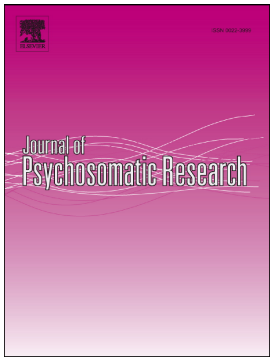
# Burnout among hospital staff during the COVID-19 pandemic: Longitudinal results from the international Cope-Corona survey study

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PII: S0022-3999(22)00387-7

DOI: https://doi.org/10.1016/j.jpsychores.2022.111102

Reference: PSR 111102

To appear in: *Journal of Psychosomatic Research*

Received date: 4 August 2022

Revised date: 18 November 2022

Accepted date: 19 November 2022

Please cite this article as: M.M. Müller, E. Baillès, J. Blanch, et al., Burnout among hospital staff during the COVID-19 pandemic: Longitudinal results from the international Cope-Corona survey study, *Journal of Psychosomatic Research* (2022), https://doi.org/10.1016/j.jpsychores.2022.111102

TITLE: Burnout among hospital staff during the COVID-19 pandemic: longitudinal results from the international Cope-Corona survey study

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Abstract

Objective: Long-term changes in burnout and its predictors in hospital staff during the COVID-19 pandemic were investigated in an international study.

Methods: Two online surveys were distributed to hospital staff in seven countries (Germany, Andorra, Ireland, Spain, Italy, Romania, Iran) between May and October 2020 (T1) and between February and April 2021 (T2), using the following variables: Burnout (emotional exhaustion and depersonalization), job function, age, gender, and contact with COVID-19 patients; individual resources (self-compassion, sense of coherence, social support) and work-related resources and demands (support at the workplace, risk perception, health and safety at the workplace, altruistic acceptance of risk). Data were analyzed using linear mixed models repeated measures, controlled for age.

Results: A total of 612 respondents were included (76% women). We found an increase in burnout from T1 to T2. Burnout was high among personnel with high contact with COVID-19 patients. Individual factors (self-compassion, sense of coherence) and work-related factors (support at the workplace, risk perception, health and safety at the workplace) showed associations with burnout. Low health and safety at the workplace at T1 was associated with an increase in emotional exhaustion at T2. Men showed an increase in depersonalization if they had much contact with COVID-19 patients.

Conclusion: Burnout represents a potential problematic consequence of occupational contact with COVID-19 patients. Special attention should be paid to this group in organizational health management. Self-compassion, sense of coherence, support at the workplace, risk perception, and health and safety at the workplace may be important starting points for interventions.

Registration: Müller, M. M. (2020, August 30). Cope-Corona: Identifying and strengthening personal resources of hospital staff to cope with the Corona pandemic. Open Science Foundation.

Keywords: COVID-19; Burnout; Job Demands Resources Model; Hospital Staff; Longitudinal Survey

1. Introduction

Burnout as a reaction to long-lasting and chronic stress at the workplace is a major problem for those affected, and it can have far-reaching intrapersonal as well as work-related consequences [1]. It is shown to be particularly common in the health care sector [2]. The COVID-19 outbreak drastically changed the working conditions of this already demanding work environment. For example, a qualitative study in China [3] reported that health care workers (HCWs) experienced emotional exhaustion due to the high workload, wearing protective equipment, the risk of infection, and a feeling of powerlessness when dealing with patients. At the same time, social support and self-management strategies constituted resources amidst the challenges. Koontalay and colleagues [4] reported that HCWs are at elevated risk of emotional problems such as anxiety, agitation, depression, and stress. This high level of stress may contribute to the increase of numbers of sick leave days and turnover intentions, which have been demonstrated among nursing staff in German hospitals. [5].

Just before the global COVID-19 outbreak, a broad international meta-analysis, analyzing the results of validated self-report instruments with standard cutoff scores for high burnout symptoms, found a burnout prevalence of 11% across different nursing staff departments [6]. During the pandemic, international cross-sectional studies in hospitals showed that a high number of staff (ranging from 13 to 76%) experienced burnout symptoms [7-11], a phenomenon which also affected the staff in psychiatric and psychosomatic consultation-liaison services [12]. A deterioration in mental health can be found across different professional groups [13].

However, crises always bear the chance for development, adaptation, and growth, both on the individual and on the institutional level. Therefore, the Cope-Corona study was designed to study resources and job demands during the COVID-19 pandemic and their impact on hospital staff burnout in a longitudinal study design. The model used in the study is based on the Job-Demands-Resources (JDR) model [14] and incorporates ideas from research on the model of salutogenesis [15], burnout, and self-compassion [16]. The JDR model suggests that working conditions can be divided

into two broad categories – work-related demands and resources. Demands are primarily linked to burnout, while resources can operate as a buffer against stress and burnout [17] but also as positive influences on work engagement [18]. The JDR was considered a useful framework for the current study, since it can be used as a heuristic model where demands and resources can be specified according to the context of the field of study [19].

Maunder and colleagues [20] showed in the context of the severe acute respiratory syndrome (SARS) outbreak that the symptoms of overwork and emotional exhaustion were usually only noticed when a recovery phase occured during a pandemic. Given the very dynamic, global character of the COVID-19 pandemic , it deemed necessary to study these questions in a longitudinal, international research project.

1.1 Research questions

The present paper addresses two research questions:

(1) How does burnout change between a first (during the first wave of the COVID-19 pandemic) and a second (during the second wave) assessment? Due to an increase in job demands, we expected an increase in burnout from time 1 to time 2 in the overall sample, with the highest levels of burnout in staff who reported working directly with COVID-19 patients.

(2) What are factors that influence burnout? More precisely, we analyzed sex, job characteristics (function, contact with COVID-19 patients); job demands and resources (health and safety at the workplace, risk perception related to the virus, support at the workplace, and altruistic acceptance of risk); and individual resources (social support, self-compassion, sense of coherence). We expected individual and job-related resources to be negatively associated with burnout, which means that persons with high levels of these resources have lower levels of burnout. Job demands, on the other hand, were expected to have an increasing effect on burnout.

2. Method

2.1. Design of the study

The surveys were distributed online via the Qualtrics survey tool (https://www.qualtrics.com) using announcements on the intranet, internal mailinglists, newsletters, groups in messenger apps, and posters with QR codes that allowed access via smartphones (cf. table 2 for more information on participating hospitals). Local language translations were provided in German, English, Spanish, Catalan, Italian, Romanian, and Farsi. Additional versions in Polish and Chinese were available only at T2 and were therefore not included in the current paper based on longitudinal data. The qualtrics tool read the language settings from the users' browser and presented the appropriate language version accordingly.

The survey was fully anonymized. No IP addresses or geolocation data (e.g., the location of a Wi-Fi access point) were stored in the background in the online survey. Subjects were asked to give a self-generated identification code, in order to match subjects at the different assessment points in time. Ethical approval was obtained from the Institutional Review Board of Paracelsus Medical University, General Hospital Nuremberg (IRB-2020-017). Local ethical approval at the participating centers was received accordingly. All participants received full disclosure and provided informed consent.

To ensure the validity of the responses all participants who answered less than 50% of the questions were excluded from the analysis.

2.2. Participants and study points in time

The study surveyed the participants at two assessment points in time (T1 and T2). Data collection for T1 took place between May and November 2020. This time frame was due to the fact that the individual centers obtained ethical approval at different moments in the process. At T2, data collection started in February 2021 and ended in April 2021. Although the dynamics of the pandemic varied largely in global dimensions, these study periods were chosen to reflect the first (T1) and end of the second wave (T2) of the COVID-19 pandemic [21]. A third time point (T3) is planned in summer 2022 and will be reported elsewhere.

The Cope-Corona Study Group was established with the support of the European Association of Psychosomatic Medicine (EAPM), with the group at Paracelsus Medical University, Nuremberg General Hospital and Catholic University of Eichstätt-Ingolstadt as the lead. All members of EAPM were informed about the research initiative via a mailing list and were asked to participate. This process resulted in a group of partners in Ireland, Andorra, Spain, Germany, Italy, Romania and Iran for T1. For T2, partners in Poland and China joined the working group. All adult (+18 years) employees of the hospitals and their subcontractors were asked to participate in the survey.

2.3. Instruments

The constructs in the questionnaire were measured using established and validated psychometric scales or with ad hoc instruments when appropriate operationalizations were not available. All scales were set to local languages (German, English, Catalan, Spanish, Italian, Romanian, Farsi, and Chinese) using validated translations, if available. When translations were not available, items were translated by native-speaking members of the Cope-Corona study group.

2.3.1. Individual resources

*State Self-Compassion*. Self-Compassion is a concept introduced by Neff [22] that is described as a kind and understanding attitude towards one's own difficult and stressful experiences. It encompasses being open to and moved by one's own suffering, experiencing feelings of caring and kindness toward oneself, taking an understanding, nonjudgmental attitude toward one's inadequacies and failures, and recognizing that one's own experience is part of the common human experience. Derived from the Self-Compassion Scale (SCS), the State Self-Compassion Scale asks participants to focus on a current situation that is painful or difficult, and to respond to statements [23]. The short form consists of six items (State Self-Compassion Scale – Short, SSCS-S), with answers being scaled from 1 ("not at all true for me") to 5 ("pretty much true for me"). The total score is calculated as the mean of all items. Cronbach's alpha in the sample was .61.

*Social Support*. The ENRICHD Social Support Inventory (ESSI) is a 5-item scale constructed from items from other validated support scales [24]. Answers are scaled from 1 ("none of the time") to 5 ("all of the time). Cronbach's alpha in the sample was .90.

*Sense of Coherence*. Sense of coherence is a central idea in the model of salutogenesis proposed by Antonovsky [15] and is defined as the ability to understand and integrate (comprehensibility), handle (manageability) and make sense (meaningfulness) of an experience to increase the potential to successfully cope with that experience. Originally, the sense of coherence scale (SOC) was developed with 29 items [25]. In 1995, Lundberg and Peck published a 3-item version of the SOC [26]. It contains one item for each of the three components of the sense of coherence (understandability, manageability, and meaningfulness). The answers can range from 1 to 7. The SOC-3 shows a one-factor structure [27]. Cronbach's alpha in the sample was .69.

2.3.2. Job-related demands and resources

*Contact with COVID-19 patients.* Professional contact with COVID-19 patients was measured using one item ("Do you deal directly with coronavirus-infected patients or suspected cases in your work?") and a four point scale ranging from "Not at all" to "Very much". The four point scale was split to a binary scale ("hardly any" – "much") for further analyses.

*Risk Perception*. In the risk perception scale, two items (probability of infection and severity) were taken from the COSMO (COVID-19 Snapshot Monitoring) project [28] (item example: "How would you rate an infection with the coronavirus for yourself?" with answers ranging from 1 – completely harmless to 5 – extremely dangerous). In addition, a further item was added to capture concerns about infecting someone in one's environment with COVID-19. Cronbach's alpha in the sample in the sample was .55.

*Support at the Workplace.* Perceived support at the workplace was measured using five newly constructed items. These items encompass team cohesion, cross-team communication, recognition from supervisors, trust in decisions of supervisors, and information from hospital management (item

example: “My team is working well together at the present time to support each other.”). A four point scale (from “strongly disagree” to “strongly agree”) was used. Cronbach’s alpha in the sample was .76.

*Altruistic Acceptance of Risk*. In order to measure COVID-19 related altruistic acceptance of risk, we used a single item that was used in a previous study on the psychological impact of the 2003 SARS pandemic: “Because I want to help COVID-19 patients, I am willing to accept the risks involved.” [29, 30] and that was shown to be a relevant factor of work engagement in the COVID-19 pandemic [31]. The item used a 5 point scale ranging from “Fully agree” (5) to “Completely disagree” (1).

*Health and Safety at the Workplace*. Two items were used to measure subjective feelings about health and safety at the workplace, one on the availability of personal protective equipment (PPE), and one stating “I am confident that I can stay healthy at work”. Both items were rated on a five point scale from “Strongly agree” to “strongly disagree” and recoded later, so that higher values express stronger feelings of health and safety. Inter-item correlation in the sample was .67.

2.3.3. Dependent variables.

*Burnout: Emotional Exhaustion and Depersonalization*. Maslach and Jackson [1] published the Maslach Burnout Inventory (MBI) with the three burnout factors - emotional exhaustion, performance (dis)satisfaction, and depersonalization. West et al. [32] extracted two items that loaded particularly high on their factors (emotional exhaustion: “I feel burned out from my work.” and depersonalization, also termed “cynicism”: “I have become more callous toward people since I took this job.”) as two single item-measures for use with medical professionals. The items use a 7 point scale ranging from zero (“Never”) to six (“Every day”). In multivariate analyses, these items were used as continuous variables. To describe prevalence of burnout, we used cut-off scores commonly used in other studies [32, 33] of feelings of emotional exhaustion or depersonalization once a week or more (scores equal to or greater than four). Both dimensions of burnout were evaluated separately throughout the analyses.

2.3.4. Demographic variables.

As demographic variables, age, sex (male/female/diverse). Job Experience was measured in three categories (less than 3 years, 3 to 6 years, more than 6 years). Function at work was measured in 11 categories that are used as 5 in the present study: MD, nurse, medical-technical personnel, administration, and others. For the description of the sample, we also report data on previous COVID-19 infection and whether the respondents had received a vaccination at the time of T2.

2.3.5. Additional variables

In addition to the variables reported here, the questionnaires contained items measuring perceived stress (Perceived Stress Scale, PSS-4) [34], anxiety (Generalized Anxiety Disorder, GAD-2), and depression (Patient Health Questionnaire, PHQ-2) [35], as well as post-traumatic growth (Post-Traumatic Growth Inventory, PGI-10) [36]. Furthermore, more detailed assessments of burnout using items from the Oldenburg Burnout Inventory [37] were included in the T2 questionnaire. These variables will be the focus of further analyses in upcoming publications.

2.4. Statistical Analyses

Statistical analyses were performed using SPSS Statistics 26 (IBM Corp., Armonk, NY, USA) and R (R Core Team, 2020).

All scales newly constructed for the survey were tested by factor and reliability analyses, using the data at T1. Principal axis factor analyses were calculated. Factors were extracted using the Kayser-Meyer-Olkin criterion (KMO > .50), the Kaiser-Guttman criterion (Eigenvalues > 1), and based on the screeplots. All items with a factor loading > .40 were considered for scaling. The scales were then tested for longitudinal measurement invariance [38, 39], using the packages SEMtools [40] and lavaan [41] for R.

In order to analyse changes in the dependent variables and influences of predictor variables, we performed mixed models repeated measures analyses (MMRM), using non-imputed data. The dependent variables were emotional exhaustion and depersonalization, measured at T1 and T2. Predictor variables were measured at T1. The variable Age was used as a covariate. In order to reduce the risk of overfitting, the predictors were entered in the analyses in separate steps. The decision for model choice was based on a penalized likelihood rationale using the Bayesian information criterion [42] as an indicator of model fit. For changes in prevalence, Fisher's exact test was used.

## 3. Results

### 3.1. Participants

At T1, a total of 2097 respondents participated in the survey and answered at least 50% of the items. For T2, 4240 participants could be included. By matching the self-generated code, a total of 612 respondents could be identified for the longitudinal analyses. This longitudinal sample was used for the following analyses. The majority of the participants were female (76%). Half of the sample (50%) were 45 years old or younger. A broad range of functions was represented in the sample: 84 MDs (14%), 182 nurses (30%), 73 medical-technical staff (12%), and 147 administrative staff (24%). 120 participants (20%) were categorized as "other" (comprising psychologists, social service, pastoral care, rescue service, research, trainees, and service staff). Table 1 provides demographic data for the longitudinal sample, and table 2 shows the number of participants in each center.

### 3.2. Reliability and validity of newly constructed scales

The reliability and validity of the newly constructed scales are reported here for T1. The three items for risk perception loaded on one factor, explaining 34% of the variance. The alpha was .56. Excluding items did not increase reliability, therefore we decided to use the scale with three items. For health and safety at the workplace, the inter-item correlation was .50. The five items of the scale support at

the workplace loaded on one factor, explaining 39% of the variance. The alpha was satisfying with .76. All scales were analysed using methods of longitudinal measurement invariance. The fit measures indicated satisfying results for all scales (results not shown).

3.3. Results for burnout

In descriptive analyses, Emotional Exhaustion (T1: N = 612, M = 1.74, SD = 1.59; T2: N = 610, M = 1.90, SD = 1.65) was higher at both measurement points in time than depersonalization (T1: N = 610, M = 0.95, SD = 1.47; T2: N = 608, M = 1.14, SD = 1.58).

To analyze differences between T1 and T2, wn a first step, we analyzed the sample for emotional exhaustion and depersonalization using MMRM (Table 3, controlling for age as a covariate), and found a significant increase with small effect sizes (emotional exhaustion: $F_{TIME}$ = 6.20, *df* = 609.52, *p* = .01; depersonalization: $F_{TIME}$ = 9.83, *df* = 605.37, *p* = .002).

When burnout prevalence was analyzed as feelings of emotional exhaustion or depersonalization once a week or more, significant increases of prevalence were found both for emotional exhaustion (15% at T1 to 18% T2) and depersonalization (8% at T1 to 9% at T2), the latter with a lower overall prevalence (Table 4).

The burnout prevalences for different levels of contact with COVID-19 patients (measured at T1) are also depicted in Table 4. They show that the levels of burnout increased for all groups, and that the highest percentages of emotional exhaustion (25%) were found at T2 in respondents with high amount of contact.

In the next step, sex, function, and contact with COVID-19 patients (measured at T1) were entered into the analyses (Table 5). Concerning sex, as none of the participants classified themselves as "diverse", this category was not included in the analyses.

For emotional exhaustion, only the main effect of contact with COVID-19 patients (*F* = 11.38, *df* = 1/584.61, *p* = .001) was significant, but not interactions with time. We found the lowest amount of emotional exhaustion in staff with no contact with COVID-19 patients. Staff with much contact with

COVID-19 patients had the highest degrees of emotional exhaustion. All other groups did not differ significantly.

For depersonalization, we found a significant main effect of contact with COVID-19 patients ($F$ = 7.28, $df$ = 1/580.91, $p$ = .007). Staff with much contact with COVID-19 patients experienced significantly more depersonalization. Additionaly, the two-way interaction of time with contact with COVID-19 patients ($F$= 4.52, $df$ = 1/580.00, $p$ = .03) and the three-way interaction of time, contact with COVID-19 patients, and sex became significant ($F$= 6.17, $df$ = 2/580.56, $p$ = .002). Table 5 shows that the increase in depersonalization was medium to large in staff with much contact with COVID-19 patients. This increase was caused by a large effect among male staff who had much contact with COVID-19 patients, as shown in table 6, who had rather low levels of depersonalization at T1, but higher levels at T2. Table 5 also shows that nurses, medical technical staff had a significant increase in depersonalization in post-hoc contrasts (the interaction between time and function was not significant, however).

Individual and organizational factors were then entered into the analyses using them as binary variables (median split). Data are shown in table 7.

Individual factors had significant main effects on emotional exhaustion and depersonalization. Participants with higher levels of social support ($F_{exhaustion}$ = 4.95, $df$ = 1/530.57, $p$ = .03; $F_{depersonalization}$ = 7.92, $df$ = 1/527.11, $p$ = .005), self-compassion ($F_{exhaustion}$ = 23.52, $df$ = 1/531.64, $p$ < .001; $F_{depersonalization}$ = 9.47, $df$ = 1/528.19, $p$ = .002), and sense of coherence ($F_{exhaustion}$ = 39.31, $df$ = 1/530.62, $p$ < .001; $F_{depersonalization}$ = 6.20, $df$ = 1/527.26, $p$ = .01) had generally lower levels of emotional exhaustion and depersonalization. However, we did not find significant interactions with time.

Work-related factors, likewise, had main effects on emotional exhaustion and depersonalization. High risk perception was associated with higher levels of emotional exhaustion and depersonalization ($F_{exhaustion}$ = 19.09, $df$ = 1/584.11, $p$ < .001; $F_{depersonalization}$ = 8.61, $df$ = 1/581.74, $p$ = .003). High levels of support at the workplace were associated with less emotional exhaustion and depersonalization

($F_{exhaustion}$ = 24.74, *df* = 1/583.89, *p* < .001; $F_{depersonalization}$ = 6.76, *df* = 1/581.46, *p* = .01). Altruistic acceptance of risk was not associated with burnout variables.

Health and safety at the workplace were associated with lower levels of emotional exhaustion, but not with depersonalization ($F_{exhaustion}$ = 8.70, *df* = 1/584.17, *p* = .003). In addition, a significant interaction of health and safety at the workplace with time was found for emotional exhaustion ($F_{exhaustion}$ = 4.53, *df* = 1/584.11, *p* = .03). Respondents who rated their health and safety at their workplace as low at T1 were at higher risk of an increase in emotional exhaustion at T2, while those with high health and safety at their workplace did not have significantly increased levels of emotional exhaustion at T2.

3.4. Sensitivity analyses

Finally, to check the validity of the results, we performed sensitivity analyses. These included two steps: First, we compared respondents from the cross-sectional sample at T1 who did not participate in the second survey at T2 (non-completers) with the longitudinal sample (completers). Second, we compared participants from Nuremberg (Germany) with those from the other centers.

To compare the completers (longitudinal dataset, N = 612) with non-completers from T1 (N = 1498), we used demographical data and the two burnout items. Differences concerning sex were not significant ($chi^2$ = 4.42, df = 2, p = .18). We found significant differences concerning contact with COVID-19 patients at T1 ($chi^2$ = 13.50, df = 1, p < .001), with relatively less staff with much contact with COVID-19 patients completing both assessment points in time, and function ($chi^2$ = 31.54, df = 4, p < .001), with relatively less MDs and more administrative staff completing both surveys. The relative number of completers varied significantly between centers, ranging from 2% (Cluj-Napoca) to 36% (Andorra). Completers were older (t-test, F = 4.09, df = 2105, p < .001), had similar levels of emotional exhaustion (F = 0.78, df = 2106, p = .44) but lower levels of depersonalization (T = 2.24, df = 2104, p = .03).

As participants from Nuremberg were by far the largest group in the longitudinal survey, we performed sensitivity analyses by adding a binary variable (Nuremberg, n = 426, vs. other centers, n = 186) to the MMRM analyses. There were differences in the MBI items between these two groups (lower levels of emotional exhaustion and depersonalization at Nuremberg General hospital), we did not find a significant interaction of Time and Institution in the analyses ($F_{exhaustion}$ = 1.98, df = 1/608.91, p = .160, $F_{depersonalisation}$ = 0.01, df = 1/604.91, p = .885), showing that the main results were not affected by the differences in the institutions.

## 4. Discussion

The present study investigated, in a longitudinal survey design with hospital staff from nine countries, changes in burnout (measured as emotional exhaustion and depersonalization) during the COVID-19 pandemic and how work-related and individual factors influence burnout. We found an increase in emotional exhaustion and depersonalization between the two measurement points in time, the first in summer 2020, and the second in spring 2021. These changes were found in the continuous variables, but also measured as the percentage of staff with high levels of burnout.

The results showed that a high level of contact with COVID-19 patients was associated with higher levels of emotional exhaustion and depersonalization. In staff with high levels of contact with COVID-19 patients, we found a prevalence of emotional exhaustion of 25% at T2, a number that is higher than the average level of burnout in nursing staff estimated before the pandemic [6]. Among the group of high contact, being male was associated with an increase in depersonalization at T2. Job function did not have any associations with the outcomes. Sense of coherence, and self-compassion, and to a lesser degree, social support were associated with lower levels of burnout at both points in time without interaction of these factors with time. Risk perception, health and safety at the workplace, and support at the workplace were also related to burnout. Remarkably, staff with low levels of perceived health and safety at the workplace experienced an increase in emotional

exhaustion and depersonalization. Altruistic acceptance of risks, a factor previously shown to be associated with higher job engagement, did not prove to be a significant factor for burnout.

The burden on hospitals during the COVID-19 pandemic has had a long-time impact on staff burnout, measured as job emotional exhaustion and depersonalization. Working in direct contact with COVID-19 patients was most obviously associated with higher levels of burnout. These findings are in line with the JD-R model that posits that high job demands – caring for infected and ill patients being one such demand – can lead to symptoms of burnout [43]. Contrary to previously published data on psychological burden in healthcare workers, we did not find that being a nurse and being female was associated with higher levels or different courses of burnout [44]. One possible reason could be the fact that changes over time are not associated with occupation type, as opposed to absolute levels or rates of burnout studied in cross-sectional research. These findings will have to be corroborated in the analyses using results from the T3 survey in 2021.

For sex, however, we found an increase in depersonalization for men working directly with COVID-19 patients. This can be due to the relatively low level of depersonalization in males at T1, which increased to a similar level of that of women for T2. Another study reported gender differences in burnout dimensions [45], and found higher levels of depersonalization in males in a cross-sectional study with frontline nurses in Wuhan at the beginning of the pandemic in February 2020.

Professional function, on the other hand, did not have an influence on the outcomes.

In line with previously published work [46], resources, both individual and job-related, were found to have a limiting effect on burnout. But even individuals with high levels of resources had an increase in burnout from T1 to T2. Moreover, health and safety prevented an increase in burnout from T1 to T2. It can be argued that the overall job burden, combined with the increased societal burden caused by public health measures, increases staff burnout regardless of possible resources. To investigate this question further, it will be important to follow up the survey at a third assessment point in time.

The study bears a number of implications for health management. First, the findings on the relatively high prevalence in burnout among staff with high contact with COVID-19 patients show that this

group of health care workers should be an important target of interventions. However, it is also important to note that burnout levels increased in all groups, therefore lower prevalences of burnout do not imply that other groups should not be addressed.

Occupational healthcare often proposes the individuals as targets of stress management programs. The findings give first indications that these interventions, if based on the training of self-compassion [47, 48] and the staff's sense of coherence [49] could be promising. Caring for health and safety of the staff – which encompasses only the availability of PPE, but also mental health – is a key component of measures to prevent burnout.

Above these individual approaches to burnout prevention, the findings also suggest that creating a supporting and trusting work environment from the perspective of the staff is a consistently strong job-related resource. Research and practice on psychological safety climate can be useful as a reference [50, 51]: Building trust within and between teams, with supervisors and the hospital direction is key to a healthy work environment that can promote the well-being of staff [52] at hospitals worldwide.

4.1. Limitations

The study has a number of limitations. The COVID-19 pandemic has developed a very strong dynamic globally, with rapid changes in diagnostic, treatment, and vaccination opportunities, but also rapid changes in virus variants and their characteristics, as well as a wide range of public health measures [53]. Therefore, not all possible confounders could be included in the analyses. For example, the hospitals in different countries operate in a variety of healthcare systems, and the dynamics of the pandemic varied not only from country, but also regionally. Data show that Germany, as compared to other European countries, was only weakly affected during the first wave, and that a peak of cases and deaths occurred in winter 20/21 [21]. This might explain the relatively lower levels of burnout in Nuremberg compared to the other centers. However, the data show that trends can be found

despite the variety and diversity of the centers involved, as stress levels increased internationally [54].

Also, the dependent variables were measured with one item each. Although this can be a useful way to measure given the constraints of time, and attempts were made to use established instruments, their validity in the current context may be a matter of discussion. Therefore, more items with a validated scale should be used in addition to the one-item measure used here. Moreover, translations of scales were performed with the highest level of attention, but due to time pressure, could not be performed along guidelines.

Although the study has the advantage of using a longitudinal approach, this also bears some limitations. First, the number of participants at both points in time was relatively low compared to both cross-sectional surveys. This may be related to the nature of recruitment: Employees were explicitly invited to participate in the survey at T2, even if they had not answered the first questionnaire at T1. Second, causal interference should be made only with caution. For example, we used a scale measuring self-compassion as a state (as opposed to a trait), and would be plausible to argue that low state self-compassion can be a consequence rather than a cause of burnout. Third, for organizational reasons, the first survey covered a period of several months. As a result, we may not have been able to capture potential changes in burnout levels accurately enough, as no significant change occurred between fall 2020 and spring 2021. This should be questioned more closely by looking at the data from 2022 in further publications.

Finally, we found relatively low levels of internal consistency (Cronbach's alpha) in some of the scales (i.e., risk perception, and the State Self-Compassion Scale - Short), which reduced the reliability. We, however, found a satisfying level of internal consistency in the SOC-3 scale (Cronbach's alpha = .69), a much higher value than the .39 reported by Olsson et al. [55]. The validity of the scale, as reported by Olsson et al., is subject to debate. It was, however, important to make the survey as short as possible, making it possible for busy clinicians to respond without losing many participants due to dropout.

4.2. Strengths

In the quickly developing field of research on COVID-19 and its consequences on the mental health of hospital staff, many of the studies were cross-sectional in design and focused on either one country or few centers. Longitudinal studies have recently begun to be published, and they are consistent with the main findings of our own work [56-59]. The present study has the strength of presenting data from a wide range of international hospitals. Furthermore, is was developed from the outset as a longitudinal study that bears the potential of finding long-term effects of demands and resources on burnout in hospital staff. Finally, we would like to underline that it is important to study the entire staff at hospitals, as this study did. This approach enabled us to study differences and similarities between groups with high and low amount of contact with COVID-19 patients, and also to analyse the role of a wide variety of functions, such as medical doctors, nurses, medical-technical staff, administration, and others. The findings indicate that, in our data, direct work with COVID-19 patients was more influential for emotional exhaustion and depersonalization than function or sex.

4.3. Conclusions

Our international, longitudinal data show after two periods of observation that individual factors such as self-compassion and sense of coherence, and work-related factors such as safety and occupational support are closely related to burnout. The data suggest that research into interventions focusing on these factors could be a promising next step in research on burnout prevention during pandemic crises. The next observation period in summer 2022 will show which other factors can modulate the time course of burnout, but also of work engagement and other mental health-related outcomes. From this, interventions could be derived that could be used in the health management of hospitals to protect their employees.

List of abbreviations

COSMO - COVID-19 Snapshot Monitoring

EAPM - European Association of Psychosomatic Medicine

ESSI - ENRICHD Social Support Inventory

GAD-2 - Generalized Anxiety Disorder-2

HCW - Health Care Workers

JDR model - Job-Demands-Resources model

KMO - Kayser-Meyer-Olkin criterion

MBI - Maslach Burnout Inventory

MMRM - Mixed Models Repeated Measures

PGI-10 - Post-Traumatic Growth Inventory

PHQ-2 - Patient Health Questionnaire-2

PPE - Personal Protective Equipment

PSS-4 - Perceived Stress Scale

SARS - Severe Acute Respiratory Syndrome

SCS - Self-Compassion Scale

SOC - Sense of Coherence

SSCS-S - State Self-Compassion Scale – Short

T1 - First assessment period between May and November 2020

T2 - Second assessment period between February and April 2021

Declarations

*Ethics approval and consent to participate*

All methods were carried out in accordance with relevant guidelines and regulations. Ethical approval was granted from the Institutional Review Board of Paracelsus Medical University, General Hospital Nuremberg (RB-2020-017). Additional ethical approvals were obtained from the local ethical

commitees of the participating centres. The study team obtained informed consent from all participants. Participants were made aware that they could withdraw at any time.

*Consent for publication*

Not applicable.

*Availability of data and materials*

All data are available from the corresponding author on reasonable request.

*Competing interests*

The authors have no competing interests to report-

*Funding*

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

*Authors' contributions*

MMM, CW, and BS designed the study with the support of all authors. MMM, SK and SS performed the data analysis and performed the literature research. MMM wrote the first draft, all authors contributed revisions of the manuscript. All authors contributed in coordinating the assessment at the participating hospitals.

*Acknowledgements*

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**Table 1**
Sociodemographic, job-related and COVID-19-related data on the longitudinal sample (N = 612).

| | Category | N | % |
|---|---|---|---|
| Age (T1) | < 26 | 74 | 12 |
| | 26-35 | 92 | 15 |
| | 36-45 | 140 | 23 |
| | 46-55 | 180 | 29 |
| | 56-65 | 123 | 20 |
| | > 65 | 3 | < 1 |
| SEX (T1) | Male | 149 | 24 |
| | Female | 462 | 75 |
| | Diverse | 0 | 0 |
| | Missing | 1 | < 1 |
| FUNCTION (T1) | MD | 84 | 14 |
| | Nurse | 182 | 30 |
| | Med-Tech | 73 | 12 |
| | Administration | 147 | 24 |
| | Other[a] | 120 | 20 |
| | Missing | 6 | 1 |
| JOB EXPERIENCE (T1) | < 3 years | 97 | 16 |
| | 3-6 years | 37 | 6 |
| | > 6 years | 475 | 78 |
| | Missing | 3 | < 1 |
| USER LANGUAGE (T1) | Catalan | 95 | 16 |
| | German | 427 | 70 |
| | English | 15 | 2 |
| | Spanish | 20 | 3 |
| | Farsi | 12 | 2 |
| | Italian | 42 | 7 |
| | Romanian | 1 | < 1 |
| Past COVID-19 Infection (T2) | Without Symptoms | 12 | 2 |
| | With Symptoms | 49 | 8 |
| COVID-19 vaccination (T2) | | 384 | 63 |
| Contact with COVID-19 patients or suspected cases (T1) | Hardly Any | 424 | 69 |
| | Much | 187 | 31 |
| | Missing | 1 | < 1 |

Abbreviations: T1 = First assessment period between May and November 2020; T2 = Second assessment period between February and April 2021.
[a] The "Other" category contains the following categories used in the questionnaire: Psychologists, Pastoral Care, Rescue Service, Service, Research, Trainee/Student, Social Work, and Other.

**Table 2**

Institutions participating in the surveys at T1 and T2 with number and percentage of respondents.

| Country | Hospital/Sector | N | % |
|---|---|---|---|
| Andorra | Hospital Nostra Senyora de Meritxell, Escaldes-Engordany | 89 | 15 |
| Germany | General Hospital Nuremberg | 426 | 70 |
| Ireland | Staff from private and public hospitals | 15 | 2 |
| Iran | Tehran University of Medical Sciences, Tehran | 12 | 2 |
| Italy | Università degli Studi G. d'Annunzio Chieti e Pescara, Campus Chieti | 42 | 7 |
| Romania | University of Medicine and Pharmacy Iuliu Hatieganu, Cluj-Napoca | 1 | < 1 |
| Spain | Dexeus University Hospital, Barcelona | 3 | < 1 |
| Spain | Hospital Clínic de Barcelona, Barcelona | 24 | 4 |

Abbreviations: T1 = First assessment period between May and November 2020; T2 = Second assessment period between February and April 2021.

**Table 3**

Changes in emotional exhaustion and depersonalization between T1 and T2 for the entire longitudinal sample (N = 612)[a].

| | T1<br>Mean (SE), N | T2<br>Mean (SE), N | $d_{(within)}$ | P |
|---|---|---|---|---|
| Emotional Exhaustion | 1.74 (0.07), 612 | 1.90 (1.65), 610 | 0.10 | .01 |
| Depersonalization | 0.95 (0.06), 610 | 1.14 (0.06), 608 | 0.13 | .002 |

Abbreviations: T1 = First assessment period between May and November 2020; T2 = Second assessment period between February and April 2021.

[a] Results from MMRM analyses with age as covariate.

**Table 4**

Burnout prevalence[a] in emotional exhaustion and depersonalization in staff with hardly any vs. much contact with COVID-19 patients, at T1 and T2.

| | N (%) | Contact with COVID-19 patients at T1 | | |
|---|---|---|---|---|
| | | Hardly Any N = 424 | Much N = 187 | p (Fisher's test) |
| Emotional Exhaustion at T1 | 89 (15%) | 51 (12%) | 38 (20%) | .009 |
| Emotional Exhaustion at T2 | 108 (18%) | 61 (14%) | 47 (25%) | .002 |
| Depersonalization at T1 | 49 (8%) | 26 (6%) | 23 (12%) | .01 |
| Depersonalization at T2 | 57 (9%) | 29 (7%) | 28 (15%) | .002 |

Abbreviations: T1 = First assessment period between May and November 2020; T2 = Second assessment period between February and April 2021.

[a] Burnout was defined as feelings of emotional exhaustion or depersonalization once a week or more.

**TABLE 5**
Emotional exhaustion and depersonalization at T1 for T2 for sex, amount of contact with COVID-19 patients, and function with effect sizes (Cohen's d).

| | Emotional Exhaustion | | | | Depersonalization | | | |
|---|---|---|---|---|---|---|---|---|
| | T1 m (SE), n | T2 m (SE), n | $d_{(within)}$[a] | p | T1 m (SE), n | T2 m (SE), n | $d_{(within)}$[a] | p |
| *Sex* | | | | | | | | |
| Female | 1.86 (0.10), 462 | 1.98 (0.10), 462 | 0.08 | .23 | 1.12 (0.09), 460 | 1.25 (0.09), 460 | 0.09 | .17 |
| Male | 1.75 (0.23), 149 | 2.20 (0.23), 147 | 0.29 | .051 | 0.88 (0.21), 149 | 1.46 (0.21), 147 | 0.39 | .007 |
| $d_{(between)}$ | 0.07 | 0.13 | | | 0.16 | 0.14 | | |
| p | .64 | .41 | | | .28 | .37 | | |
| *Contact with COVID-19 patients* | | | | | | | | |
| Hardly any | 1.46 (0.10), 424 | 1.70 (0.10), 423 | 0.15 | .01 | 0.96 (.09), 423 | 0.96 (.09), 421 | 0.07 | .23 |
| Much | 2.16 (0.23), 187 | 2.47 (0.23), 186 | 0.20 | .16 | 1.14 (.21), 186 | 1.75 (.21), 186 | 0.61 | .005 |
| $d_{(between)}$ | 0.44 | 0.48 | | | 0.19 | 0.54 | | |
| p | .005 | .002 | | | .21 | .001 | | |
| *Function*[b] | | | | | | | | |
| MD | 1.73 (0.18), 84 | 1.93 (0.18,, 84 | 0.13 | .24 | 1.37 (.16), 83 | 1.50 (.16), 83 | 0.09 | .44 |
| Nurse | 1.79 (0.15), 182 | 1.88 (0.15), 182 | 0.07 | .50 | 1.05 (.13), 182 | 1.41 (.13), 182 | 0.24 | .008 |
| Medical-Technical | 1.58 (0.33), 73 | 2.08 (0.33), 73 | 0.32 | .13 | 0.90 (.31), 73 | 1.60 (.31), 73 | 0.47 | .03 |
| Administration | 1.88 (0.4.), 147 | 2.19 (0.42), 147 | 0.20 | .45 | 0.76 (.39), 147 | 0.85 (.39), 146 | 0.06 | .83 |
| Other | 2.06 (0.21), 120 | 2.33 (0.22), 118 | 0.17 | .20 | 0.91 (.20), 119 | 1.42 (.20), 118 | 0.34 | .01 |

Abbreviations: T1 = First assessment period between May and November 2020; T2 = Second assessment period between February and April 2021.
Data present parameter estimates and standard errors from linear mixed models repeated measures (MMRM) analyses. Means adjusted for age at T1 as a covariate.
[a] Cohen's d (within-effects from T1 to T2) calculated based on the overall covariance matrix.
[b] For Function, differences between groups were not significant.

**TABLE 6**

Depersonalization at T1 for T2 for sex and contact with COVID-19 patients, with effect sizes (Cohen's d).

| | | Depersonalization | | | |
|---|---|---|---|---|---|
| | | T1<br>m (SE), n | T2<br>m (SE), n | $d_{(within)}$ [a] | p |
| *Sex* | *Contact with COVID-19 patients* | | | | |
| Female | Hardly any | 0.62 (.10), 319 | 0.85 (.10), 319 | 0.15 | .02 |
| | Much | 1.63 (.16), 143 | 1.66 (.16), 143 | 0.02 | .84 |
| | $d_{(between)}$ | 0.69 | 0.55 | | |
| | p | < .001 | < .000 | | |
| Male | Hardly any | 1.09 (.15), 104 | 1.08 (.15), 104 | 0.01 | .94 |
| | Much | 0.66 (.39), 44 | 1.84 (.39), 44 | 0.79 | .003 |
| | $d_{(between)}$ | 0.29 | 0.52 | | |
| | p | .31 | .07 | | |

Abbreviations: T1 = First assessment period between May and November 2020; T2 = Second assessment period between February and April 2021.

Data present parameter estimates and standard errors from linear mixed models repeated measures (MMRM) analyses. Means adjusted for age at T1 as a covariate.

[a] Cohen's d (within-effects from T1 to T2) calculated based on the overall covariance matrix.

**Table 7**

Changes in emotional exhaustion and depersonalization from T1 to T2 in relation to individual and work-related factors (at T1), with effect sizes (Cohen's d).

| | | Emotional Exhaustion | | | | Depersonalization | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | T1 m (SE) | T2 m (SE) | $d_{(within)}$[a] | p | T1 m (SE) | T2 m (SE) | $d_{(within)}$[a] | p |
| *Individual Factors* | | | | | | | | | |
| Social Support | Low | 1.84 (0.10) | 2.00 (0.10) | 0.10 | .13 | 1.05 (0.09) | 1.31 (0.09) | 0.17 | .008 |
| | High | 1.60 (0.09) | 1.72 (0.09) | 0.08 | .23 | 0.79 (0.09) | 0.93 (0.09) | 0.09 | .15 |
| | $d_{(between)}$ | 0.16 | 0.19 | | | 0.18 | 0.26 | | |
| | p | .077 | .043 | | | .054 | .004 | | |
| Self-Compassion | Low | 2.05 (0.09) | 2.12 (0.09) | 0.04 | .43 | 1.09 (0.09) | 1.31 (0.09) | 0.14 | .02 |
| | High | 1.40 (0.10) | 1.59 (0.19) | 0.12 | .08 | 0.75 (0.10) | 0.92 (0.10) | 0.11 | .10 |
| | $d_{(between)}$ | 0.43 | 0.35 | | | 0.23 | 0.27 | | |
| | p | < .001 | < 001 | | | .014 | .005 | | |
| Sense of Coherence | Low | 2.11 (0.10) | 2.26 (0.10) | 0.09 | .17 | 1.09 (0.10) | 1.25 (0.10) | 0.10 | .13 |
| | High | 1.33 (0.10) | 1.50 (0.10) | 0.11 | .21 | 0.75 (0.09) | 0.98 (0.09) | 0.15 | .02 |
| | $d_{(between)}$ | 0.52 | 0.50 | | | 0.23 | 0.18 | | |
| | p | < .001 | < .001 | | | .016 | .066 | | |
| *Work-related Factors* | | | | | | | | | |
| Risk Perception | Low | 1.44 (0.10) | 1.56 (0.10) | 0.08 | .22 | 0.73 (0.09) | 0.98 (0.09) | 0.16 | .009 |
| | High | 1.95 (0.10) | 2.05 (0.10) | 0.06 | .27 | 1.09 (0.09) | 1.26 (0.09) | 0.11 | .07 |
| | $d_{(between)}$ | 0.33 | 0.31 | | | 0.24 | 0.19 | | |
| | p | < .001 | < .001 | | | .005 | .025 | | |
| Health and Safety | Low | 1.80 (0.08) | 2.06 (0.08) | 0.17 | .001 | 1.00 (0.08) | 1.22 (0.08) | 0.14 | .006 |
| | High | 1.52 (0.12) | 1.55 (0.12) | -0.03 | .74 | 0.83 (0.11) | 1.03 (0.11) | 0.13 | .08 |
| | $d_{(between)}$ | 0.13 | 0.33 | | | 0.11 | 0.13 | | |
| | p | .134 | < .001 | | | .220 | .164 | | |
| Support at the Workplace | Low | 2.03 (0.10) | 2.03 (0.10) | 0.00 | .99 | 1.06 (.10) | 1.25 (0.10) | 0.12 | .06 |
| | High | 1.35 (0.09) | 1.58 (0.09) | 0.15 | .02 | 0.76 (0.09) | 0.99 (0.09) | 0.15 | .01 |
| | $d_{(between)}$ | 0.44 | 0.29 | | | 0.20 | 0.17 | | |
| | p | < .001 | .001 | | | .016 | .038 | | |
| Altruistic Acceptance of Risk | Low | 1.61 (0.11) | 1.73 (0.11) | 0.08 | .31 | 0.79 (0.11) | 1.05 (0.11) | 0.17 | .02 |
| | High | 1.77 (0.08) | 1.89 (0.08) | 0.08 | .17 | 1.04 (0.08) | 1.19 (0.08) | 0.10 | .06 |
| | $d_{(between)}$ | 0.03 | 0.10 | | | 0.17 | 0.09 | | |
| | p | .236 | .235 | | | .058 | .298 | | |

Abbreviations: T1 = First assessment period between May and November 2020; T2 = Second assessment period between February and April 2021.

Data present parameter estimates and standard errors from linear mixed models repeated measures (MMRM) analyses. Means adjusted for age at T1 as a covariate.

[a] Cohen's d (within-effects from T1 to T2) calculated based on the overall covariance matrix.

Highlights

- We surveyed hospital staff in an international, longitudinal study
- Burnout was high among hospital staff with high contact with COVID-19 patients
- Lower burnout was found for high self-compassion and sense of coherence
- Perceived support at the workplace and health and safety at the workplace were predictive of lower levels of burnout