (Table 3).



Modeling psychological outcomes using mixed effects models

Table 3 displays the estimated models for the DASS-21 subscales. The results show that stress scores significantly increase at T1 in comparison to the baseline values (T0) and depression scores significantly increase at T2 in comparison to the baseline values (T0). Moreover, we found a significant positive effect of worry, working condition, and psychological/psychiatric history in all models. Higher levels of worry, worse working conditions, and having a psychological/psychiatric history significantly increase anxiety, depression, and stress levels. Living alone significantly decreases all DASS-21 subscales. Having undergone an emergency training significantly decreases

participants' anxiety levels. Higher levels of perceived social support decrease depression and stress levels.

Considering the effects of coping strategies, we found that the use of problem-focused coping significantly decreases all DASS-21 subscales, avoidant coping significantly increases all DASS-21 subscales, and emotion-focused coping significantly increases only stress levels. Finally, nurses show higher anxiety levels than physicians.

Table 3. Estimates (standard-errors) of the linear mixed effects models for the DASS-21 subscales. Depression and anxiety scales were square root transformed.

Parameter	Depression	Anxiety	Stress
Intercept	0.11(0.68)	-1.03(0.63)	-3.38(3.85)
Time (T1 vs T0)	0.14(0.15)	-0.1(0.14)	1.86(0.87)*
Time (T2 vs T0)	0.32(0.16)*	0.28(0.15)	1(0.93)
AGE	-0.0005(0.006)	-0.01(0.01)	-0.06(0.03)
GENDER (Female vs Male)	0.19(0.17)	0.15(0.16)	0.26(0.98)
Occupation (Ref= Physicians)			
Nurses	-0.13(0.2)	0.51(0.19)**	-1.18(1.14)
Clerks	-0.21(0.32)	0.07(0.29)	-0.79(1.8)
Other healthcare	-0.2(0.21)	0.31(0.19)	-0.01(1.19)
WARD COVID (Yes vs No)	-0.03(0.13)	-0.04(0.12)	-0.87(0.74)
WORRY	0.36(0.07)***	0.42(0.07)***	1.82(0.43)***
CONDWORK	0.54(0.07)***	0.44(0.07)***	4.41(0.42)***
PSYCH HISTORY (Yes vs No)	0.56(0.15)***	0.53(0.14)***	3.84(0.87)***
LIVE ALONE (Yes vs No)	-0.3(0.18)	-0.49(0.17)**	-3.65(1.03)***
EMERGENCY_TRAINING (Yes vs No)	-0.28(0.18)	-0.37(0.16)*	-1.28(0.99)
MSPSS	-0.02(0)***	-0.01(0)	-0.06(0.03)*
COPE – Problem-Focused	-0.42(0.14)**	-0.29(0.13)*	-2.58(0.81)**
COPE – Emotion-Focused	0.38(0.21)	0.16(0.19)	3.21(1.18)**
COPE – Avoidant	0.94(0.17)***	0.87(0.16)***	5.43(0.96)***
T1 : Occupation = Nurses	0.37(0.21)	0.32(0.19)	1.69(1.2)
T2 : Occupation = Nurses	0.11(0.22)	0.09(0.21)	2.38(1.31)
T1 : Occupation = Clerks	0.61(0.33)	0.35(0.31)	2.92(1.94)
T2 : Occupation = Clerks	0.31(0.35)	-0.11(0.32)	1.53(2.02)
T1 : Occupation = Other healthcare	0.2(0.21)	0.18(0.2)	0.16(1.25)
T2 : Occupation = Other healthcare	-0.24(0.22)	-0.21(0.2)	-0.33(1.29)

*** p<0.0001; ** p<0.01; * p<0.05

Table 4 displays the estimated models for the MBI subscales. The results show that the emotional exhaustion score significantly increases at T2 compared to T0 and the increase is greater for nurses and other healthcare workers. Moreover, only for other healthcare workers, also the depersonalization score significantly increases at T2 compared to T0. Focusing on the occupation, overall nurses report lower personal accomplishment levels and clerks report lower emotional exhaustion and depersonalization scores.

Working in COVID-19 wards and having a psychological/psychiatric history significantly impact on the emotional exhaustion score. Higher levels of worry significantly increase the emotional exhaustion and the depersonalization score. Worse working conditions significantly increase emotional exhaustion and depersonalization levels and decrease personal accomplishment scores. Having undergone an emergency training and higher levels of perceived social support decrease the emotional exhaustion and depersonalization scores and increase the personal accomplishment score. Older age significantly decreases the depersonalization score. Finally, we found that the use of problem-focused and emotion-focused coping strategies significantly increase emotional exhaustion and depersonalization levels.

Table 4. Estimates (standard-errors) of the linear mixed effects models for the MBI subscales. Square root transformation was applied to the MBI depersonalization scale and the MBI emotional exhaustion scale, while scores on the MBI personal accomplishment scale were raised to the power of two.

Parameter	MBI EMO EX	MBI DEPERS	MBI PERS ACCOMP
Intercept	2.17(0.69)**	3.21(0.63)***	416.36(270.23)
Time (T1 vs T0)	0.09(0.12)	0.06(0.13)	-73.24(55.1)
Time (T2 vs T0)	0.39(0.13)**	0.01(0.14)	-96.54(58.99)
AGE	-0.004(0.01)	-0.02(0.01)***	3.17(2.4)
GENDER (Female vs Male)	0.31(0.18)	-0.35(0.16)*	4.77(69.25)
Occupation (Ref= Physicians)	-0.33(0.2)	-0.3(0.18)	49.86(78.6)
Nurses	-0.13(0.31)	-0.36(0.29)	-617.23(123.49)***
Clerks	-0.57(0.2)**	-0.99(0.19)***	-116.01(81.72)
Other healthcare	-0.1(0.11)	-0.11(0.11)	52.09(48.3)
WARD COVID (Yes vs No)	0.21(0.07)**	0.11(0.07)	-4.32(28.41)
WORRY	0.46(0.07)***	0.23(0.06)***	-15.29(27.95)

Parameter	MBI EMO EX	MBI DEPERS	MBI PERS ACCOMP
CONDWORK	0.68(0.16)***	0.31(0.14)*	-121.98(61.7)*
PSYCH HISTORY (Yes vs No)	-0.52(0.19)**	-0.2(0.17)	41.08(73.47)
LIVE ALONE (Yes vs No)	-0.22(0.18)	-0.08(0.16)	20.95(70.43)
EMERGENCY_TRAINING (Yes vs No)	-0.02(0)***	-0.02(0)***	3.78(1.91)*
MSPSS	-0.5(0.15)***	-0.45(0.13)***	309.08(57.46)***
COPE – Problem-Focused	0.77(0.22)***	0.64(0.2)**	-92.65(84.13)
COPE – Emotion-Focused	0.8(0.18)***	0.44(0.16)**	-9.61(68.29)
COPE – Avoidant	0.19(0.17)	-0.07(0.17)	-34.94(75.56)
T1 : Occupation = Nurses	0.05(0.19)	0.05(0.19)	-27.19(82.61)
T2 : Occupation = Nurses	0.6(0.27)*	0.22(0.28)	89.62(122.1)
T1 : Occupation = Clerks	0.5(0.29)	-0.18(0.29)	64.31(127.72)
T2 : Occupation = Clerks	0.1(0.18)	0.04(0.18)	76.9(78.59)
T1 : Occupation = Other healthcare	-0.22(0.18)	0.3(0.19)	5.85(81.4)
T2 : Occupation = Other healthcare	2.17(0.69)**	3.21(0.63)***	416.36(270.23)

*** p<0.0001; ** p<0.01; * p<0.05

Table 5 displays the estimated models for the IES-R subscales. The results show that the IES-R avoidance score significantly decreases at T1 compared to T0. Overall females report higher IES-R intrusion and avoidance scores, and nurses report higher IES-R intrusion levels. Higher levels of worry, worse working conditions, and using avoidant coping strategies significantly increase all IES-R subscales. Living alone, having a psychological/psychiatric history, and perceived social support significantly influence IES-R intrusion and hyperarousal scores. Finally, older age significantly increases the IES-R intrusion score.

Table 5. Estimates (standard-errors) of the linear mixed effects models for the IES-R subscales. All scales were square root transformed.

Parameter	Intrusion	Avoidance	Hyperarousal
Intercept	-0.61(0.19)**	-0.48(0.18)**	-0.42(0.18)*
Time (T1 vs T0)	-0.02(0.03)	-0.08(0.04)*	-0.07(0.04)
Time (T2 vs T0)	-0.01(0.04)	-0.06(0.04)	-0.05(0.04)
AGE	0.003(0.002)*	0.002(0.002)	0.003(0.002)
GENDER (Female vs Male)	0.1(0.05)*	0.1(0.05)*	0.09(0.05)
Occupation (Ref= Physicians)			
Nurses	0.13(0.05)*	0.09(0.05)	0.05(0.05)
Clerks	-0.07(0.08)	0.01(0.08)	0.01(0.08)
Other healthcare	-0.03(0.06)	0.03(0.05)	0.05(0.06)
WARD COVID (Yes vs No)	0(0.03)	-0.02(0.03)	-0.07(0.03)
WORRY	0.11(0.02)***	0.09(0.02)***	0.13(0.02)***
CONDWORK	0.14(0.02)***	0.09(0.02)***	0.16(0.02)***
PSYCH HISTORY (Yes vs No)	0.11(0.04)*	0.08(0.04)	0.15(0.04)***
LIVE ALONE (Yes vs No)	-0.14(0.05)**	-0.08(0.05)	-0.18(0.05)***
EMERGENCY_TRAINING (Yes vs No)	-0.1(0.05)	-0.003(0.05)	-0.07(0.05)
MSPSS	-0.003(0.001)*	-0.002(0.001)	-0.003(0.001)*

Parameter	Intrusion	Avoidance	Hyperarousal
COPE – Problem-Focused	-0.01(0.04)	-0.03(0.04)	-0.05(0.04)
COPE – Emotion-Focused	0.08(0.06)	0.05(0.06)	0.08(0.06)
COPE – Avoidant	0.34(0.05)***	0.45(0.04)***	0.3(0.05)***
T1 : Occupation = Nurses	0.06(0.05)	0.1(0.05)*	0.1(0.05)
T2 : Occupation = Nurses	0.09(0.05)	0.04(0.06)	0.1(0.06)
T1 : Occupation = Clerks	0.08(0.07)	0.08(0.08)	0.1(0.09)
T2 : Occupation = Clerks	0.001(0.08)	0.15(0.09)	0.05(0.09)
T1 : Occupation = Other healthcare	0.03(0.05)	0.08(0.05)	0.09(0.06)
T2 : Occupation = Other healthcare	0.02(0.05)	-0.03(0.05)	-0.05(0.06)

*** p<0.0001; ** p<0.01; * p<0.05

Table 6 displays the estimated models for the ISI total score and the State Anger scale. It is possible to observe that state anger scores significantly increase at T1 and T2 in comparison to the baseline values (T0), with a larger increase at T1. Focusing on the occupation, overall nurses and other healthcare workers report higher ISI scores than physicians. Higher levels of worry and worse working conditions significantly increase both ISI and State Anger scale scores. Older age and having a psychological/psychiatric history significantly increase the ISI score and higher levels of perceived social support decrease the ISI score. Finally, we found that using avoidant coping significantly increases all considered scales and the use of problem-focused coping strategies significantly decreases state anger scores.

Table 6. Estimates (standard-errors) of the linear mixed effects models for the ISI total score and the State Anger scale. Square root transformation was applied to the ISI total score, while ordered quantile normalization was used for the State Anger scale.

Parameter	ISI TOT	STATE Anger
Intercept	1(0.27)***	-1.94(0.41)***
Time (T1 vs T0)	0.04(0.06)	0.34(0.09)***
Time (T2 vs T0)	0.05(0.06)	0.25(0.09)**
AGE	0.01(0)***	-0.001(0.004)
GENDER (Female vs Male)	0.06(0.07)	-0.13(0.1)
Occupation (Ref= Physicians)		
Nurses	0.26(0.08)**	0.09(0.12)
Clerks	0.18(0.12)	0.08(0.19)
Other healthcare	0.18(0.08)*	0.24(0.12)
WARD COVID (Yes vs No)	-0.06(0.05)	0.11(0.07)
WORRY	0.13(0.03)***	0.15(0.04)***
CONDWORK	0.27(0.03)***	0.26(0.04)***
PSYCH HISTORY (Yes vs No)	0.15(0.06)*	0.18(0.09)
LIVE ALONE (Yes vs No)	-0.11(0.07)	-0.19(0.11)
EMERGENCY_TRAINING (Yes vs No)	-0.12(0.07)	-0.1(0.11)
MSPSS	-0.004(0.002)*	-0.001(0.003)
COPE – Problem-Focused	-0.07(0.06)	-0.19(0.09)*
COPE – Emotion-Focused	0.03(0.08)	0.25(0.13)
COPE – Avoidant	0.32(0.07)***	0.51(0.1)***
T1 : Occupation = Nurses	0.1(0.08)	0.01(0.12)
T2 : Occupation = Nurses	0.09(0.08)	0.04(0.13)
T1 : Occupation = Clerks	0.06(0.12)	0.26(0.19)
T2 : Occupation = Clerks	0.14(0.13)	0.12(0.2)

Parameter	ISI TOT	STATE Anger
T1 : Occupation = Other healthcare	0.01(0.08)	-0.24(0.12)
T2 : Occupation = Other healthcare	-0.02(0.08)	-0.28(0.13)*

*** p<0.0001; ** p<0.01; * p<0.05

Evaluating the impact of feeling appreciated by the hospital direction and the community on the psychological outcome

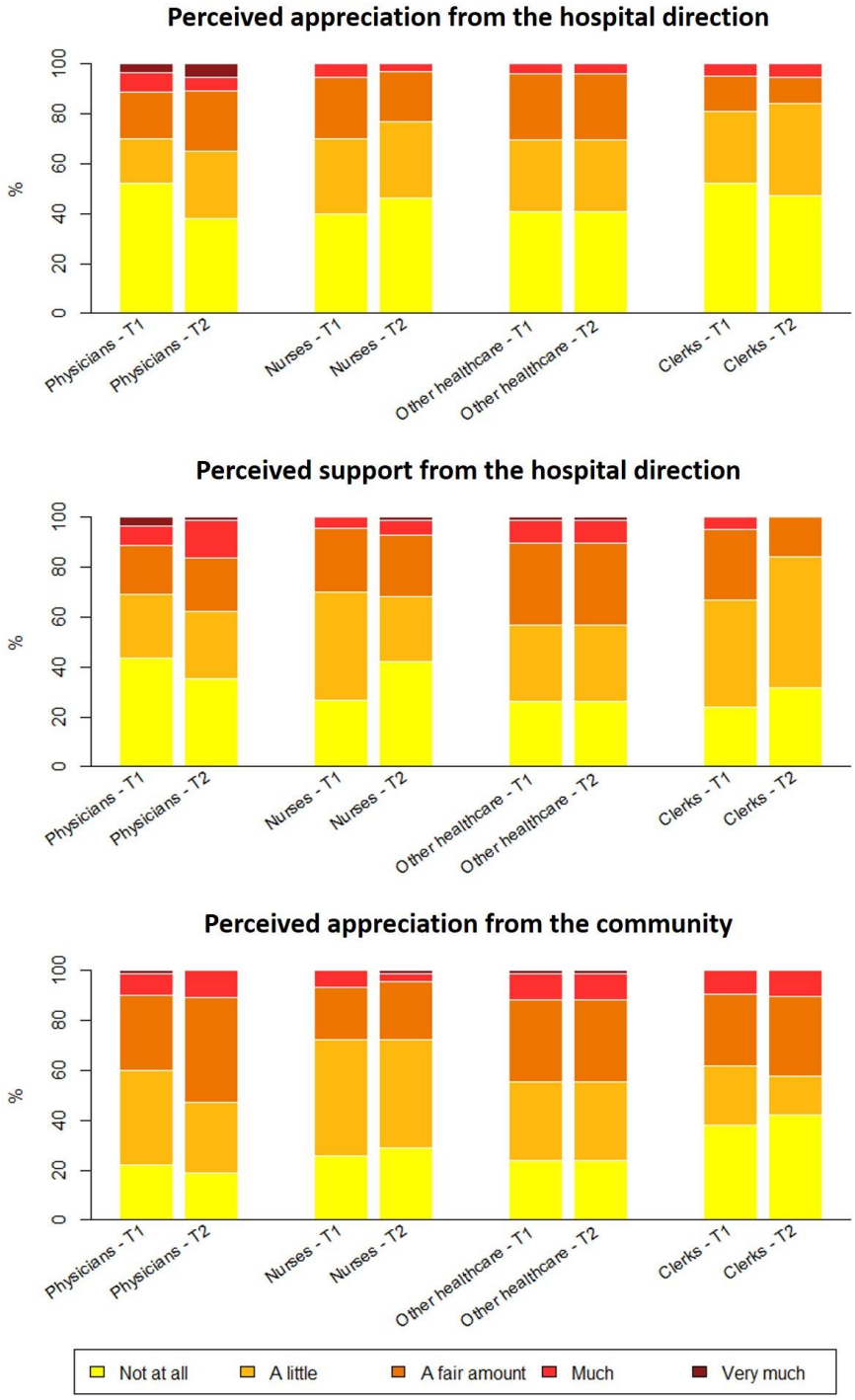
Figure 2 shows the frequency distributions of the ratings on the three items investigating respectively the perceived appreciation coming from hospital direction and the community and the perceived support coming from hospital direction for protecting them and/or their wellbeing (see Figure 2 and Table S8). LME models have been estimated to evaluate the impact of perceived appreciation and support on all the psychological scales of interest, while adjusting for time and working category.

We found a significant impact of feeling appreciated by the hospital direction only in the DASS-21 depression subscale. After adjusting for time and working category, participants declaring to feel "much"/"very much" appreciated by the hospital direction obtained significantly lower scores in the depression subscale than those assigning ratings ≤ 3 in the corresponding appreciation item (see Table S9 (a)).

Perceived support from the hospital direction significantly affected only the MBI emotional exhaustion score. After adjusting for time and working category, participants declaring to feel "much"/"very much" appreciated by the community obtained significantly lower scores in the MBI emotional exhaustion scale than those reporting ratings ≤ 3 in the corresponding appreciation item (see Table S9 (b)).

Moreover, feeling appreciated by the community significantly affected only the State Anger scale. After adjusting for time and working category, participants declaring to feel "much"/"very much" appreciated by the community obtained significantly lower scores in the State Anger scale than those assigning ratings ≤ 3 in the corresponding appreciation item (see Table S9 (c)).

Figure 2. Frequency distribution of responses on Likert items investigating respectively the perceived appreciation coming from hospital direction and the community and the perceived support coming from hospital direction for protecting them and/or their wellbeing.



Exploring the impact of psychological variables on the perceived risk of making mistakes

In Figure 3 and Table S10 are shown the frequency distributions of the ratings on the item investigating the change in the perceived risk of making mistakes in the last three months.

The response categories “much” and “very much” (i.e., 4 and 5 ratings) of this item were aggregated in one category (perceiving “high change”) to be compared to all the other response categories (i.e., ratings ≤3), which were collapsed in another category (perceiving “low change”). This procedure allowed us to obtain a binary outcome variable to be analyzed using a GLMER model. In the estimated model including time and working category as independent variables, we found only a significant time effect, emphasizing that the chances of perceiving a “high” change in the feeling of making mistakes were significantly lower at T1 and T2 compared to T0 (see Table 7).

When also entering psychological scales, one by one, only the MBI personal accomplishment scale was not associated with the perceived change in the feeling of being at risk of making mistakes. Each one of all the other psychological scales, after adjusting for time and working category, were instead positively and significantly associated with the outcome (see Table 8).

Figure 3. Frequency distribution of responses on Likert item investigating the change in the perceived risk of making mistakes in the last three months.

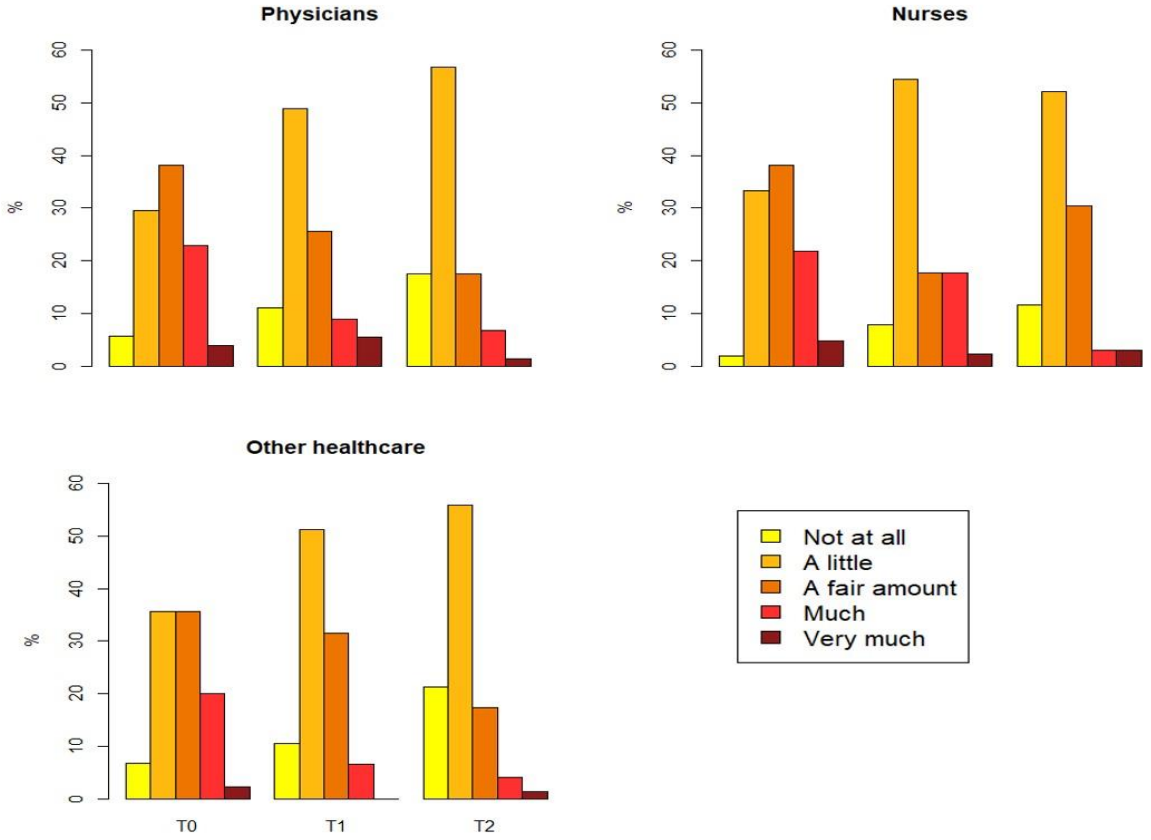


Table 7. Logistic mixed-effects model for the variable indicating a "high change" in the feeling of making mistakes in the last three months.

	Estimate	OR	Std. Error	p-value
Intercept	-1.007	0.365	0.197	<0.001
Time (T1 vs T0)	-0.745	0.475	0.225	0.001
Time (T2 vs T0)	-1.578	0.206	0.308	<0.001
Occupation (Ref= Physicians)				
Nurses	0.091	1.096	0.246	0.711
Other healthcare	-0.423	0.655	0.276	0.125

Table 8. Logistic mixed-effects models for the variable indicating a "high change" in the feeling of being at risk of making mistakes in the last three months. The table shows the estimated effect of each psychological variable, entered one by one, and adjusted for time and occupation.

	Estimate	Std. Error	OR	p-value
DASS_DEPR	0.075	0.011	1.078	<0.001
DASS_ANX	0.094	0.014	1.098	<0.001
DASS_STRESS	0.088	0.011	1.092	<0.001
ISI_TOT	0.138	0.028	1.148	<0.001
IES_INTR	0.704	0.121	2.023	<0.001
IES_AVOID	0.813	0.14	2.255	<0.001
IES_HYPER	0.737	0.117	2.089	<0.001
STATE_ANG	0.042	0.011	1.043	<0.001
MBI_EMO_EX	0.046	0.008	1.047	<0.001
MBI_DEPERS	0.084	0.016	1.088	<0.001
MBI_PERS_ACCOMP	-0.013	0.012	0.987	0.284

Exploring the impact of psychological variables on the perceived need of psychological or psychiatric support

In Figure 4 and Table S11 are shown the frequency distributions of the ratings on the item investigating the perceived need of psychological/psychiatric support.

Even for this item, the response categories "much" and "very much" (i.e., 4 and 5 ratings) were aggregated in one category ("high need") to be compared to all the other response categories (i.e., ratings $\leq$3), which were collapsed in another category ("low need"). Hence, a binary outcome variable was obtained to be analyzed using a GLMER model. In the estimated model including time

and working category as independent variables, none of the included explanatory variable was significantly associated with the outcome (see Table 7).

When entering psychological scales one by one, each psychological variable, after adjusting for time and working category, was significantly associated with the outcome and all showed a positive impact apart from personal accomplishment as measured by the MBI (see Table 10).

Figure 4. Frequency distribution of responses on Likert item investigating the perceived need of psychological/psychiatric support.

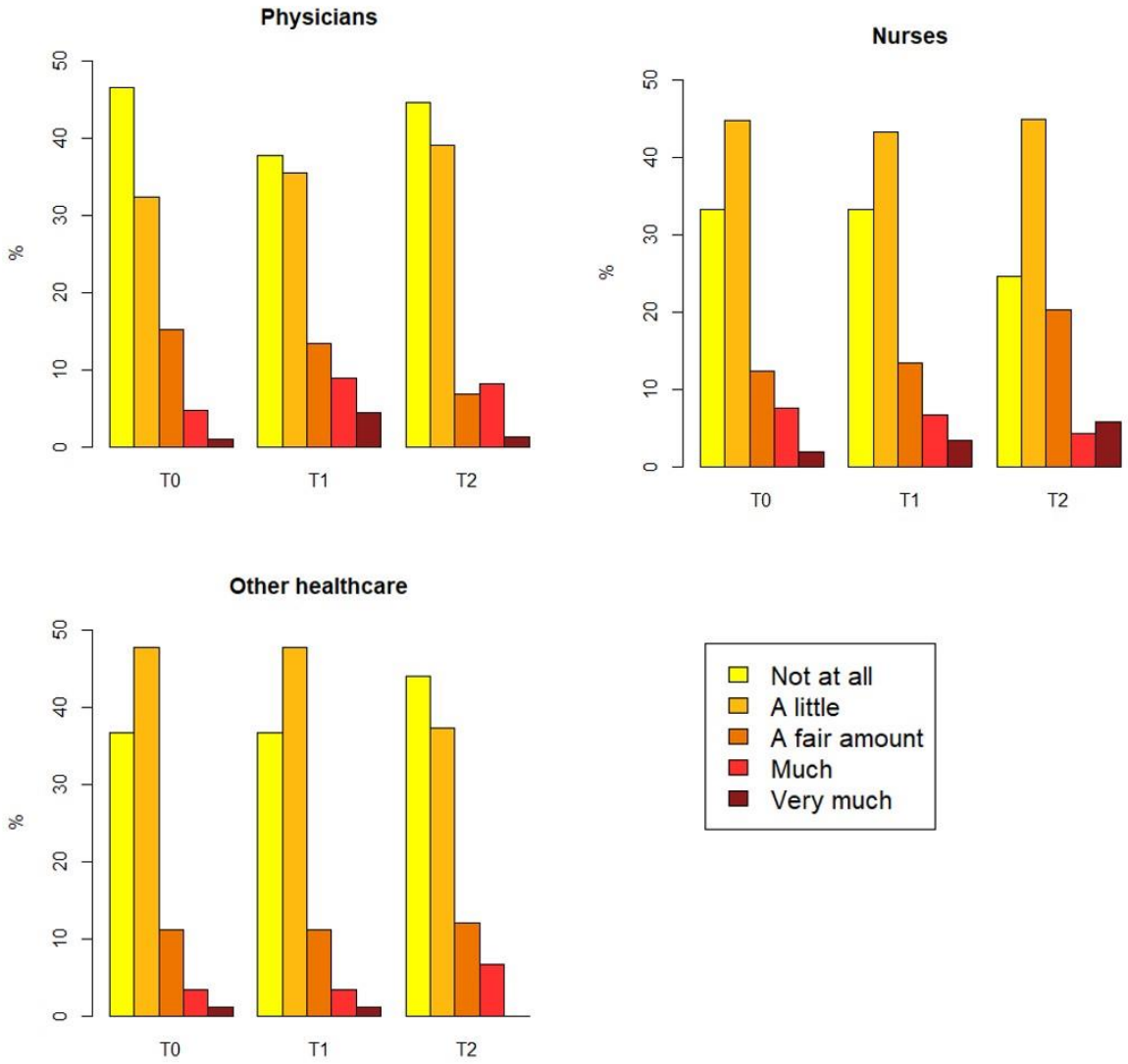


Table 9. Logistic mixed-effects model for the variable indicating a perceived "high need" of psychological/psychiatric support.

	Estimate	OR	Std. Error	p-value
Intercept	-3.034	0.048	0.385	<0.001
Time (T1 vs T0)	0.551	1.736	0.342	0.107
Time (T2 vs T0)	0.385	1.469	0.376	0.305
Occupation (Ref= Physicians)				
Nurses	0.094	1.099	0.453	0.835
Other healthcare	-0.4	0.67	0.498	0.422

Table 10. Logistic mixed-effects model for the variable indicating a perceived "high need" of psychological/psychiatric support. In the table the estimated effect of each one of the psychological variables, entered one by one, and adjusted for time and occupation are reported.

	Estimate	OR	Std. Error	p-value
DASS_DEPR	0.142	1.153	0.018	<0.001
DASS_ANX	0.154	1.167	0.021	<0.001
DASS_STRESS	0.144	1.154	0.019	<0.001
ISI_TOT	0.249	1.283	0.046	<0.001
IES_INTR	1.161	3.192	0.197	<0.001
IES_AVOID	1.316	3.728	0.223	<0.001
IES_HYPER	1.316	3.728	0.179	<0.001
STATE_ANG	0.082	1.085	0.016	<0.001
MBI_EMO_EX	0.083	1.086	0.013	<0.001
MBI_DEPERS	0.075	1.078	0.025	0.003
MBI_PERS_ACCOMP	-0.039	0.962	0.019	0.036

5.4 Discussion

The present study is the third phase of a longitudinal investigation about the long-term psychological consequences of the COVID-19 pandemic on Italian healthcare workers. To our knowledge, this is the first one-year longitudinal study that measures healthcare workers' mental health at three different time points.

In general, the psychological subscale scores remained mostly unchanged across the three measurements. These results are in line with the scant literature showing a substantial invariance of psychiatric symptoms among healthcare workers throughout the epidemic (Dufour et al., 2021; Magnavita et al., 2021; Th'ng et la., 2021). The few changes in our findings include a significant increase in stress levels and a decrease in avoidance symptoms experienced by healthcare workers

at T1 when compared to T0. T0 data were collected between May and July 2020, after the main peak of the first wave of infection in Italy, when the lockdown was over and healthcare workers had just started working with normal shifts; whereas T1 data were collected in December 2020, during the second wave of infection. In that period, Italy was in lockdown for the second time, hospitals were once again overcrowded, and healthcare workers were under high pressure. Thus, our findings align with previous epidemic literature showing higher levels of stress during the acute phase of the infection and an increase in avoidance symptoms when the spread of infection is under control (Chong et al., 2004).

Moreover, our results show an increase in depression and emotional exhaustion symptoms at T2 compared to baseline values, in accordance with the literature showing an increase in depression symptoms over a one-year period (Th'ng et al., 2021) and during the "repair" phase of previous epidemics (Chong et al., 2004). These findings may be explained by moral distress (Wilson et al., 2020) and compassion fatigue (Magnavita et al., 2020; Th'ng et al., 2021) experienced by healthcare workers during the pandemic. Moral distress is defined as the feeling of being complicit in an unethical action involuntarily, with little or no power to change it and act differently (Wilson et al., 2020). On the other hand, compassion fatigue refers to the stress derived from exposure to a traumatized patient or the trauma itself (Cavanagh et al., 2020). The prolonged exposure to patients and their relatives' suffering, as well as the long-term mismatch between hospital demands, medical resources, and knowledge about the infection, probably increased levels of burnout (Wilson et al., 2020) and depression (Magnavita et al., 2020; Th'ng et al., 2021) among healthcare workers.

Finally, feelings of anger seem to increase throughout the outbreak, both at T1 and T2. Over time, healthcare workers felt less appreciation and gratitude from the community (Magnavita et al., 2021), which may have increased state anger scores (Chew et al., 2020b; Magnavita et al., 2021). This hypothesis is supported by our findings, which show that participants who felt most appreciated by the community reported lower state anger scores.

As far as risk factors are concerned, in line with the literature (Varghese et al., 2021; Gualano et al., 2021; Muller et al., 2020; Yuan et al., 2021), worse working conditions and worry about the infection predict higher levels of depression, anxiety, stress, burnout, PTSD, insomnia, and state anger. Furthermore, in line with the literature (Dobson et al., 2021; Şahin et al., 2020), a history of psychiatric illness seems to make healthcare workers more vulnerable to higher levels of depression, anxiety, stress, insomnia, and PTSD symptoms during the COVID-19 outbreak. Moreover, in line with the literature (Muller et al., 2020), working in COVID-19 wards seems to be a risk factor for higher levels of emotional exhaustion.

Focusing on the occupation, in line with the literature (Sanghera et al., 2020; Shaukat et al., 2020; Vizheh et al., 2020; Yuan et al., 2021), nurses seem to experience higher levels of anxiety, insomnia, intrusion symptoms, and lower levels of personal accomplishment than physicians, probably due to the longer time spent with patients and less power in medical decisions. Other healthcare workers experienced higher levels of insomnia than physicians, probably because they are less used to working irregular shifts. Conversely, clerks seem to experience lower levels of burnout symptoms than physicians, probably because they work in an office and do not have direct contact with patients.

Regarding socio-demographic factors, female gender seems to be a risk factor for higher levels of PTSD symptoms, in line with the literature (Yuan et al., 2021), which shows that PTSD symptoms are twice as common in women as in men, probably due to a combination of greater exposure, higher heritability, and genetic vulnerability (Yehuda et al., 2015). Interestingly, older age represents a risk factor for both insomnia and intrusion symptoms, in line with T1 and literature, which shows an association between increasing age and a physiological decline in sleep quality (Dzierzewski et al., 2018) and a positive association between age and PTSD symptoms during the COVID-19 pandemic, probably because the elderly are a high-risk category for infection and death (Li et al., 2020; Qiu et al., 2020). Moreover, older age represents a protective factor for lower levels of depersonalization

symptoms. Probably, experience allowed older healthcare workers to care for patients even in such a difficult and unprecedented situation without the need to step back to protect themselves.

Concerning protective factors, in line with the literature (Muller et al., 2020; Sanghera et al., 2020), high levels of perceived social support seem to predict lower levels of depression, stress, burnout, insomnia, and PTSD. Even if it seems counterintuitive, living alone predicts lower levels of stress, depression, and anxiety. Indeed, while high perceived social support from relatives aids healthcare workers in coping with work-related stress, living with children or the elderly may heighten concerns about infecting them (Yuan et al., 2020). However, living alone seems to be a risk factor for higher intrusion and hyperarousal symptoms, in line with previous epidemic literature indicating a link between social isolation and separation from family and higher PTSD rates (Carmassi et al., 2020).

Moreover, according to the literature on previous epidemics (Lancee et al., 2008; Maunder et al., 2006), having undergone an emergency training seems to be a protective factor for lower anxiety and burnout symptoms, supporting its effectiveness.

Regarding coping strategies, the use of avoidant strategies seems to be a risk factor for higher stress, depression, anxiety, insomnia, state anger, and PTSD symptoms, in line with the literature (Besirli et al., 2021; Labrague, 2020; Tahara et al., 2020). The use of emotion-focused strategies predicts higher levels of stress and burnout symptoms. However, the heterogeneity of strategies included in this subscale produced mixed findings in the literature (Ben-Zur, 2009; Labrague 2020). Interestingly, the use of problem-focused strategies seems to be both a protective factor for higher levels of stress, depression, anxiety, and state anger, in line with T1 and literature (Chew et al., 2020c; Labrague, 2021), and a risk factor for higher levels of burnout. Probably, using problem-focused strategies to try to change the situation in the absence of knowledge and medical resources most likely increased feelings of helplessness and moral distress, thereby exacerbating emotional exhaustion and depersonalization symptoms (Wilson et al., 2020).

Moreover, fear of making medical mistakes seems to be associated to all the psychiatric symptoms measured, which is in line with the literature showing an association between poor mental health

and medical error rates (Fahrenkopf et al., 2008; Tawfic et al., 2018). Our findings also show that the fear of making medical mistakes decreases over time. Probably, healthcare workers became more self-confident as their knowledge of the infection and its treatment grew over time.

Conversely, despite being associated with general mental health, our sample's need for psychological or psychiatric support appears to be restrained and stable over the year. Subclinical symptoms experienced by most of the sample probably explain the lack of need for psychological support; additionally, the stigma associated with mental health probably increases the reluctance to seek psychological support (Latoo et al., 2021; Galbraith et al., 2021).

Finally, over the course of one year, the perception of appreciation from hospital direction appears to be a protective factor for depression symptoms. This result is consistent with the literature, which shows that in this unprecedented situation with little knowledge about the infection, healthcare workers need support and recognition from their supervisors (Th'ng et al., 2021; Gualano et al., 2021).

Consistently, the perception of adequate protection and attention to their wellbeing from the hospital direction is a protective factor for lower levels of emotional exhaustion. Indeed, hospitals must address both the emotional and practical needs of healthcare workers to promote their wellbeing and prevent burnout symptoms (Shanafelt et al., 2012).

However, it is important to notice that few healthcare workers of our sample perceived high appreciation from hospital direction and the community, as well as adequate protection and attention to their wellbeing from hospital direction.

5.4.1 Conclusions

In conclusion, our findings highlight that, in general, healthcare workers experienced subclinical psychiatric symptoms during the first year of pandemic. The psychological subscale scores remained mostly unchanged across the three measurements, except for an increase in stress, depression, state anger, and emotional exhaustion symptoms.

Despite the subthreshold distress scores obtained by our sample, the distress experienced during this year may have influenced their efficiency, as healthcare workers' distress is known to adversely affect the quality of care, patient satisfaction, and medical errors rates (Marvaldi et al., 2021; Hall et al., 2016; Shanafelt et al., 2012; Tawfic et al., 2018). As work-related stress has both a health and an economic impact, it is in governments' and healthcare institutions' best interests to find the most effective ways to avoid it (De Giorgi & Dinkelaar, 2021). Funding for healthcare workers' physical and mental health is thus required.

Below, we recommend some suggestions to protect and preserve healthcare professionals' mental health.

It would be useful to set up a decompression room for healthcare workers to use when they need to cool down and regain strength. Furthermore, hospital administration could place posters around the hospital with information about the support available to them and the patients to combat mental health stigma. Other posters could summarize tips for bad news communication. Finally, it may be beneficial to provide healthcare workers with some practical suggestions for stress management, such as monitoring their emotional reactions and behaviors, remembering the original reason why they chose their job when feeling overwhelmed, maintaining a space for spare time and physical activity, taking care of themselves through healthy food and adequate sleep, and expressing their concerns with a colleague or a psychologist without feeling judged.

GENERAL DISCUSSION

The “Healthcare workers’ wellbeing (Benessere Operatori)” project aimed at providing insight into the impact of the COVID-19 pandemic on healthcare workers’ mental health, to identify vulnerable categories and monitor short- and long-term psychological consequences of the pandemic. We used a longitudinal approach to compare mental health outcomes across the different phases of the pandemic. Moreover, an innovative and more flexible data mining statistical approach (i.e., a regression trees approach for repeated measures data) allowed us to identify risk factors and derive classification rules that could be useful in implementing targeted interventions for healthcare workers.

Our findings highlight that during the first year of the pandemic, healthcare workers experienced subclinical depression, anxiety, stress, and insomnia symptoms, as well as medium and high levels of burnout. Throughout the outbreak, these symptoms remained mostly unchanged, with an increase in depression and emotional exhaustion scores at the second follow-up. Although it may be argued that participants who did not complete all waves of the survey could have worse mental health at baseline, leading to overly optimistic interpretations of mental health trends over time (Czeisler et al., 2021), a comparison of the answers given at T0 from participants who only answered at T0 and participants who participated in all three waves of the study shows no significant differences in their mental health outcomes (see tables S12-S15).

Our findings also show that COVID-19 had a different impact on different categories of healthcare workers, with nurses and healthcare professionals working in COVID-19 wards suffering the most. Specific risk and protective factors have been identified. On the one hand, higher levels of worry, worse working conditions, working in COVID wards, a previous history of psychiatric illness, being a nurse, and the use of avoidant and emotion-focused coping strategies seem to be risk factors for healthcare workers’ mental health. On the other hand, higher levels of perceived social support, the attendance of an emergency training, problem-focused coping strategies, appreciation from

hospital direction and the community, and adequate attention to healthcare workers' wellbeing from hospital direction play a protective role for their mental health.

However, as the pandemic is still ongoing, a conclusive evaluation of its impact on healthcare workers' mental health could not be outlined. Although it appears that a significant proportion of healthcare workers are currently suffering from psychopathological symptoms and burnout, their levels seem to be mild. Moreover, there is insufficient evidence to determine whether this prevalence increased as a result of the pandemic (Gualano et al., 2021). Research on the mental health consequences of the pandemic is at an early stage. Many existing studies are cross-sectional, use convenience samples, and describe the prevalence of self-reported psychiatric symptoms (i.e., psychological distress), rather than psychiatric disorders. Moreover, the pandemic's consequences have varied geographically and over time in terms of infection, mortality, and social disruption. Therefore, long-term longitudinal studies that are specific to regions/countries will be required to develop an accurate picture of mental health consequences (Latoo et al., 2021).

Further research on the assessment of interventions in different organizational contexts is also required in order to better understand how to address and reduce this psychological burden. As a recent Cochrane review (Pollock et al., 2020) pointed out, there is a lack of strong evidence about effective interventions for healthcare workers' resilience and mental health during or after epidemics and pandemics. Future research could also investigate how many hospitals have implemented preventive psychological interventions, to study the characteristics of such support interventions in depth, and to understand how many centers were prepared to deal with the psychopathological burden of the pandemic (Gualano et al., 2021).

6.1 Limitations and strengths

Some limitations of the present research must be acknowledged. First, while a longitudinal approach is extremely useful for understanding the impact of a pandemic over time, it has the disadvantage of a high participant attrition rate. Future studies with larger samples and a low

attrition rate would enhance the generalizability of the findings (van Leeuwen et al., 2021). A survey revision may reduce dropout rates, and a focus group may help in identifying the most relevant issues. Furthermore, even with a longitudinal design, shifting from a snapshot to a movie-like perspective when measuring psychological dynamics is difficult due to the pandemic's ongoing evolution.

Second, because some of the questions in this study cover events from the previous three months, they may cause a recall bias. We believe that this bias is limited, as we did not use retrospective questions in this study. Furthermore, research has shown that people can remember long-term periods or specific events, such as the COVID-19 pandemic (Schwarz, 2007; van Leeuwen et al., 2021).

The use of self-report and ad-hoc instruments can be a limit to our research, but it allowed us to protect participants' privacy and reach a larger number of healthcare workers via an online platform (Ghio et al., 2021).

Finally, we were unable to compare our findings to previous data about participants' mental health prior to the pandemic. We did, however, inquire about any previous mental health illnesses.

Despite these limitations, the longitudinal design of our study allowed us to monitor the mental health of healthcare workers over time and investigate relationships among variables to identify potential target risk and protective factors. Furthermore, we used real-time data collection rather than retrospective methods, resulting in far more reliable conclusions about healthcare workers' experiences (van Leeuwen et al., 2021).

Another strength of our study is the inclusion of healthcare workers from various hospitals located throughout Italy.

Finally, the use of an online survey may have encouraged participants to reveal sensitive aspects of their work, without worrying about confidentiality (Gnambs & Kaspar, 2015).

6.2 Conclusions

Despite the presence of mild psychopathology in our sample, subsyndromal symptoms can also cause distress, impair functioning, and necessitate intervention (Latoo et al., 2021). Work-related stress can, in fact, lead to burnout and psychosomatic illness, resulting in a lower quality of life for healthcare workers and poorer healthcare service provision (Weinberg & Creed, 2000). Furthermore, some of our participants reported severe psychopathological symptoms, which cannot be ignored given the massive economic impact of mental disorders on society, especially through indirect costs (Trautmann et al., 2016). In addition, when mental disorders affect healthcare workers, there may be a devastating snowball effect on the general public's overall health and quality of life (De Giorgi & Dinkelaar, 2021).

Nevertheless, crises such as a pandemic provide an opportunity to rebuild in new ways (Crittenden et al., 2021). Accordingly, the COVID-19 pandemic has brought mental health to the attention of a broad audience, including the general public, governments, and policymakers. Indeed, the pandemic presents a chance to address underfunding and other barriers (e.g., stigma) to providing high-quality mental health care, as well as to make mental health a higher public health priority (Latoo et al., 2021).

Maintaining hospitals' "human capital" is undoubtedly as critical as maintaining life-saving machinery. Along with investments in new and expensive medical technology, funding for physical and mental health protection for healthcare workers is required. As the pandemic spreads, there is concern that a lack of healthcare workers, rather than a lack of equipment, will become the primary vulnerability for healthcare systems (Centers for Disease Control and Prevention 2020; United Nations International Labor Organization, 2020). Shortening the path to qualification and expertise for new healthcare workers can be a limited-scope strategy, whereas preserving current personnel may be both critical to adequate medical care and ethical hospital policy (Crittenden et al., 2021).

In particular, healthcare workers experiencing mild disorders and subsyndromal symptoms may benefit from active monitoring, relaxation techniques, support groups, and self-help material. Those with persistent mild disorders or moderate/severe disorders will require more intensive treatment.

The pandemic has hastened the development of telemedicine, which includes remote consultations, helplines, and online mental health resources. These services should run concurrently with face-to-face services, with patients given options where possible (Latoo et al., 2021).

Moreover, our findings outlined important and potentially modifiable factors that should be taken in consideration when planning interventions.

First, healthcare workers with a previous history of psychiatric illness and current high levels of worry deserve particular attention and support. Primary prevention should be done on a regular basis in order to address personal factors (such as previous psychiatric history and maladaptive coping strategies). Along with traditional modelling approach, the proposed data mining methodology allowed to derive cut-points for risk factors that should be carefully monitored. In addition, the evidence synthesized in our systematic review (Preti et al., 2020) suggests that when healthcare workers are provided with adequate protective measures, their risk perception is lower, which may result in lower levels of worry and, in turn, lower adverse psychological outcomes.

Second, positive coping strategies and emergency training have been shown to improve mental health in healthcare workers; therefore, providing theory-tested interventions or programs for the development of self-efficacy and effective coping skills may help healthcare workers better manage the increased work pressure caused by the COVID-19 pandemic and future emergencies. Due to constraints such as social distancing and lockdown measures, these interventions could be delivered in innovative ways such as webinars, online workshops, and on-demand videos (Labrague, 2021).

Third, expressing appreciation to healthcare workers from hospital administration and the community, thereby increasing social support, may provide a sense of greater emotional security among healthcare workers, allowing them to function effectively during pandemics and other emergency situations (Labrague, 2021).

Finally, our results suggest that nurses might be at higher risk for mental health problems compared with other professional positions. These findings are consistent with other review studies (Danet Danet, 2021; Schneider et al., 2021) and are not limited to the pandemic context. For instance, a

systematic review on burnout among nurses highlighted that they often work irregular hours, are understaffed, and report excessive workload and overtime (Woo et al., 2020). Furthermore, during the pandemic, nurses' daily activities were disrupted as they had to care closely for patients who had been suddenly separated from their families, resulting in a significant emotional burden and a sense of inadequacy (Gualano et al., 2021). Therefore, rethinking their work schedules and organization may lead to a reduction in stress, especially given our findings that working conditions are a recurring risk factor for psychopathological symptoms.

In general, the pandemic highlighted the need for stable psychological support for healthcare workers, not only during the pandemic's peak, when work overload and other factors influencing healthcare workers' mental health are more defined and acute, but also in everyday situations that already challenge healthcare workers' mental and physical wellbeing (Ghio et al., 2021). Hospital administrators should thus consider increasing healthcare workers' access to mental health professionals both during the pandemic and in everyday situations to encourage the expression of their feelings and concerns, as well as openly discussing their experiences and challenges in patient care and management (Labrague, 2021). This could also have a positive impact on their fear of making medical mistakes, as our study suggested.

In the long run, the changes proposed here may not only protect healthcare providers during the COVID-19 pandemic but may also make routine medical care more interpersonally and psychologically comfortable (Crittenden et al., 2021).

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APPENDIX A - Full search strategy for the Systematic Review

Search: PubMed; PsycINFO; Web of Science.

Search 1 (pandemic/endemic);
'infect*'; 'COVID*', 'SARS'; 'influenza'; 'flu'; 'MERS'; 'ebola'.

=COMBINE WITH OR

Search 2 (psychological impact);
'Mental'; 'Psych*'.

=COMBINE WITH OR

Search 3 (healthcare workers);
'Health Personnel'; 'health worker'; 'Medical Staff'; 'Physician'; 'Nurses'.

=COMBINE WITH OR

Combine Search 1 AND Search 2 AND Search 3

APPENDIX B - Supplementary figures for the Baseline Study

Figure S1. Dunn's test for DASS-21 Anxiety.

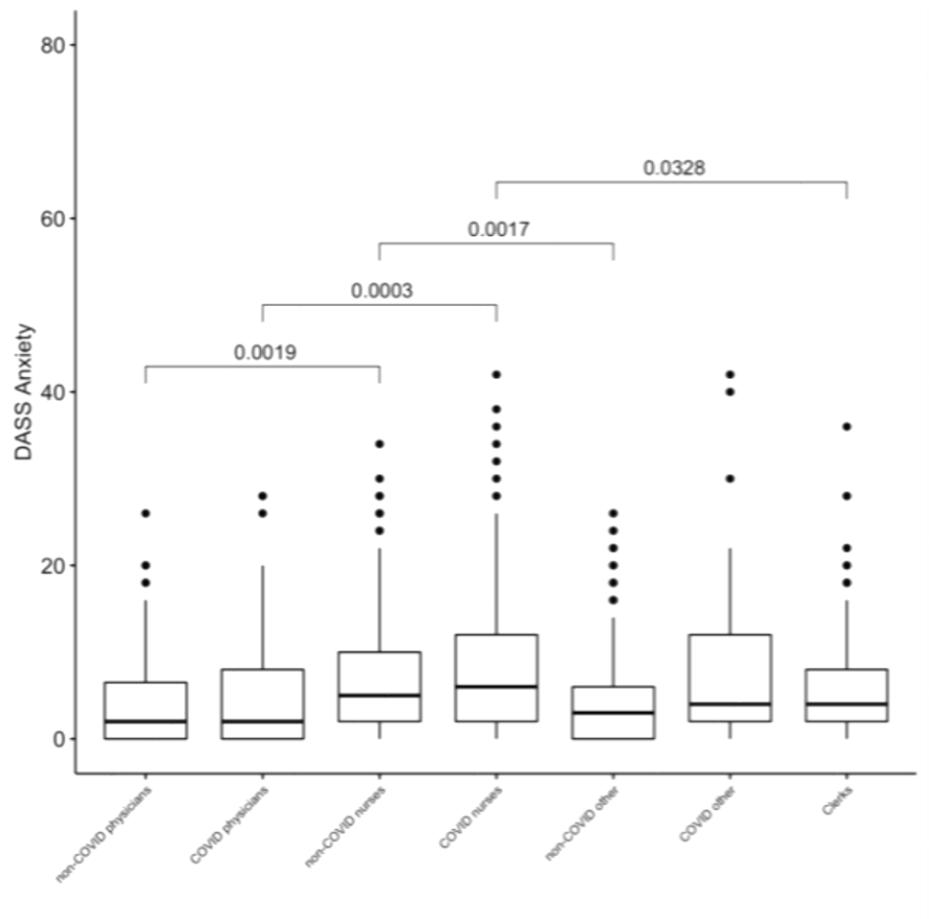


Figure S2. Dunn's test for ISI TOT.

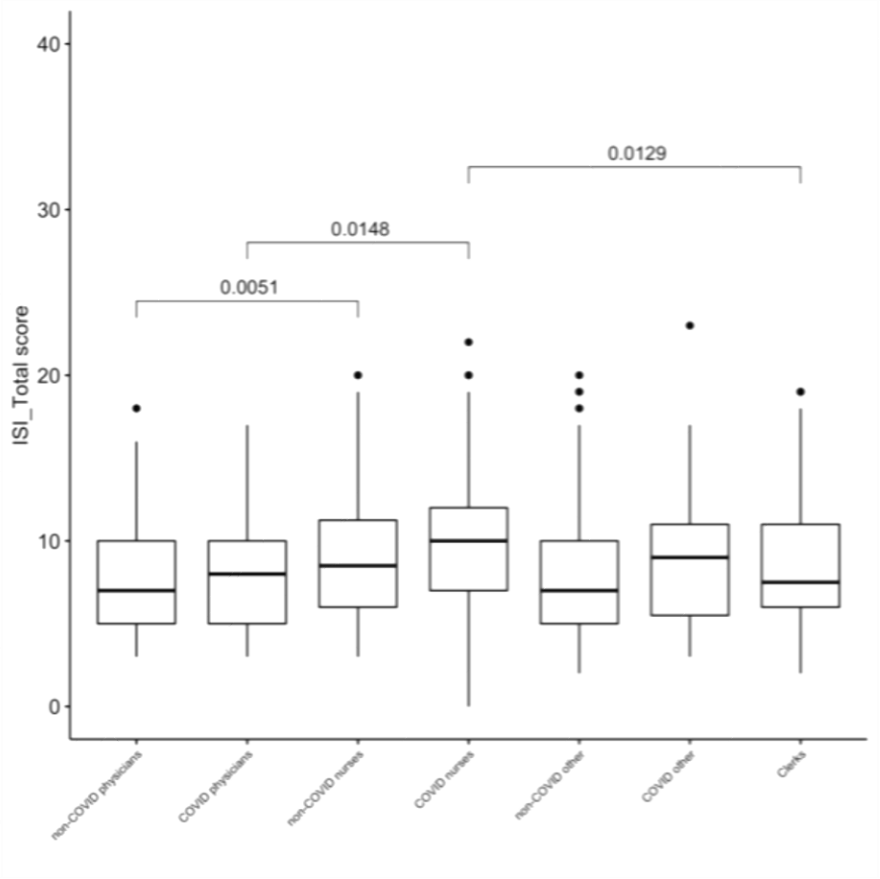


Figure S3. Dunn's test for IES-R Intrusion.

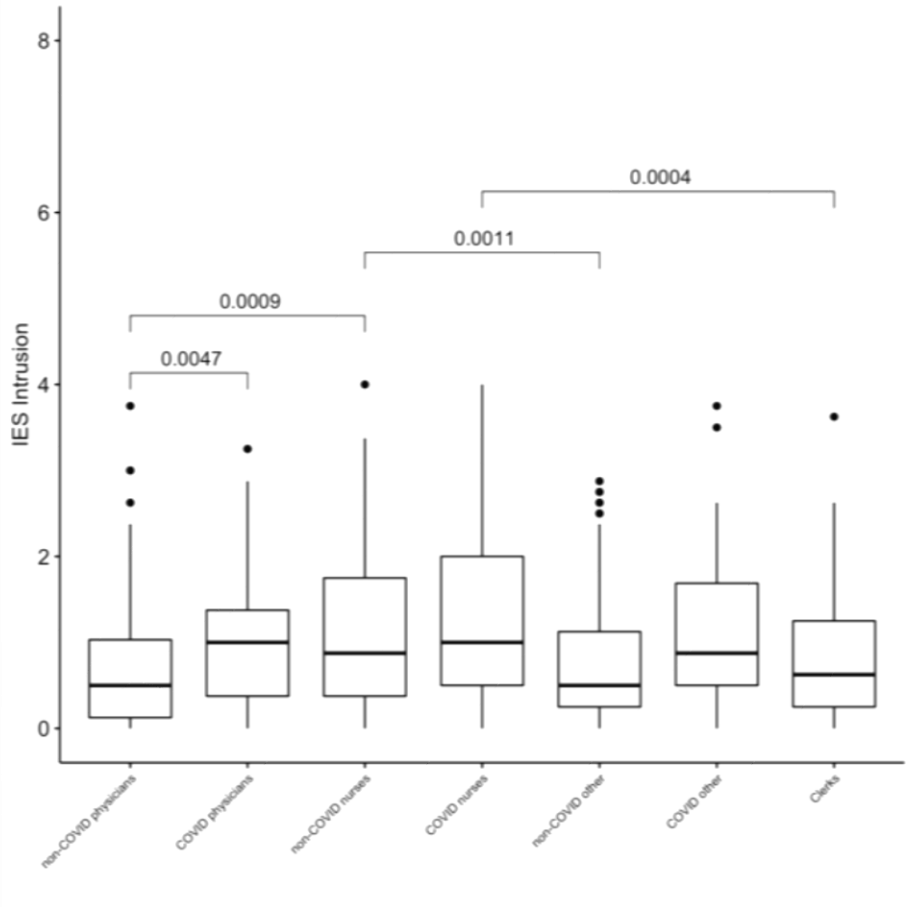


Figure S4. Dunn's test for IES-R Avoidance.

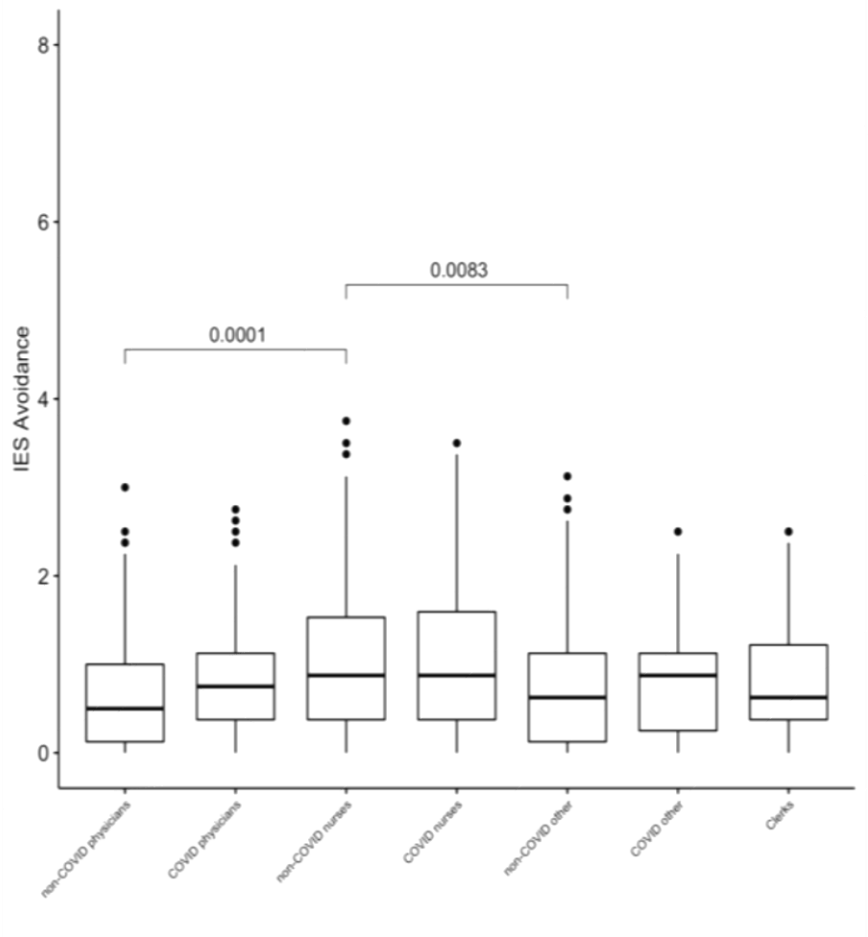


Figure S5. Dunn's test for IES-R Hyperarousal.

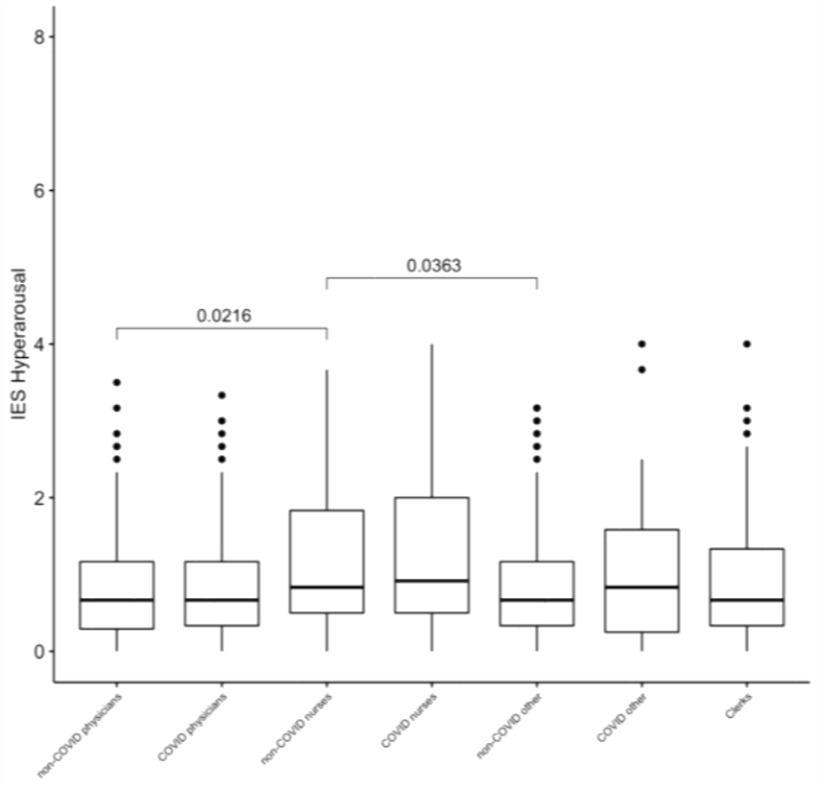


Figure S6. Dunn's test for State-Anger.

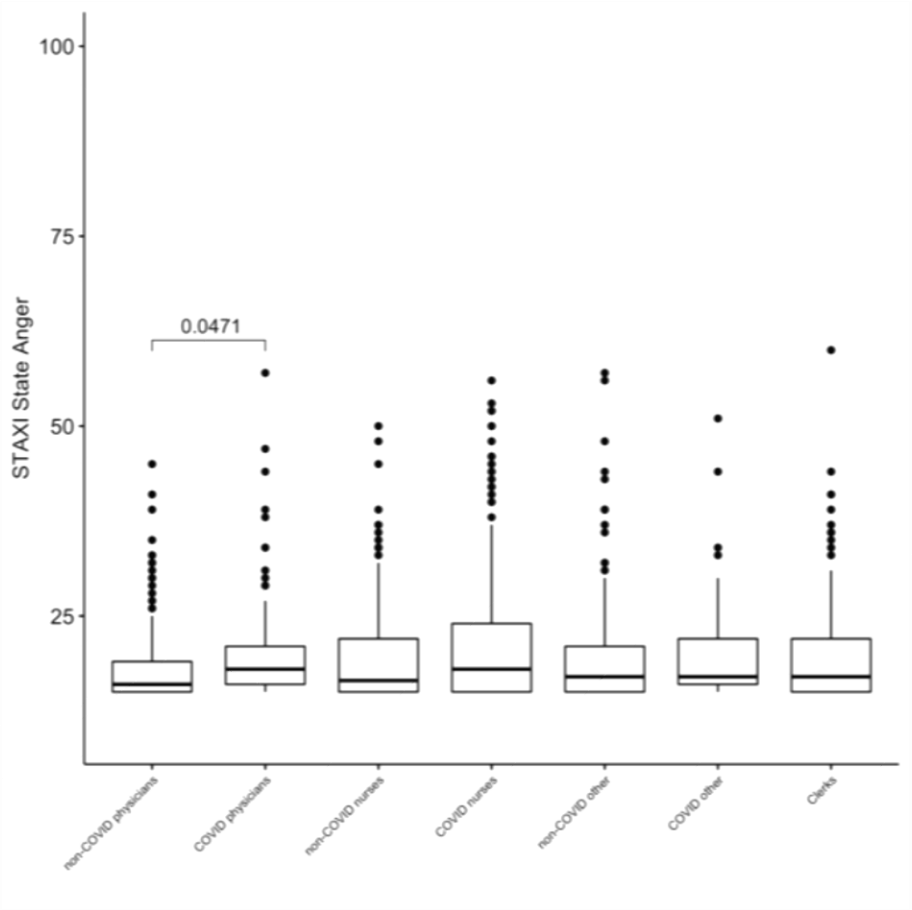


Figure S7. Dunn's test for STAXI Verbal Expression.

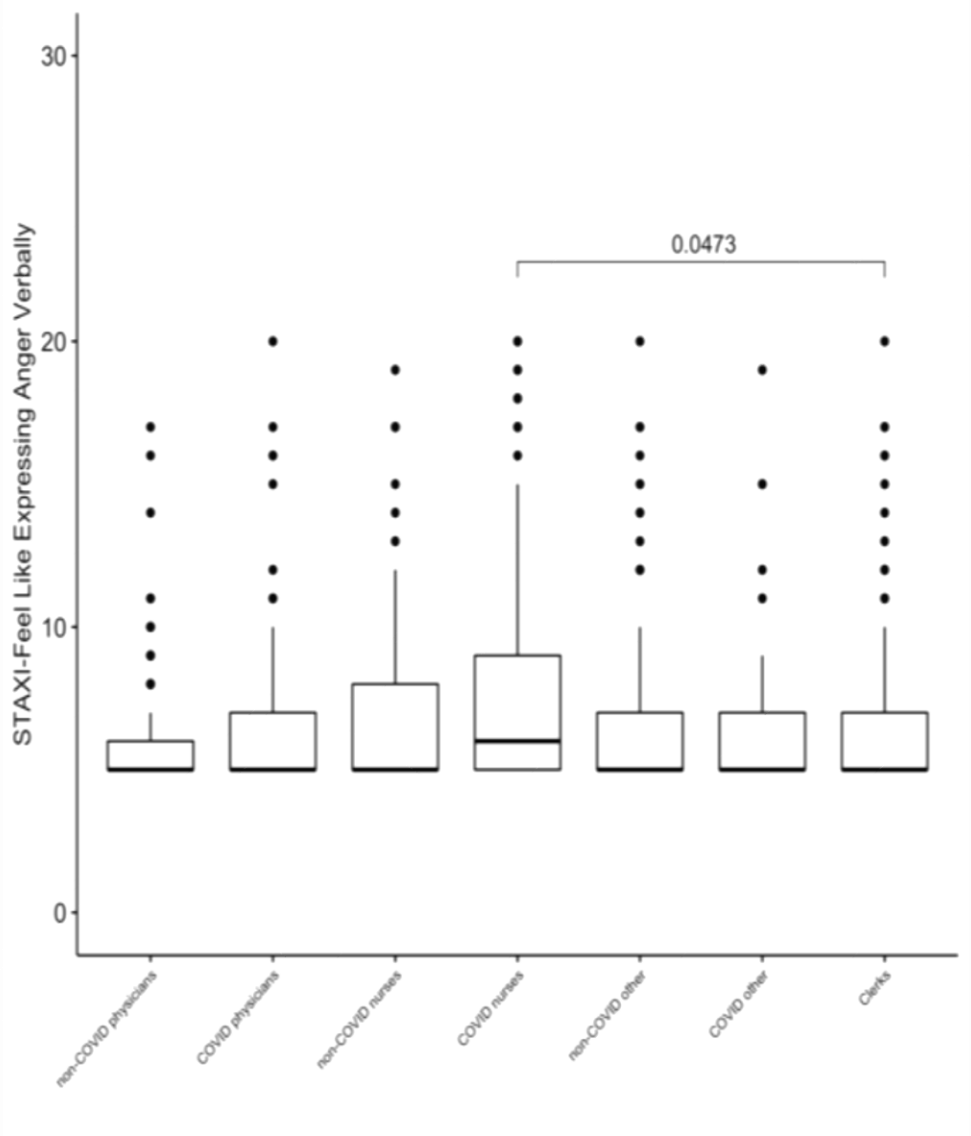


Figure S8. Dunn's test for STAXI Physical Expression.

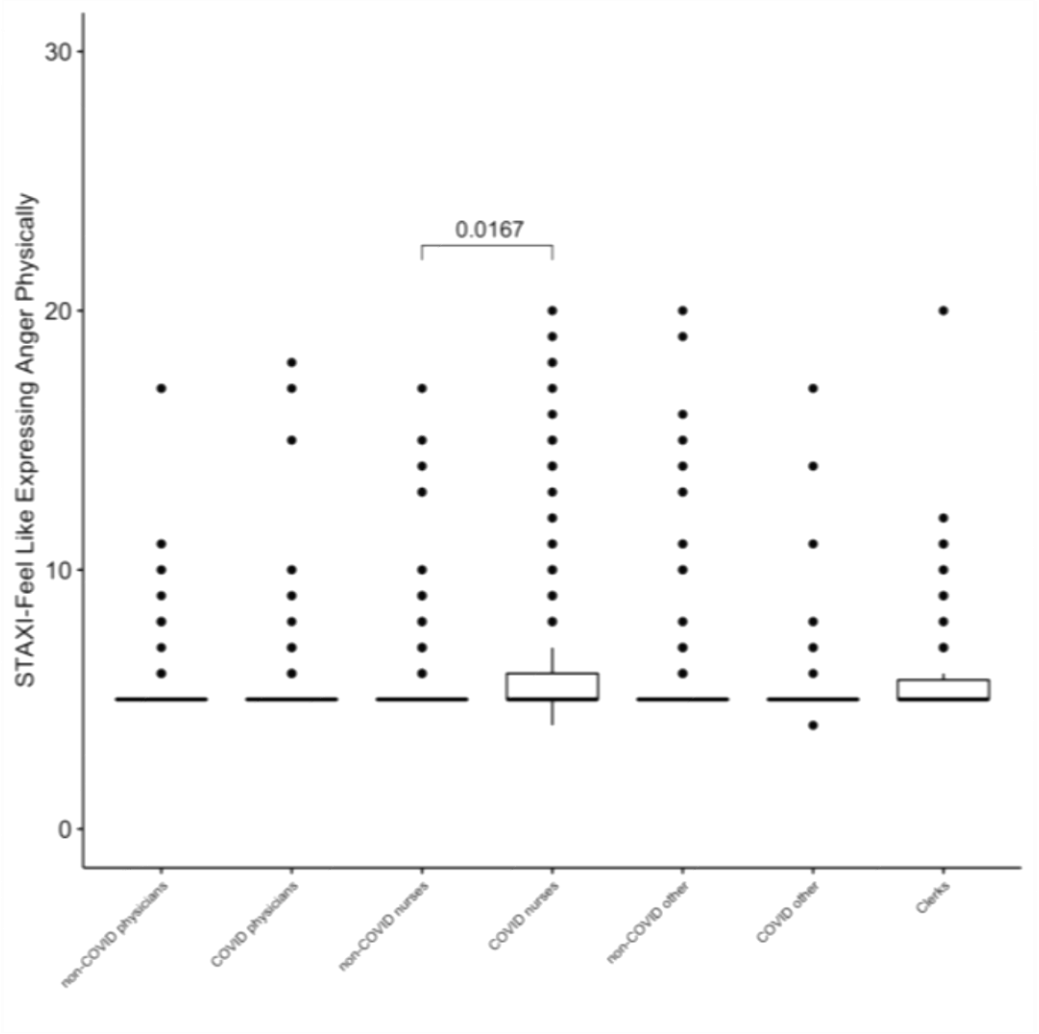


Figure S9. Dunn's test for MBI Emotional Exhaustion.

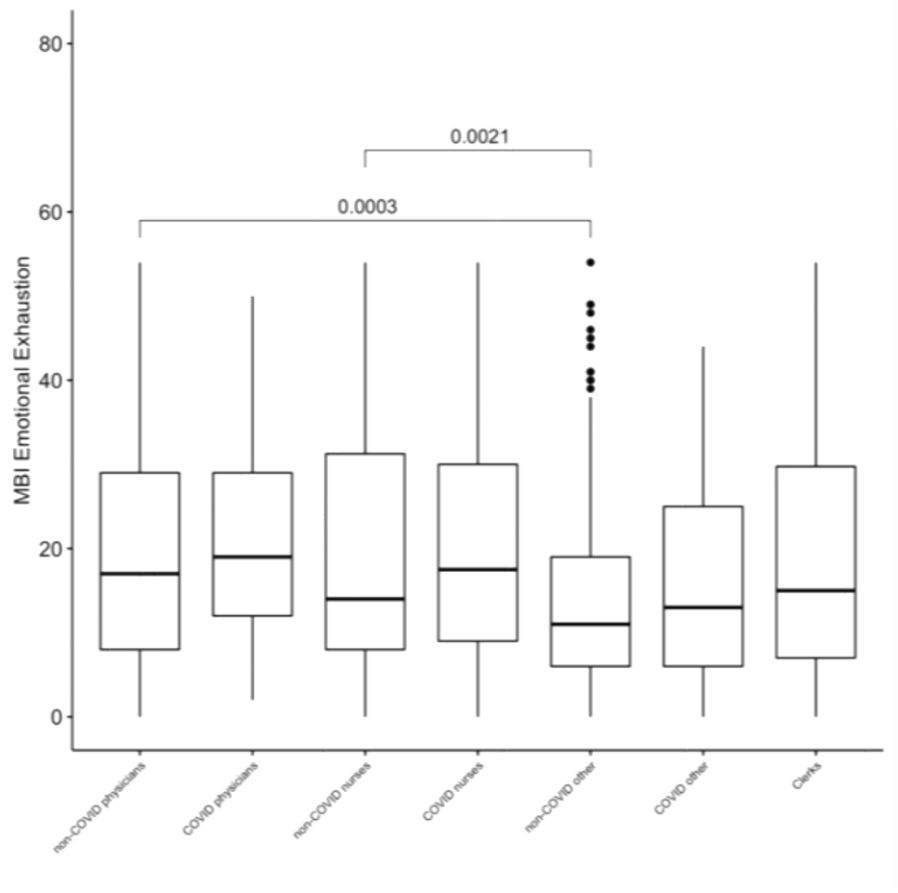


Figure S10. Dunn's test for MBI Depersonalization.

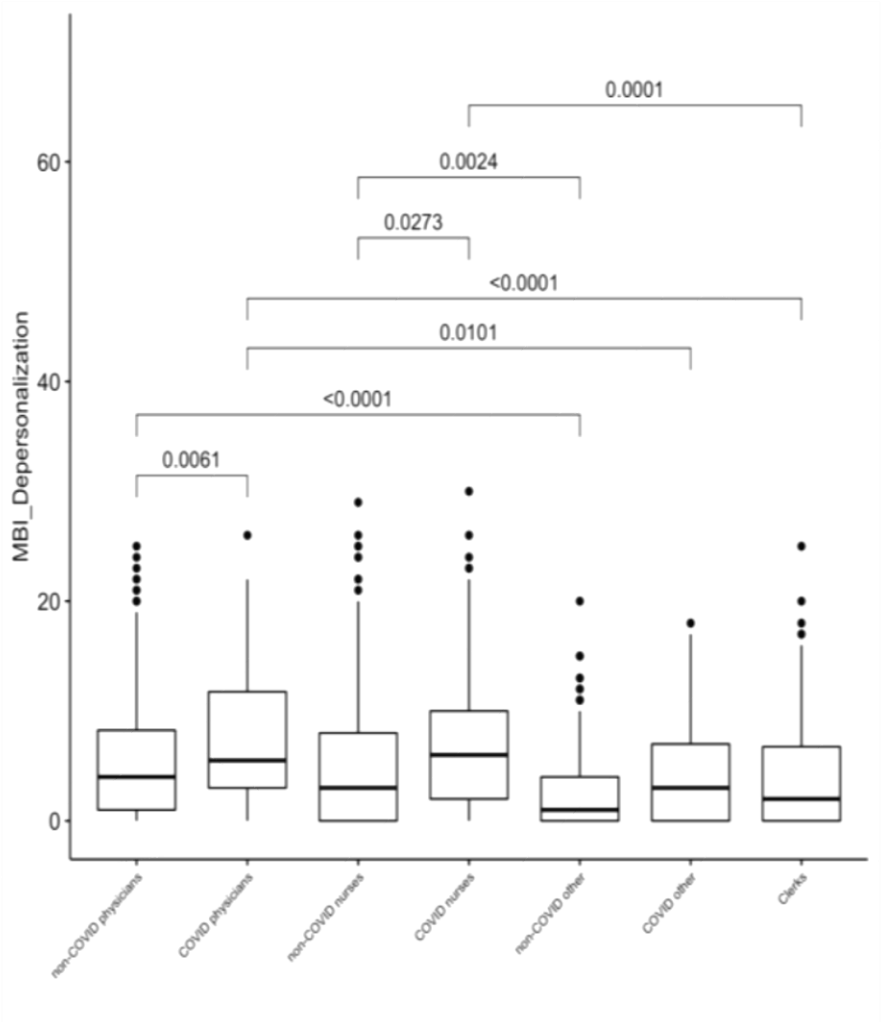


Figure S11. Dunn's test for MBI Personal Accomplishment.

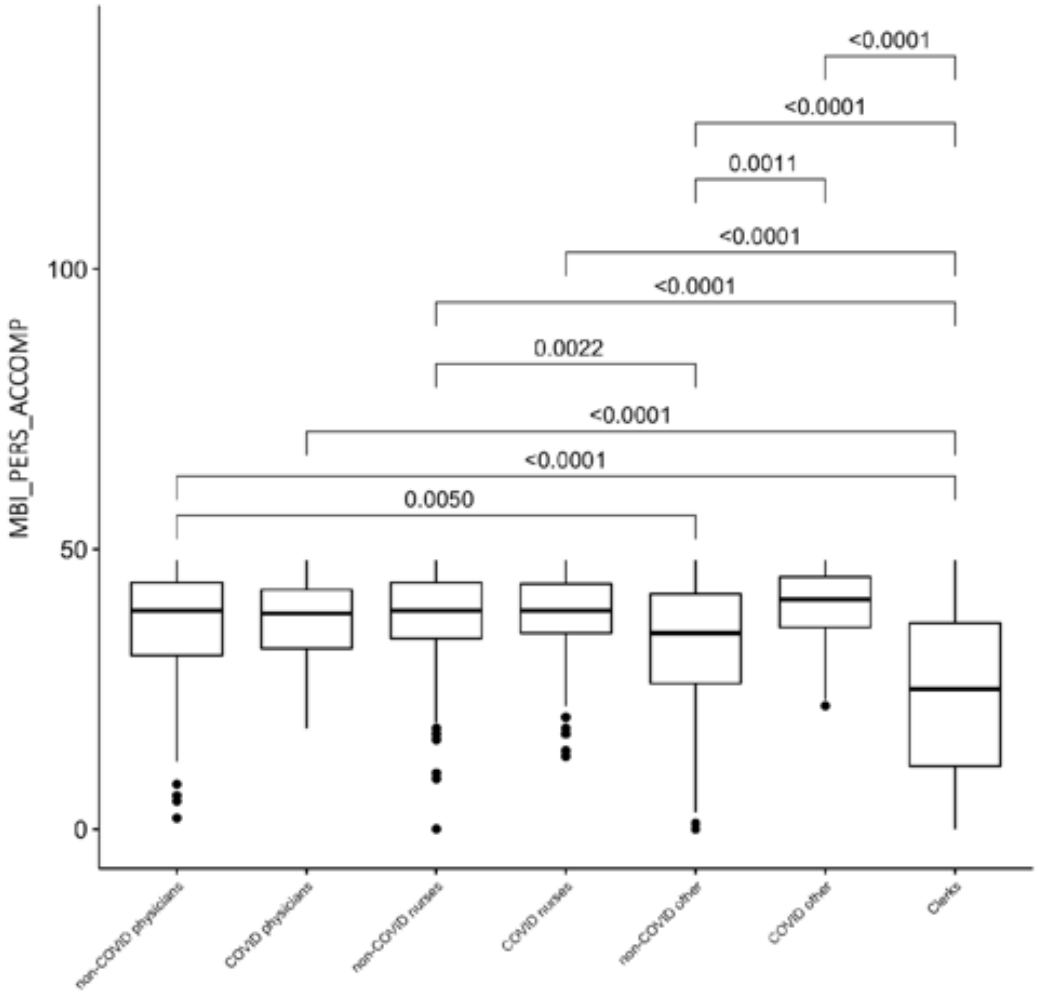


Figure S12. Dunn's test for Working Conditions.

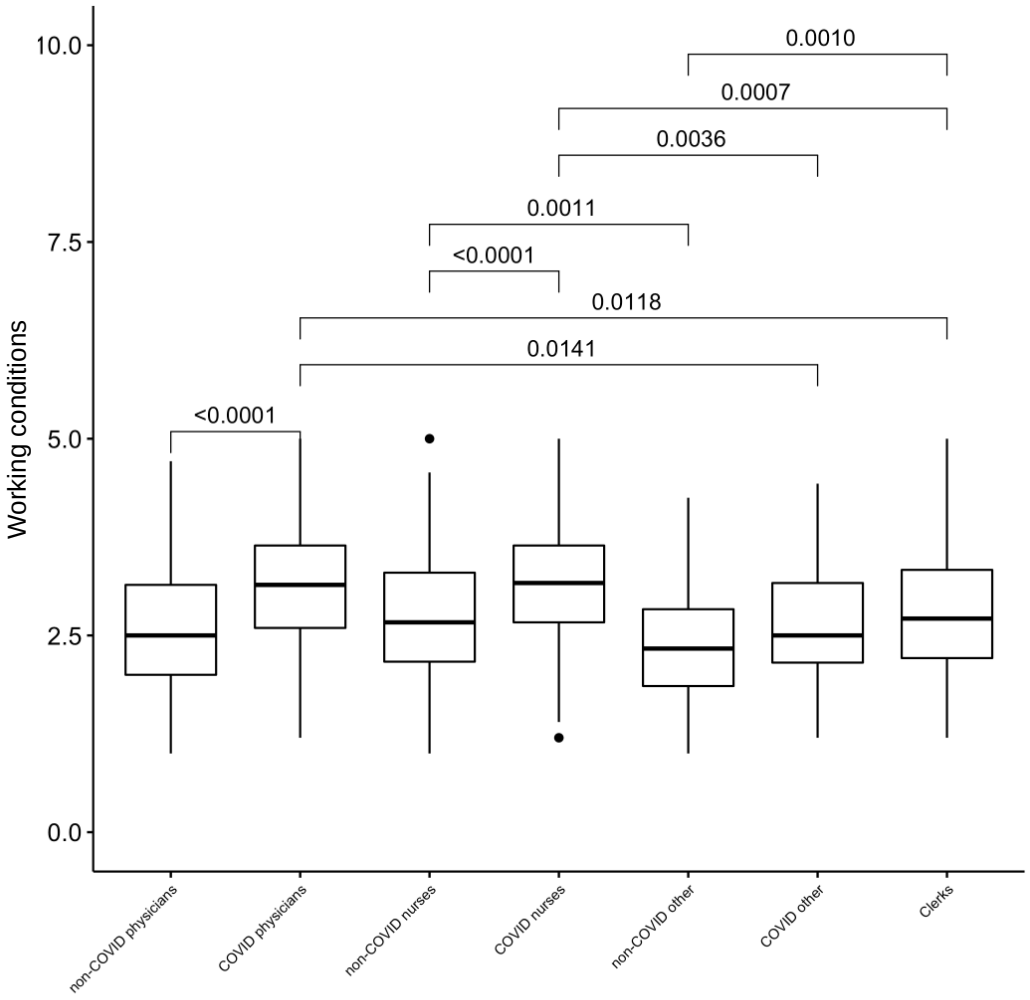
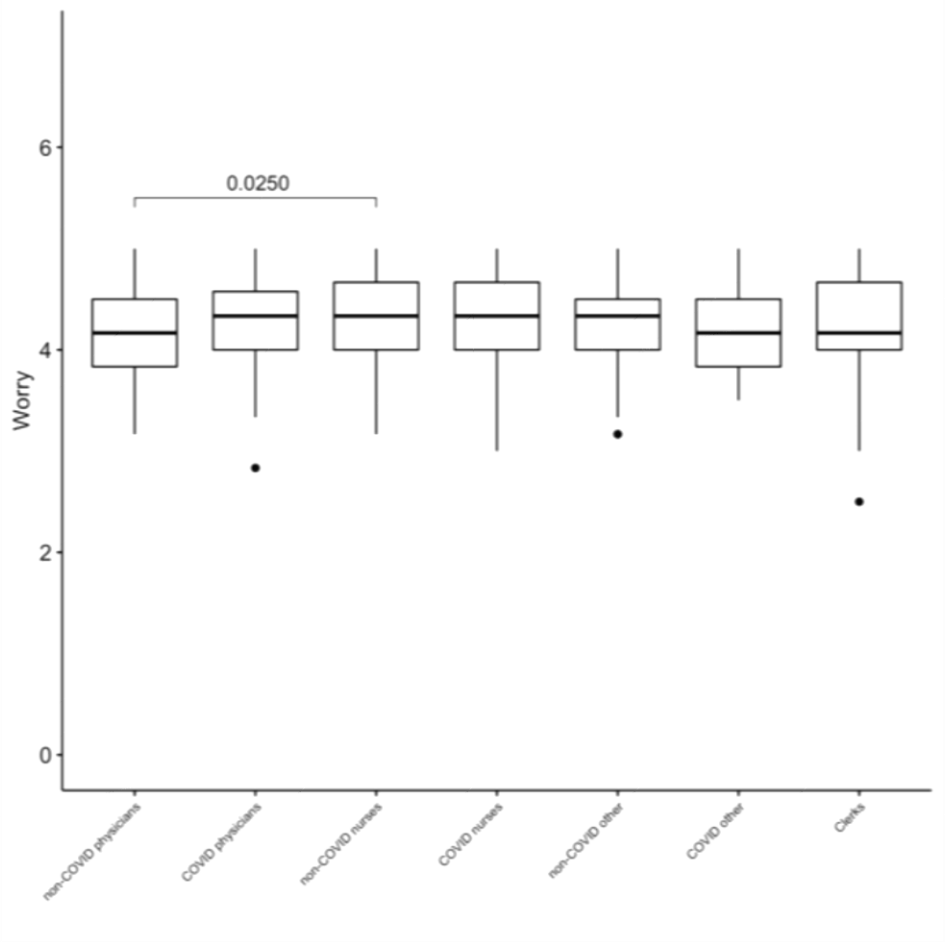


Figure S13. Dunn's test for Worry.



APPENDIX C - Supplementary tables for the Six-month Follow-up

Table S1. Cronbach's alpha values of the psychometric scales at T0 and T1 (n=291).

	T0	T1
DASS_DEPR	0.90	0.91
DASS_ANX	0.84	0.83
DASS_STRESS	0.91	0.93
ISI_TOT	0.62	0.59
IES_INTR	0.92	0.92
IES_AVOID	0.82	0.83
IES_HYPER	0.87	0.85
STATE_ANG	0.95	0.95
MBI_EMO_EX	0.93	0.93
MBI_DEPERS	0.76	0.78
MBI_PERS_ACCOMP	0.84	0.85
WORRY	0.84	0.82
CONDWORK	0.62	0.66

Table S2. Descriptive statistics of investigated psychometric variables.

	Physicians (n=91)		Nurses (n=97)		Clerks (n=22)		Other healthcare (n=81)	
	mean	**sd**	**mean**	**sd**	**mean**	**sd**	**mean**	**sd**
T0 - DASS DEPR	8.79	8.64	9.51	8.94	11.91	10.93	8.3	7.88
T0 - DASS ANX	4.53	5.97	7.63	7.43	7.73	8.93	5.88	6.55
T0 - DASS STRESS	15.23	9.82	15.57	9.19	18.09	11.49	14.96	9.01
T0 - ISI TOT	7.45	3.46	9.48	4.18	9.68	4	8.4	3.92
T0 - IES INTR	0.83	0.8	1.23	0.87	1.14	0.95	0.86	0.85
T0 - IES AVOID	0.77	0.7	1.05	0.72	1	0.72	0.81	0.68
T0 - IES HYPER	0.92	0.81	1.16	0.89	1.27	0.98	1.03	0.86
T0 - STATE ANG	19.27	6.4	21.31	8.98	21.5	8.08	20.3	7.06
T0 - MBI EMO EX	20.22	12.63	20.34	14.46	21.32	11.21	17.31	13.08
T0 - MBI DEPERS	6.69	6.05	6.39	6.29	5.18	3.78	3.15	4.22
T0 - MBI PERS ACCOMP	36.57	8.18	37.58	7.5	24.55	12.53	34.96	10.16
T1 - DASS DEPR	10.29	10.01	11.28	9.71	14.45	9.8	10	9.1
T1 - DASS ANX	4.79	6.93	8.06	7.12	8.45	8.14	6.12	6.78
T1 - DASS STRESS	16.97	10.62	17.73	9.99	20.64	10.86	16.15	10.17
T1 - ISI TOT	7.65	3.36	9.68	3.86	9.91	3.61	8.35	3.85
T1 - IES INTR	0.76	0.71	1.18	0.82	1.14	0.83	0.85	0.86
T1 - IES AVOID	0.65	0.6	1.04	0.72	0.95	0.73	0.81	0.63
T1 - IES HYPER	0.86	0.74	1.13	0.83	1.23	0.82	1.04	0.9
T1 - STATE ANG	21.35	7.95	22.86	9.6	25.95	10.6	21.54	9.62
T1 - MBI EMO EX	21.87	14.3	21.41	13.92	27.64	14.37	18.3	13.76
T1 - MBI DEPERS	7.58	7.05	6	5.93	6.59	6.33	3.56	4.81
T1 - MBI PERS ACCOMP	35.47	8.73	36.05	8.63	24.18	13.22	34.84	10.15

Table S3. Observed ranges of investigated psychometric variables.

	Physicians (n=91)		Nurses (n=97)		Clerks (n=22)		Other healthcare (n=81)	
	min	max	min	max	min	max	min	max
T0 - DASS DEPR	0	32	0	36	0	42	0	38
T0 - DASS ANX	0	26	0	30	0	36	0	30
T0 - DASS STRESS	0	42	2	40	0	42	0	42
T0 - ISI TOT	3	18	0	21	3	19	3	19
T0 - IES INTR	0	3.75	0	3.13	0	3.63	0	3.5
T0 - IES AVOID	0	3	0	3.38	0	2.5	0	2.88
T0 - IES HYPER	0	3.5	0	3.83	0	4	0	3.67
T0 - STATE ANG	15	57	15	53	15	41	15	57
T0 - MBI EMO EX	1	54	0	54	5	48	0	54
T0 - MBI DEPERS	0	24	0	24	0	12	0	20
T0 - MBI PERS ACCOMP	15	48	16	48	4	47	3	48
T0 - WORRY	1.50	4.50	1.75	4.50	1.75	4.75	1.75	5
T0 - CONDWORK	1	4.5	1.2	5	1.6	5	1	4.17
T0 - MSPSS	33	84	12	84	31	84	27	84
T0 - COPE – Problem-Focused	1.25	4	1	4	1	3.75	1.25	4
T0 - COPE –_Emotion-Focused	1.25	3.25	1	3.33	1.25	2.83	1	3.42
T0 - COPE – Avoidant	1	2.5	1	2.88	1	3	1	2.75
T1 - DASS DEPR	0	42	0	38	0	30	0	36
T1 - DASS ANX	0	34	0	34	0	24	0	28
T1 - DASS STRESS	0	40	0	40	2	36	0	38
T1 - ISI TOT	3	16	2	21	3	17	3	18
T1 - IES INTR	0	3.63	0	3.38	0	2.50	0	3.38
T1 - IES AVOID	0	2.5	0	3	0	2.625	0	2.75
T1 - IES HYPER	0	3.17	0	3.33	0	2.8	0	3.50
T1 - STATE ANG	15	60	15	60	15	56	15	58
T1 - MBI EMO EX	0	52	0	54	3	50	0	52
T1 - MBI DEPERS	0	24	0	21	0	25	0	20
T1 - MBI PERS ACCOMP	0	48	9	48	0	45	0	48
T1 - WORRY	1.75	5	1.5	5	1.5	4.5	1.5	5
T1 - CONDWORK	1	4.57	1.29	4.43	1.43	3.57	1	4

Table S4. Estimates (standard-errors) of the models. Square root transformation was applied to MBI depersonalization scale, while scores on the MBI personal accomplishment scale were raised to the power of two.

Parameter	MBI DEPERS	MBI PERS ACCOMP
Intercept	2.66(0.67)***	422.9(286.12)
Time (T1 vs T0)	0.03(0.12)	-57.01(56.57)
AGE	-0.02(0.01)***	3.28(2.59)
GENDER (Female vs Male)	-0.32(0.18)	56.15(75.6)
Occupation (Ref= Physicians)		
Nurses	-0.33(0.19)	37.86(82.95)
Clerks	-0.42(0.3)	-610.84(130.64)***
Other healthcare	-0.95(0.2)***	-76.07(86.02)
WARD COVID (Yes vs No)	0(0.12)	25.89(54.26)
WORRY	0.19(0.08)*	-34.57(35.11)
CONDWORK	0.25(0.07)***	-10.82(32.54)
PSYCH HISTORY (Yes vs No)	0.26(0.16)	-157.58(67.14)*
EMERGENCY TRAINING (Yes vs No)	-0.03(0.18)	51.43(76.76)
MSPSS	-0.02(0.0049)***	3.09(2.11)***
COPE – Problem-Focused	-0.45(0.14)**	346.52(61.14)
COPE – Emotion-Focused	0.57(0.21)**	-115.34(89.52)
COPE – Avoidant	0.46(0.17)**	-2.2(73.26)
T1 : Occupation = Nurses	-0.05(0.17)	-26.92(75.76)
T1 : Occupation = Clerks	0.21(0.27)	53.41(123.13)
T1 : Occupation = Other healthcare	0.05(0.17)	54.68(78.8)

*** p<0.0001; ** p<0.01; * p<0.05

Table S5. Estimates (standard-errors) of the models. Square root transformation was applied to scores on both IES-R Avoidance and Hyperarousal scales.

Parameter	IES Avoidance	IES Hyperarousal
Intercept	-0.7(0.18)***	-0.77(0.19)***
Time (T1 vs T0)	-0.1(0.04)**	-0.08(0.04)*
AGE	0.003(0.002)*	0.004(0.002)*
GENDER (Female vs Male)	0.07(0.05)	0.07(0.05)
Occupation (Ref= Physicians)		
Nurses	0.1(0.05)	0.08(0.06)
Clerks	0(0.08)	0(0.09)
Other healthcare	-0.03(0.06)	0.01(0.06)
WARD COVID (Yes vs No)	-0.02(0.04)	-0.07(0.04)
WORRY	0.12(0.02)***	0.16(0.02)***
CONDWORK	0.07(0.02)**	0.14(0.02)***
PSYCH HISTORY (Yes vs No)	0.09(0.04)*	0.19(0.04)***
EMERGENCY TRAINING (Yes vs No)	-0.04(0.05)	-0.12(0.05)*
MSPSS	-0.002(0.001)	-0.003(0.001)
COPE – Problem-Focused	-0.04(0.04)	-0.06(0.04)
COPE – Emotion-Focused	0.11(0.06)*	0.15(0.06)*
COPE – Avoidant	0.46(0.05)***	0.32(0.05)***
T1 : Occupation = Nurses	0.09(0.05)	0.07(0.05)
T1 : Occupation = Clerks	0.08(0.08)	0.1(0.09)
T1 : Occupation = Other healthcare	0.1(0.05)	0.09(0.06)

*** p<0.0001; ** p<0.01; * p<0.05

APPENDIX D - Supplementary tables for the One-year Follow-up

Table S6. Cronbach's alpha values of the psychometric scales at T0, T1, and T2 (n=325).

	T0	T1	T2
DASS_DEPR	0.89	0.91	0.92
DASS_ANX	0.83	0.83	0.86
DASS_STRESS	0.91	0.93	0.92
ISI_TOT	0.60	0.59	0.56
IES_INTR	0.91	0.92	0.92
IES_AVOID	0.83	0.83	0.87
IES_HYPER	0.87	0.86	0.88
STATE_ANG	0.94	0.95	0.95
MBI_EMO_EX	0.93	0.93	0.93
MBI_DEPERS	0.75	0.77	0.84
MBI_PERS_ACCOMP	0.83	0.85	0.86
WORRY	0.84	0.82	0.81
CONDWORK	0.64	0.66	0.69

Table S7. Descriptive statistics of investigated psychometric variables (mean (sd)).

	Physicians	Nurses	Clerks	Other healthcare
T0 - DASS DEPR	8.91 (8.70)	9.94 (8.98)	10.48 (10.57)	7.96 (7.94)
T0 - DASS ANX	4.46 (5.64)	7.89 (7.58)	7.04 (8.62)	5.93 (6.52)
T0 - DASS STRESS	15.10 (9.59)	16.27 (9.56)	17.12 (10.97)	14.51 (9.03)
T0 - ISI TOT	7.45 (3.39)	9.50 (4.03)	9.60 (3.83)	8.18 (3.57)
T0 - IES INTR	0.82 (0.78)	1.21 (0.87)	1.00 (0.95)	0.84 (0.83)
T0 - IES AVOID	0.76 (0.70)	1.06 (0.76)	0.95 (0.69)	0.86 (0.69)
T0 - IES HYPER	0.90 (0.78)	1.17 (0.90)	1.19 (0.94)	1.01 (0.84)
T0 - STATE ANG	18.88 (6.07)	21.39 (8.79)	20.56 (6.53)	19.61 (6.49)
T0 - MBI EMO EX	20.41 (12.88)	20.83 (14.13)	21.32 (11.45)	16.18 (12.54)
T0 - MBI DEPERS	6.73 (6.06)	6.58 (6.19)	5.36 (3.66)	2.89 (4.08)
T0 - MBI PERS ACCOMP	37.13 (7.92)	37.92 (6.96)	24.68 (12.27)	34.94 (10.27)
T1 - DASS DEPR	10.29 (10.02)	11.71 (9.84)	13.81 (9.55)	10.03 (9.28)
T1 - DASS ANX	4.82 (6.96)	8.18 (7.21)	7.71 (7.54)	6.50 (6.87)
T1 - DASS STRESS	17.00 (10.65)	18.27 (10.03)	20.10 (10.82)	16.45 (10.44)
T1 - ISI TOT	7.70 (3.35)	9.74 (3.88)	9.86 (3.69)	8.47 (3.89)
T1 - IES INTR	0.75 (0.72)	1.21 (0.83)	1.10 (0.84)	0.88 (0.89)
T1 - IES AVOID	0.65 (0.60)	1.06 (0.73)	0.93 (0.74)	0.84 (0.63)
T1 - IES HYPER	0.85 (0.75)	1.16 (0.83)	1.19 (0.82)	1.08 (0.93)
T1 - STATE ANG	21.33 (8.00)	23.24 (9.84)	24.52 (8.41)	21.78 (10.17)
T1 - MBI EMO EX	21.84 (14.40)	21.99 (14.00)	27.05 (14.46)	18.47 (13.90)
T1 - MBI DEPERS	7.74 (7.07)	6.24 (6.02)	6.71 (6.46)	3.54 (4.70)
T1 - MBI PERS ACCOMP	35.87 (8.66)	36.03 (8.21)	24.48 (13.47)	34.84 (10.30)
T2 - DASS DEPR	9.14 (9.29)	10.90 (11.14)	10.21 (9.14)	6.59 (7.04)
T2 - DASS ANX	4.73 (6.96)	8.55 (8.76)	5.47 (7.60)	4.61 (5.28)
T2 - DASS STRESS	13.89 (8.94)	16.81 (10.74)	14.95 (10.44)	12.83 (8.71)
T2 - ISI TOT	6.95 (2.99)	9.23 (3.80)	9.05 (4.12)	7.27 (3.27)
T2 - IES INTR	0.62 (0.64)	1.16 (0.93)	0.64 (0.69)	0.64 (0.61)
T2 - IES AVOID	0.58 (0.65)	0.98 (0.87)	0.93 (0.72)	0.60 (0.58)
T2 - IES HYPER	0.66 (0.70)	1.12 (1.01)	0.88 (0.77)	0.64 (0.62)
T2 - STATE ANG	18.72 (4.96)	21.52 (9.00)	22.42 (10.07)	19.11 (7.27)
T2 - MBI EMO EX	22.66 (13.04)	22.14 (15.67)	25.00 (12.97)	15.47 (11.38)
T2 - MBI DEPERS	7.12 (6.71)	6.68 (7.14)	5.42 (7.53)	3.71 (5.11)
T2 - MBI PERS ACCOMP	36.16 (7.28)	36.64 (7.34)	24.47 (13.97)	32.59 (12.47)

Table S8. Frequency distribution of responses on Likert items investigating respectively perceived appreciation coming from the hospital direction and the community and perceived support coming from the hospital direction for protecting them and/or their wellbeing.

	Physicians	**Nurses**	**Clerks**	**Other heathcare**
T1 - Perceived appreciation from the hospital direction				
Not at all	47 (52.2)	36 (40.0)	11 (52.4)	31 (40.8)
A little	16 (17.8)	27 (30.0)	6 (28.6)	22 (28.9)
A fair amount	17 (18.9)	22 (24.4)	3 (14.3)	20 (26.3)
Much	7 (7.8)	5 (5.6)	1 (4.8)	3 (3.9)
Very much	3 (3.3)	0 (0.0)	0 (0.0)	0 (0.0)
T1 - *Perceived support from the hospital direction*				
Not at all	39 (43.3)	24 (26.7)	5 (23.8)	20 (26.3)
A little	23 (25.6)	39 (43.3)	9 (42.9)	23 (30.3)
A fair amount	18 (20.0)	23 (25.6)	6 (28.6)	25 (32.9)
Much	7 (7.8)	4 (4.4)	1 (4.8)	7 (9.2)
Very much	3 (3.3)	0 (0.0)	0 (0.0)	1 (1.3)
T1 - *Perceived appreciation from the community*				
Not at all	20 (22.2)	23 (25.6)	8 (38.1)	18 (23.7)
A little	34 (37.8)	42 (46.7)	5 (23.8)	24 (31.6)
A fair amount	27 (30.0)	19 (21.1)	6 (28.6)	25 (32.9)
Much	8 (8.9)	6 (6.7)	2 (9.5)	8 (10.5)
Very much	1 (1.1)	0 (0.0)	0 (0.0)	1 (1.3)
T2 - Perceived appreciation from the hospital direction				
Not at all	28 (37.8)	32 (46.4)	9 (47.4)	31 (41.3)
A little	20 (27.0)	21 (30.4)	7 (36.8)	20 (26.7)
A fair amount	18 (24.3)	14 (20.3)	2 (10.5)	15 (20.0)
Much	4 (5.4)	2 (2.9)	1 (5.3)	8 (10.7)
Very much	4 (5.4)	0 (0.0)	0 (0.0)	1 (1.3)
T2 - *Perceived support from the hospital direction*				
Not at all	26 (35.1)	29 (42.0)	6 (31.6)	14 (18.7)
A little	20 (27.0)	18 (26.1)	10 (52.6)	30 (40.0)
A fair amount	16 (21.6)	17 (24.6)	3 (15.8)	21 (28.0)
Much	11 (14.9)	4 (5.8)	0 (0.0)	7 (9.3)
Very much	1 (1.4)	1 (1.4)	0 (0.0)	3 (4.0)
T2 - *Perceived appreciation from the community*				
Not at all	14 (18.9)	20 (29.0)	8 (42.1)	15 (20.0)
A little	21 (28.4)	30 (43.5)	3 (15.8)	21 (28.0)
A fair amount	31 (41.9)	16 (23.2)	6 (31.6)	29 (38.7)
Much	8 (10.8)	2 (2.9)	2 (10.5)	7 (9.3)
Very much	0 (0.0)	1 (1.4)	0 (0.0)	3 (4.0)

Table S9. LME models for evaluating the impact of perceived appreciation (a,c) and support (b), as measured by the three Likert items, on all the psychological scales of interest, while adjusting for time and working category. Item responses have been transformed in a binary outcome where "much" and "very much" response categories (i.e., 4 and 5 ratings) have been aggregated in one category to be compared to all the other response categories, collapsed in another category, which included all the ratings lower than or equal to 3.

(a) Perceived appreciation from hospital direction

Outcome	Estimate	Std. Error	p-value
DASS_DEPR	**-0.279**	**0.139**	**0.047**
DASS_ANX	-0.005	0.131	0.972
DASS_STRESS	-0.095	0.146	0.519
ISI_TOT	-0.113	0.145	0.437
IES_INTR	-0.131	0.126	0.301
IES_AVOID	-0.197	0.142	0.166
IES_HYPER	-0.118	0.141	0.405
STATE_ANG	-0.251	0.136	0.067
MBI_EMO_EX	-0.095	0.13	0.466
MBI_DEPERS	0.017	0.136	0.898
MBI_PERS_ACCOM	0.103	0.148	0.486

(b) Perceived support from hospital direction

Outcome	Estimate	Std. Error	p-value
DASS_DEPR	-0.184	0.126	0.146
DASS_ANX	0.003	0.119	0.977
DASS_STRESS	-0.22	0.132	0.098
ISI_TOT	-0.228	0.13	0.082
IES_INTR	-0.168	0.115	0.145
IES_AVOID	-0.225	0.128	0.081
IES_HYPER	-0.208	0.127	0.104
STATE_ANG	-0.196	0.123	0.114
MBI_EMO_EX	**-0.249**	**0.118**	**0.036**
MBI_DEPERS	-0.106	0.123	0.389
MBI_PERS_ACCOM	0.151	0.134	0.259

(c) Perceived appreciation from the community

Outcome	Estimate	Std. Error	p-value
DASS_DEPR	-0.074	0.124	0.549
DASS_ANX	-0.191	0.116	0.101
DASS_STRESS	-0.067	0.13	0.605
ISI_TOT	-0.134	0.128	0.3
IES_INTR	-0.12	0.111	0.282
IES_AVOID	0.022	0.126	0.862
IES_HYPER	-0.182	0.125	0.148
STATE_ANG	**-0.255**	**0.121**	**0.036**
MBI_EMO_EX	-0.088	0.114	0.443
MBI_DEPERS	-0.026	0.121	0.831
MBI_PERS_ACCOM	0.253	0.131	0.056

Table S10. Frequency distribution of responses on Likert item investigating the change in the perceived risk of making mistakes in the last three months.

		Physicians	Nurses	Other healthcare
T0	Not at all	6 (5.7)	2 (1.9)	6 (6.7)
	A little	31 (29.5)	35 (33.3)	32 (35.6)
	A fair amount	40 (38.1)	40 (38.1)	32 (35.6)
	Much	24 (22.9)	23 (21.9)	18 (20.0)
	Very much	4 (3.8)	5 (4.8)	2 (2.2)
T1	Not at all	10 (11.1)	7 (7.8)	8 (10.5)
	A little	44 (48.9)	49 (54.4)	39 (51.3)
	A fair amount	23 (25.6)	16 (17.8)	24 (31.6)
	Much	8 (8.9)	16 (17.8)	5 (6.6)
	Very much	5 (5.6)	2 (2.2)	0 (0.0)
T2	Not at all	13 (17.6)	8 (11.6)	16 (21.3)
	A little	42 (56.8)	36 (52.2)	42 (56.0)
	A fair amount	13 (17.6)	21 (30.4)	13 (17.3)
	Much	5 (6.8)	2 (2.9)	3 (4.0)
	Very much	1 (1.4)	2 (2.9)	1 (1.3)

Table S11. Frequency distribution of responses on Likert item investigating the perceived need of psychological/psychiatric support.

		Physicians	Nurses	Other healthcare
T0	Not at all	49 (46.7)	35 (33.3)	33 (36.7)
	A little	34 (32.4)	47 (44.8)	43 (47.8)
	A fair amount	16 (15.2)	13 (12.4)	10 (11.1)
	Much	5 (4.8)	8 (7.6)	3 (3.3)
	Very much	1 (1.0)	2 (1.9)	1 (1.1)
T1	Not at all	34 (37.8)	30 (33.3)	24 (31.6)
	A little	32 (35.6)	39 (43.3)	29 (38.2)
	A fair amount	12 (13.3)	12 (13.3)	17 (22.4)
	Much	8 (8.9)	6 (6.7)	5 (6.6)
	Very much	4 (4.4)	3 (3.3)	1 (1.3)
T2	Not at all	33 (44.6)	17 (24.6)	33 (44.0)
	A little	29 (39.2)	31 (44.9)	28 (37.3)
	A fair amount	5 (6.8)	14 (20.3)	9 (12.0)
	Much	6 (8.1)	3 (4.3)	5 (6.7)
	Very much	1 (1.4)	4 (5.8)	0 (0.0)

APPENDIX E - Supplementary tables for the General Discussion

Table S12. Comparison of T0 psychometric variables scores of physicians who only participated at T0 and physicians who participated in all three waves of the study.

Physicians	T0	T0.T1.T2	p-value	adj. p
n	202	59		-
DASS_DEPR (median [IQR])	6.00 [2.00, 14.00]	6.00 [2.00, 12.00]	0.401	1
DASS_ANX (median [IQR])	2.00 [0.00, 8.00]	2.00 [0.00, 6.00]	0.178	1
DASS_STRESS (median [IQR])	14.00 [8.00, 20.00]	12.00 [8.00, 19.00]	0.539	1
ISI_TOT (median [IQR])	7.00 [5.00, 10.00]	7.00 [5.00, 9.00]	0.232	1
IES_INTR (median [IQR])	0.62 [0.25, 1.25]	0.50 [0.12, 1.12]	0.416	1
IES_AVOID (median [IQR])	0.62 [0.25, 1.00]	0.50 [0.12, 1.06]	0.770	1
IES_HYPER (median [IQR])	0.67 [0.33, 1.17]	0.67 [0.33, 1.17]	0.904	1
STATE_ANG (median [IQR])	17.00 [15.00, 19.00]	17.00 [15.00, 20.00]	0.976	1
MBI_EMO_EX (median [IQR])	17.00 [10.00, 32.00]	18.00 [9.50, 26.00]	0.740	1
MBI_DEPERS (median [IQR])	4.00 [1.00, 10.00]	5.00 [2.00, 10.00]	0.443	1
MBI_PERS_ACCOMP (median [IQR])	38.00 [31.00, 44.00]	39.00 [30.00, 44.00]	0.886	1

Table S13. Comparison of T0 psychometric variables scores of nurses who only participated at T0 and nurses who participated in all three waves of the study.

Nurses	T0	T0.T1.T2	p-value	adj. p
n	257	54		-
DASS_DEPR (median [IQR])	8.00 [2.00, 16.00]	8.00 [2.00, 14.00]	0.843	1
DASS_ANX (median [IQR])	6.00 [2.00, 14.00]	6.00 [2.50, 10.00]	0.882	1
DASS_STRESS (median [IQR])	16.00 [8.00, 22.00]	16.00 [10.00, 20.00]	0.884	1
ISI_TOT (median [IQR])	9.00 [6.00, 12.00]	10.00 [6.25, 11.00]	0.557	1
IES_INTR (median [IQR])	1.00 [0.38, 1.88]	0.94 [0.62, 1.88]	0.360	1
IES_AVOID (median [IQR])	0.88 [0.38, 1.62]	0.88 [0.50, 1.38]	0.723	1
IES_ HYPER (median [IQR])	0.83 [0.33, 2.00]	0.83 [0.50, 1.33]	1.000	1
STATE_ANG (median [IQR])	18.00 [15.00, 23.00]	18.00 [16.00, 22.75]	0.371	1
MBI_EMO_EX (median [IQR])	17.00 [8.00, 31.00]	17.50 [8.25, 28.00]	0.876	1
MBI_DEPERS (median [IQR])	5.00 [1.00, 9.00]	5.00 [2.00, 9.00]	0.540	1
MBI_PERS_ACCOMP (median [IQR])	39.00 [34.00, 44.00]	40.50 [37.00, 43.75]	0.275	1

Table S14. Comparison of T0 psychometric variables scores of clerks who only participated at T0 and clerks who participated in all three waves of the study.

Clerks	T0	T0.T1.T2	p-value	adj. p
n	106	15		-
DASS_DEPR (median [IQR])	4.00 [2.00, 12.00]	4.00 [2.00, 16.00]	0.625	1
DASS_ANX (median [IQR])	4.00 [0.50, 8.00]	4.00 [1.00, 9.00]	0.848	1
DASS_STRESS (median [IQR])	12.00 [6.00, 18.00]	16.00 [6.00, 25.00]	0.287	1
ISI_TOT (median [IQR])	7.00 [5.25, 10.00]	11.00 [6.50, 12.00]	0.074	0.814
IES_INTR (median [IQR])	0.56 [0.25, 1.09]	0.75 [0.38, 1.38]	0.303	1
IES_AVOID (median [IQR])	0.62 [0.38, 1.00]	0.88 [0.31, 1.38]	0.372	1
IES_ HYPER (median [IQR])	0.67 [0.33, 1.29]	1.00 [0.75, 1.50]	0.103	1
STATE_ANG (median [IQR])	17.00 [15.00, 22.00]	17.00 [15.00, 22.50]	0.822	1

Clerks	T0	T0.T1.T2	p-value	adj. p
MBI_EMO_EX (median [IQR])	13.00 [6.00, 31.00]	16.00 [10.00, 25.00]	0.374	1
MBI_DEPERS (median [IQR])	1.00 [0.00, 6.00]	4.00 [2.00, 6.50]	0.160	1
MBI_PERS_ACCOMP (median [IQR])	26.00 [11.00, 37.00]	27.00 [16.00, 38.00]	0.411	1

Table S15. Comparison of T0 psychometric variables scores of other healthcare workers who only participated at T0 and other healthcare workers who participated in all three waves of the study.

Other healthcare	T0	T0.T1.T2	p-value	adj. p
n	175	61		-
DASS_DEPR (median [IQR])	4.00 [2.00, 12.00]	6.00 [2.00, 10.00]	0.826	1
DASS_ANX (median [IQR])	4.00 [0.00, 6.00]	4.00 [0.00, 8.00]	0.386	1
DASS_STRESS (median [IQR])	10.00 [6.00, 18.00]	12.00 [8.00, 22.00]	0.089	0.979
ISI_TOT (median [IQR])	7.00 [5.00, 10.00]	8.00 [5.00, 10.00]	0.510	1
IES_INTR (median [IQR])	0.56 [0.16, 1.12]	0.50 [0.25, 1.25]	0.503	1
IES_AVOID (median [IQR])	0.62 [0.12, 1.00]	0.62 [0.25, 1.12]	0.479	1
IES_HYPER (median [IQR])	0.67 [0.33, 1.17]	0.67 [0.33, 1.67]	0.158	1
STATE_ANG (median [IQR])	16.50 [15.00, 19.75]	18.00 [16.00, 21.00]	0.015	0.165
MBI_EMO_EX (median [IQR])	11.00 [5.00, 18.00]	14.00 [8.00, 25.00]	0.026	0.286
MBI_DEPERS (median [IQR])	2.00 [0.00, 5.00]	1.00 [0.00, 4.00]	0.692	1
MBI_PERS_ACCOMP (median [IQR])	37.00 [26.00, 42.00]	37.00 [30.00, 42.00]	0.653	1