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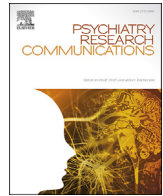
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COVID-19 related psychological burden and potential benefits of vaccination - Data from a repeated cross-sectional survey in healthcare workers

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ABSTRACT

The COVID-19 pandemic is impacting the psychological well-being, especially of health care workers, for more than two years now. Here, we followed-up on a survey we conducted at the very beginning of the pandemic, to determine potential changes in psychological strain experienced by health care workers one year later. Since our first survey in 2020, COVID-19 vaccines have been established, thus we assessed whether vaccination-status might modulate psychological burden of health care workers. We also collected data on resilience and sleep, as those might be related to successful coping. Between March and April 2021, nurses and physicians (N = 286) working at the University Hospital Augsburg - with high or low exposure to COVID-19 patients - took part in an online survey. We found that fully vaccinated personnel reported lower levels of anxiety, depression, stress and exhaustion suggesting the potential positive consequences of vaccination beyond the obvious protection against a COVID-19 infection. Nurses reported more depressive symptoms, anxiety, stress and exhaustion and lower levels of job fulfilment than physicians. Individuals with high exposure to COVID-19 patients reported higher exhaustion and depersonalization. Resilience and sleep quality were significantly correlated with psychological and work-related burden, suggesting their potential role as protective resources. In general, the comparison of the present data to the survey conducted in 2020 suggests an overall increase of psychological burden in health care workers. Despite these surely alarming findings, it should be noted that being vaccinated might come along with reduced psychological strain.

1. Introduction

The still ongoing COVID-19 pandemic demonstrates a tremendous health, economic and societal burden (Clemente-Suárez et al., 2021). The negative psycho-social impact, especially on individuals working in the health care system and who are therefore at elevated risk to infect themselves with COVID-19, was demonstrated repeatedly (Sun et al., 2021; Kramer et al., 2021). In 2020, in the very beginning of the pandemic, we investigated how physicians and nurses working in regular vs. special COVID-19 wards, were affected by the pandemic and found that nurses and especially those with frequent contact to COVID-19 patients reported higher psychological burden (Zerbini et al., 2020). As the pandemic continued so did the need to cope with ever-changing challenges due to exploding incidences and crowded ICUs. In Germany, as was the case around the globe, there have been several peaks in numbers

of COVID-19 infections since 2020, demonstrating the dynamic course of this unprecedented crisis. (Schilling et al., 2021; RKI, 2021). There is already profound cross-sectional data describing the negative psychosocial consequences of the pandemic for the general population and especially for individuals working in the health care system (Vizheh et al., 2020; Xiong et al., 2020; Sahebi et al., 2021), however only few studies so far investigated changes in psychological well-being across the time course of the pandemic. Studies that actually examined their samples repeatedly, mostly focused on a time frame of three, at maximum six months and found both an increase (Dosil et al., 2020; Sasaki et al., 2020, 2021; Zhou et al., 2021; Steinmetz et al., 2020; Lyu et al., 2021; Dufour et al., 2021; Kok et al., 2021) or even decrease in the prevalence of psychological or psychiatric symptoms across time points (Hines et al., 2021; Kelker et al., 2020; Chew et al., 2020; Cai et al., 2020; Roberts et al., 2021). However, surveys with prolonged follow-up periods,

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investigating the effects of the pandemic on psychological well-being in the health care system are - up to now - rather scarce.

To this end, from March to April 2021 we conducted a survey in health care professionals working at the University Hospital Augsburg (tertiary care hospital) – analogue to the survey we did in early 2020 – to capture the psychological status quo more than one year after the progression of the pandemic and to identify potential changes since 2020. We used a repeated cross-sectional design assessing the same variables on psychological strain via the Personal Health Questionnaire, (PHQ) (Spitzer et al., 1999), and the Maslow Burnout Inventory, (MBI) (Korczak et al., 2010), in a sample drawn from the same study population (physicians and nurses working at the University Hospital Augsburg) as in 2020.

Since our first survey in 2020, COVID-19 vaccines were established and thus, we now also asked participants whether they were already vaccinated against COVID-19, in order to investigate whether the vaccination-status might be associated with indicators of psychological well-being.

Besides the necessary assessment of psychological symptoms and distress, the identification of sources to successfully cope with the situation appears equally relevant. Accordingly, in the present survey we included a widely used instrument to measure resilience conceptualized as one's ability to successfully cope with stress and adversity (Connor and JonathanDavidson, 2003) that is the 10-item Connor-Davidson Resilience Scale (CD-RISC-10); (Campbell-Sills and Stein, 2007; Sarubin et al., 2015). We furthermore captured problems with sleep and daytime functioning using a newly validated economic instrument the Athens Insomnia Scale for Non-Clinical Application (AIS-NCA) (Sattler et al., 2021). Studies on sleep quality during the pandemic so far have yielded mixed results (Cellini et al., 2020; Korman et al., 2020; Leone et al., 2020; Robillard et al., 2021; Kocavska et al., 2020), however, first studies show that sleep problems were often accompanied by psychological burden (Al-Ajlouni et al., 2020; Franceschini et al., 2020; Killgore et al., 2020).

In sum, considering the dramatic changes and consequences that the ongoing crisis meant for the population, we expected to see an increase in psychological burden comparing our first survey in 2020 and data collected in 2021. With regard to potential differences in psychological burden following vaccination, we expected to find lower levels of psychological symptoms and work related stress in already fully vaccinated individuals as reported recently for individuals sampled from the general population (Clemente-Suárez et al., 2021). Moreover, in line with previous findings, we hypothesized that nurses report higher levels of psychological burden compared to physicians (Kramer et al., 2021) and that the level of exposure to COVID-19 patients would additionally impact health care workers negatively (Zerbini et al., 2020). Further, we assumed to find an association of resilience and sleep quality with indicators of psychological burden.

2. Methods and materials

The study was evaluated and approved by the responsible Ethical Committee of the University of Munich (ethics approval number: 20–1084). The study was conducted between March and April 2021 at the University Hospital of Augsburg, during the third pandemic wave in Germany. A total of 286 health-care professionals (183 females; ages between 18 and 60 years) took part in the survey. All hospital employees were invited via an institutional newsletter to take part in the survey. Data from N = 134 physicians and N = 152 nurses is reported. At the beginning of the survey, participants were asked to indicate their level of exposure to COVID-19 patients during the past 4 weeks on a 6-point scale (“never”, “almost never”, “sometimes”, “often”, “very often”, “always”). The answers to this question were later dichotomized for further analyses. 47.2% (N = 134) of the participants responded either “never” or “almost never” and were assigned to the group with a low level of exposure to COVID-19 patients, while the remaining 52.8% (N = 152) of the participants responded either “sometimes”, “often”, “very often” or “always” and were assigned to the group with a high level of exposure to COVID-19 patients.

59.0% (N = 79) of the physicians and 47.4% (N = 72) of the nurses had a high level of exposure to COVID-19 patients. At the moment of the survey the COVID-19 vaccination campaign was in progress thus, not everybody was already vaccinated or even got the opportunity of getting vaccinated. These circumstances made it possible to allocate participants in two experimental groups based on their vaccination status. Of all participants, n = 182 individuals were already fully vaccinated while n = 59 were not (yet) vaccinated. Furthermore, n = 42 had an incomplete vaccination status (i.e. first of two necessary doses) or did not answer the question on vaccination and were left out for this set of analysis.

2.1. Questionnaires

Participants filled in the Patient Health Questionnaire (PHQ) (Spitzer et al., 1999) and the Maslach Burnout Inventory (MBI) (Korczak et al., 2010), which were also used during our previous data collection in 2020 (for a more detailed description of these questionnaires see: Zerbini et al., 2020). In addition to mental health and burnout symptoms, we also assessed resilience and sleep to explore potential resources for coping in our participants. For this purpose, we used the 10-item Connor-Davidson Resilience Scale (CD-RISC-10) (Campbell-Sills and Stein, 2007; Sarubin et al., 2015) and the Athens Insomnia Scale for Non-Clinical Application (AIS-NCA) (Sattler et al., 2021). The CD-RISC-10 is a short version of the original CD-RISC scale, developed by Connor and Davidson to assess resilience (Connor KM and Davidson JRT, 2003). The response options were given on a 6-point Likert scale (0 = not true at all, 1 = rarely true, 2 = sometimes true, 3 = often true, 4 = very often true and 5 = always true) with the maximal score being 50. To assess problems with sleep and daytime functioning, we used a newly developed scale (Sattler et al., 2021). The scale comprises 7 items with scores ranging between 1 and 5 (higher scores indicate poorer sleep and daytime functioning). For an overview of the questionnaire scores see Table 1.

2.2. Statistical analysis

Statistical analyses were performed with IBM SPSS (version 26) and “R” (version 4.0.0; Team, R Core, 2020). Differences between - at the moment of the survey - fully-vaccinated (n = 182) compared to not (yet) vaccinated (n = 59) personnel, were analyzed using separate one-way ANOVAs per PHQ and MBI subscale score. Separate two-factorial ANOVAs, employing profession (physicians vs. nurses) and level of exposure to COVID-19 patients (high vs. low) as between-subject factors were conducted per MBI and PHQ subscale. Furthermore, Pearson's correlations were computed between the questionnaires assessing mental health and burnout symptoms (PHQ and MBI) and the questionnaires assessing resilience (CD-RISC-10) and sleep problems (AIS-NCA). The significance level was set at $p < .05$, 2-tailed. Finally, to compare the results of the current study with our previous survey conducted in March–April 2020 (Zerbini et al., 2020) we calculated effect sizes

Table 1
Questionnaire scores.

Scale	Physicians (N = 134)		Nurses (N = 152)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
MBI Exhaustion	15.42	7.44	18.57	8.46
MBI Depersonalization	5.63	3.85	6.78	4.16
MBI Fulfilment	24.18	5.01	22.98	5.17
PHQ Depression	6.21	4.82	8.39	5.01
PHQ Anxiety	5.28	3.95	6.87	4.42
PHQ Stress	5.35	3.46	7.01	3.37
AIS-NCA	2.57	0.66	2.95	0.65
CD-RISC	31.60	7.01	31.06	7.84

Note: Reported are mean scores and standard deviation for the subscales of the Personal Health Questionnaire (PHQ) and the Maslow Burnout Inventory (MBI), the global score of the Athens Insomnia Scale for Non-Clinical Application (AIS-NCA) and the sum score of the Connor-Davidson Resilience Scale (CD-RISC-10), split by healthcare profession.

(Cohen's *d*) for the PHQ and MBI subscale score differences between 2020 and 2021, separately per profession.

3. Results

3.1. MBI and PHQ results with respect to professions and COVID-19 exposure level

Analysis of the MBI revealed that nurses reported significantly higher exhaustion [$F(1,282) = 12.31, p = .001$], depersonalization [$F(1,282) = 6.82, p = .009$] and significantly lower levels of fulfilment [$F(1,282) = 4.12, p = .04$] compared to physicians. Furthermore, regarding exhaustion [$F(1,282) = 4.82, p = .03$] and depersonalization [$F(1,282) = 5.96, p = .02$] a high level of exposure to COVID-19 patients led to significantly higher scores, irrespective of healthcare profession. All remaining main effects or interaction effects failed to reach significance, all $ps > .13$.

Analysis of the PHQ subscales revealed a significant effect of healthcare profession regarding the subscales depression [$F(1,282) = 14.54, p < .001$], anxiety [$F(1,282) = 10.40, p = .001$] and stress [$F(1,282) = 16.52, p < .001$] due to higher scores reported by nurses compared to physicians. However, neither the factor exposure to COVID-19 patients nor the interaction effect (profession*COVID-19 exposure) were significant for any of the PHQ subscales, all $ps > .14$, see Fig. 1.

3.2. Correlation of sleep and resilience with PHQ and MBI

Correlation analyses revealed significant associations of sleep (AIS-NCA) with exhaustion, $r = .53, p < .001$, depersonalization, $r = 0.28, p < .001$ and fulfilment, $r = -0.34, p < .001$, as measured with the MBI. Similarly, sleep was significantly correlated with all PHQ subscales ($N = 286$, depression, $r = 0.66, p < .001$; anxiety, $r = 0.60, p < .001$; stress, $r = 0.57, p < .001$).

Resilience (CD-RISC-10) was significantly correlated with the MBI

subscales exhaustion ($r = -0.26, p < .001$) and fulfilment ($r = 0.43, p < .001$), while there was no significant correlation with the subscale depersonalization ($r = -0.11, p = .07$). Further, resilience was significantly correlated with all PHQ subscales ($N = 286$, depression, $r = -0.29, p < .001$; anxiety, $r = -0.34, p < .001$; stress, $r = -0.26, p < .001$).

3.3. Comparison of MBI and PHQ subscale scores: 2020 vs. 2021

Descriptive comparisons of data captured in 2020 vs. 2021 revealed that nurses and physicians alike reported higher levels of exhaustion, depressive symptoms, anxiety and stress more than one year after the beginning of the pandemic. Especially the increase in stress levels were of moderate to strong effect size. Interestingly, the level of fulfilment received from the job remained rather stable across time, which was also true for the level of depersonalization experienced in contact with the patients reported by nurses. Physicians instead reported a clear decrease in depersonalization. For an overview of all comparisons, including effect sizes (Cohens *d*) of the mean differences, see Fig. 2.

3.4. Vaccination

Analysis of the MBI subscales showed higher scores for exhaustion [$F(1,239) = 6.86, p = .001$], depersonalization [$F(1,239) = 4.99, p = .03$] and lower levels of fulfilment [$F(1,239) = 5.45, p = .02$] for not (yet) vaccinated personnel compared to fully vaccinated individuals.

Similarly, analysis of PHQ subscale scores with reference to the participants' COVID-19 vaccination status revealed higher scores regarding the subscales depression [$F(1,239) = 4.82, p = .03$], anxiety [$F(1,239) = 6.24, p = .01$] and stress [$F(1,239) = 5.22, p = .02$] for not (yet) vaccinated personnel compared to fully vaccinated individuals, see Fig. 3.

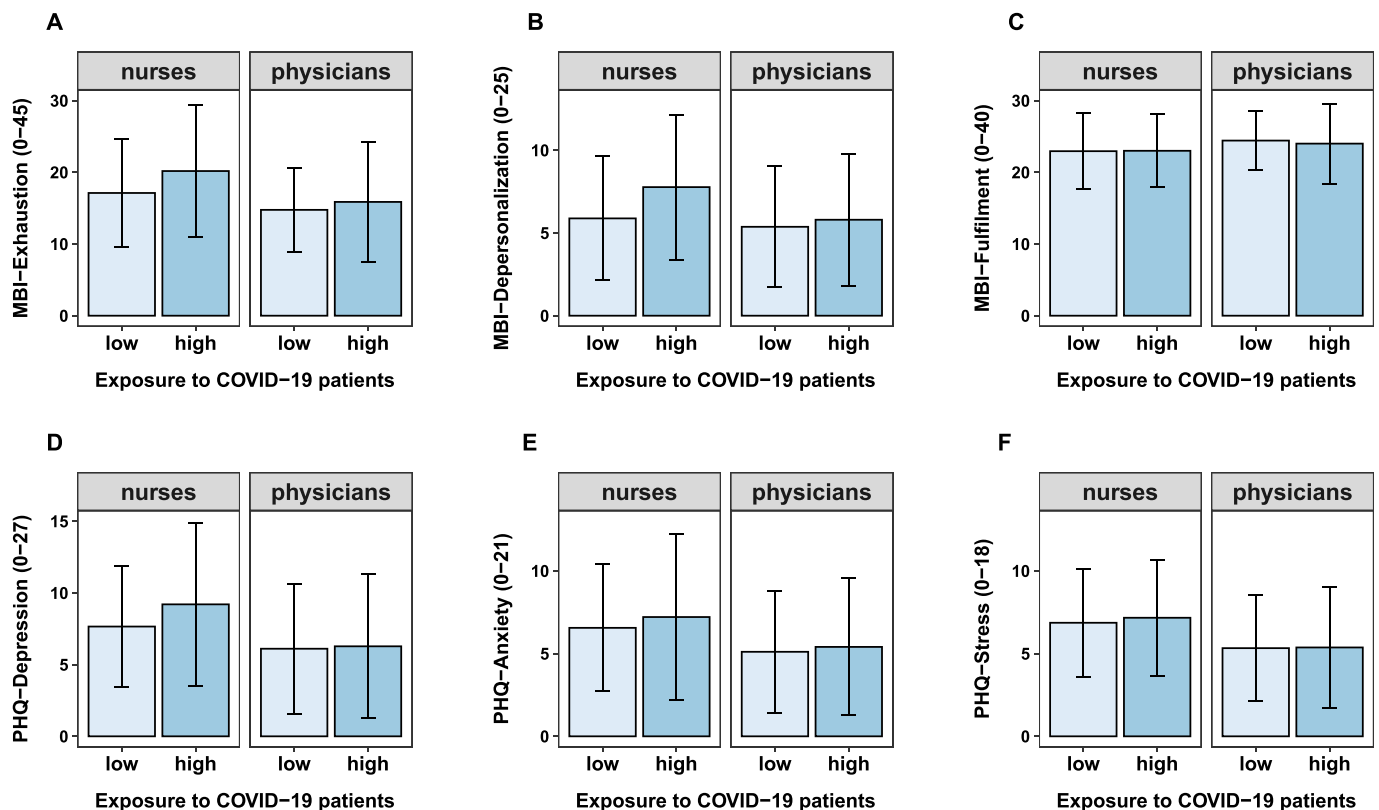


Fig. 1. Mean ± SD of the MBI (A–C) and PHQ (D–F) subscales, separate for health care profession (nurses vs. physicians) and level of exposure to COVID-19 patients (high vs. low).

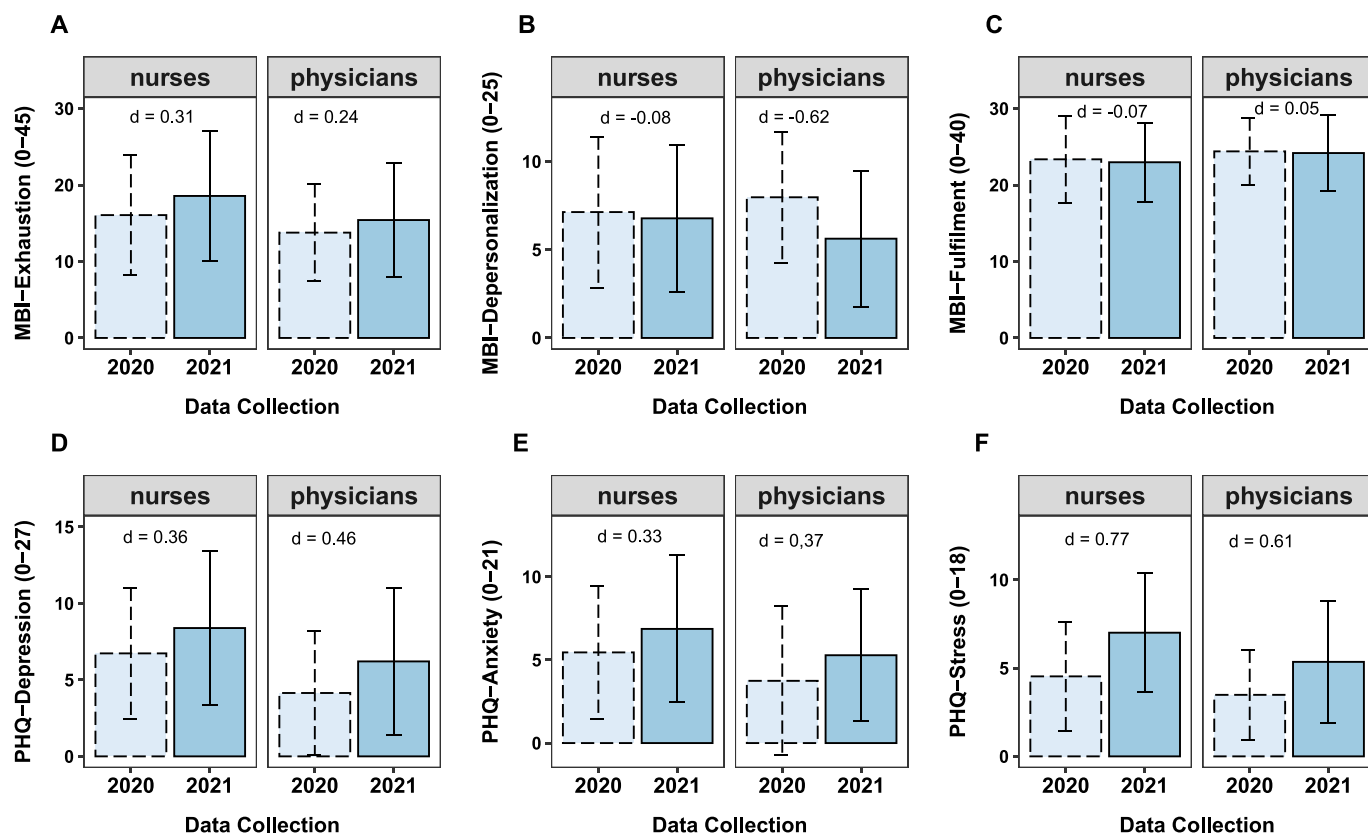


Fig. 2. Mean ± SD of the MBI (A–C) and PHQ (D–F) subscales, separate for health care profession (nurses vs. physicians) and time of survey (March–April 2020, N = 110 vs. March–April 2021, N = 286). Cohens' d effect sizes are provided for the comparison of 2020 vs. 2021.

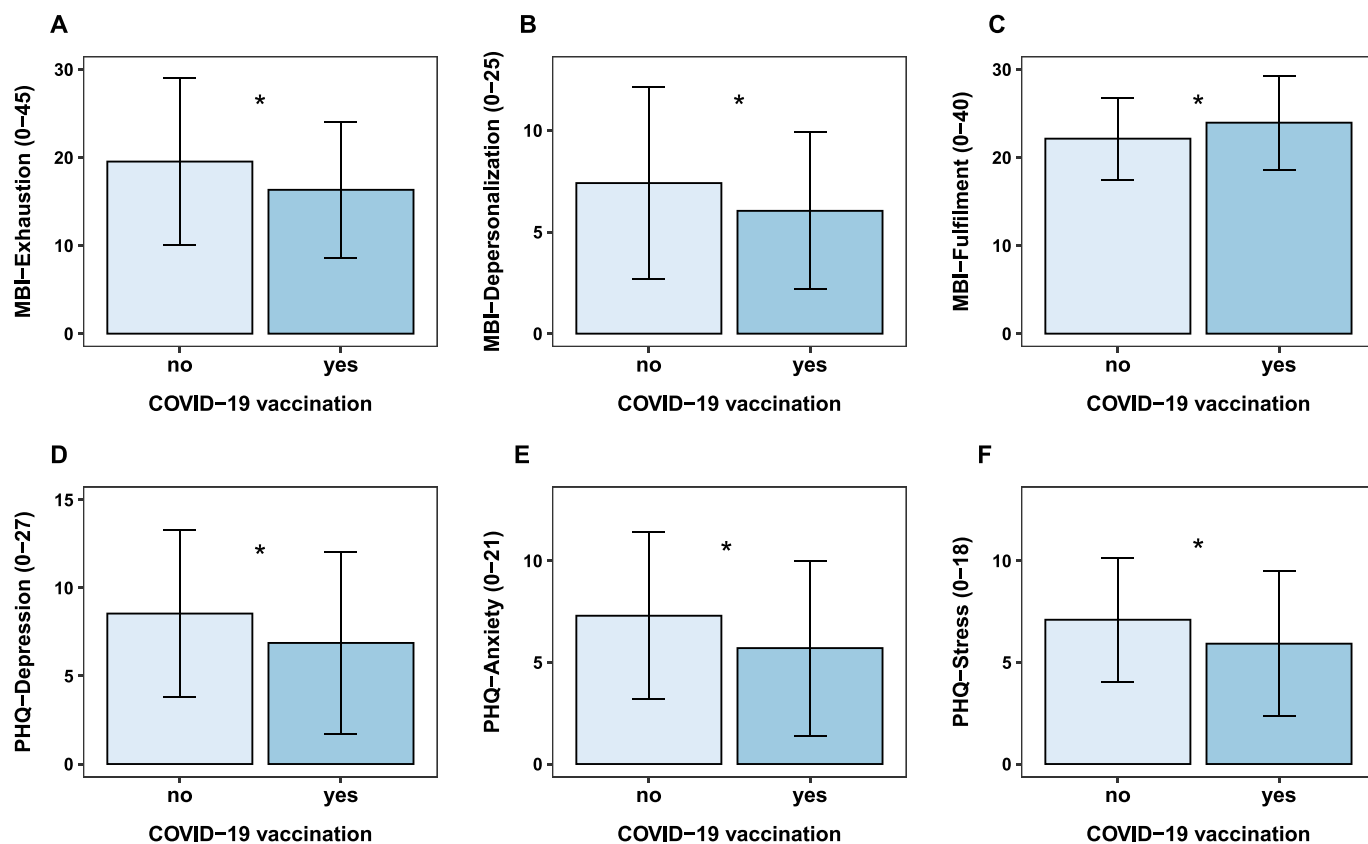


Fig. 3. Mean ± SD of the MBI (A–C) and PHQ (D–F) subscales, separate for not (no) and fully vaccinated personnel (yes) * p < .05.

4. Discussion

In the present study we showed again that healthcare workers, especially nurses, still suffer from psychological strain and job-related distress due to the COVID-19 pandemic, with psychological burden being even higher compared to the very beginning of the pandemic. A promising finding of the present study was that health care workers who were fully vaccinated against COVID-19 reported less psychosocial burden than those not (yet) vaccinated.

Here we show higher levels of exhaustion, depersonalization and job fulfilment as well as more depressive symptoms, anxiety and stress in nurses compared to physicians, replicating earlier findings, which demonstrated a similar pattern for the different health care professions (e.g. Alonso et al., 2021; Dosil et al., 2020; García-Fernández et al., 2020; Rossi et al., 2020; Kramer et al., 2021). In the beginning of the pandemic, special COVID-19 wards were installed at the University Hospital Augsburg and part of the staff was working exclusively in these units. The survey conducted in 2020 demonstrated that especially nurses working in COVID-19 wards reported higher levels of exhaustion and depressive symptoms compared to their colleagues working in regular wards (Zerbini et al., 2020). In the meantime, dedicated COVID-19 wards were discontinued, however the amount of contact to COVID-19 patients still highly varied across employees. Here we found that participants with regular exposure to COVID-19 patients compared to those with no or only infrequent contact demonstrated increased exhaustion and depersonalization, irrespective of their profession. Supposedly, the elevated measures regarding individual safety precautions and infection prevention, which are time-consuming and might create a physical (and psychological) barrier with the patients, might be responsible for these results.

The comparison of our present data with the survey conducted in 2020 suggests that within one year, psychological resources declined remarkably, as indicated by the increase in reported stress and anxiety. Thus, despite individual as well as systemic adaptations (such as increased COVID-19 testing resources, vaccination, social contact management) to these unprecedented circumstances, health care workers still are struggling with the challenges of the pandemic. Interestingly, levels of job fulfilment did not change substantially since our previous survey, which might be indicative for the strong dedication of nurses and physicians to their work. In addition to system level factors (i.e., vaccination) playing an important role for psychological well-being, we investigated the potential association of crucial individual level variables with psychological well-being during the pandemic. We found that resilience and - to an even larger degree - sleep problems were significantly correlated with stress, anxiety, depressive symptoms and exhaustion suggesting their critical role for well-being as demonstrated previously (e.g. Pan et al., 2020; Bozdağ and Ergün, 2020; Teo et al., 2021; Li et al., 2021). Resilience was also positively associated with the level of job fulfilment, which could reflect a shared underlying mechanism, such that the capacity to deal with everchanging demands and obstacles comes along with the ability to retrieve satisfaction from the job, despite increased workload and adverse events, and vice versa (Kašpárková et al., 2018; Alameddine et al., 2021). Given their potential function as protective and preventive resources, resilience and especially sleep might be beneficially addressed to alleviate the psychological burden in the future management of the crisis and the negative consequences for health care personnel (Pappa et al., 2021).

Recently, a survey conducted in the general population in the US demonstrated that even incomplete COVID-19 vaccinations (i.e. first dose) had a positive effect on psychological symptom reports (Clemente-Suárez et al., 2021). In the present study, the comparison of fully vaccinated health care personnel with those who were not yet fully vaccinated, revealed a similar picture: fully vaccinated individuals reported lower levels of stress, anxiety, depressive symptoms, and experienced lower levels of exhaustion at work. This data might be suggestive for additional positive effects which come along with a vaccination on psychological well-being and work-related strain, beyond the obvious benefits of a

reduced risk of infection or a severe course of disease (Tregoning et al., 2021). These findings might suggest that getting vaccinated could act as a buffer against the psychological burden of the pandemic.

There are several limitations of this study, which need to be considered when interpreting our findings. First, here we present repeated cross-sectional data from a monocentric study, which includes only 286 individuals, which might hamper generalizability of the present findings, given that the impact of the COVID-19 pandemic had on hospitals and healthcare workers at different sites might vary substantially. Since all employees of the hospital were invited to participate via newsletter instead of individualized invitation, we have no clear indication of response rates. Related to that, we are lacking crucial individual (pre-pandemic) information of our sample such as premorbid personality aspects or any prior psychiatric history, which makes it difficult to infer the net effect of the pandemic on psychological well-being. Similarly, we cannot exclude that the group of already fully vaccinated individuals in comparison to those that were not already vaccinated differed in a variety of psychological, social or health(risk) aspects - not fully captured by those variables collected within the present survey - which might explain group differences beyond the effect of vaccination status. Furthermore, conclusions regarding changes over time need to be drawn carefully at this point, given the cross-sectional nature of the data collection. However, since the two samples were drawn from the same study population (nurses and physicians) and at the same study site (University Hospital Augsburg, Germany), it seems fair to consider the results of both surveys in the context of a temporal development. Nevertheless, strict longitudinal designs, which encompass a dense series of data points, ample study intervals, sufficient sample size and multi-center data collection are necessary, to reliably capture the complex psychological consequences related to a pandemic.

In summary, the psychological well-being of healthcare workers is still - or even more - seriously affected by the ongoing pandemic. From an objective point of view, one may argue that the situation for healthcare workers might have improved, given the diverse measures that were taken meanwhile. However, such a perspective neglects the long-term effects this unprecedented crisis has, especially on psychological well-being, which needs further assessment and adaptive intervention in the future. In addition to individual based supportive strategies, system level interventions - in particular vaccination - are critical, to prevent a health care collapse, but also to cope with the psychological burden immanent to the pandemic and to prevent stress-associated diseases in healthcare workers.

Author contributions

PR, GZ, MK, AH conceptualized the study. PR, GZ and MK collected and analyzed data. All Authors discussed the results. PR, GZ and MK wrote the initial draft of the manuscript. All authors revised the manuscript.

Availability of data and material

Data can be requested from the corresponding author.

Declaration of competing interest

All authors report no conflicts of interest with regard to the scope of this work. Within the last five years, Alkomiet Hasan has received paid speakerships from Janssen, Otsuka, Recordati and Lundbeck. He was member of Rovi, Recordati, Otsuka, Lundbeck, and Janssen advisory boards. All other authors do not report any conflicts of interest.

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