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EMPIRICAL RESEARCH QUANTITATIVE

Depression and anxiety among nurses during the COVID-19 pandemic: Longitudinal results over 2 years from the multicentre VOICE–EgePan study

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Abstract

Aims: To examine symptoms of depression and generalised anxiety among nurses over 2 years during the pandemic and compare them to the general population.

Background: The COVID-19 pandemic has led to a significant increase in mental stress among the population worldwide. Nursing staff have been identified as being under remarkable strain.

Design: A multicentre prospective longitudinal study.

Methods: Symptoms of depression and generalised anxiety in 507 nurses were examined at four different time points (T1: April–July 2020, T2: November 2020–January 2021, T3: May–July 2021, T4: February–May 2022). Results were compared with values of the German general population, presence of gender-specific differences was analysed and frequencies of clinically relevant levels of depression and anxiety were determined.

Results: Throughout the study (T1–T4), a significant increase in depressive and anxiety symptoms was observed. At all four measurement time points, nurses showed significantly higher prevalence for depression and anxiety compared to the German general population. No significant gender differences were found. Frequencies for probable depression and generalised anxiety disorder among nurses were: 21.6% and 18.5% (T1), 31.4% and 29.2% (T2), 29.5% and 26.2% (T3), 33.7% and 26.4% (T4).

Conclusion: During the pandemic, symptoms of depression and generalised anxiety among nurses increased significantly and remained elevated. Their symptom levels were permanently higher than in the general population. These findings strongly suggest that the circumstances of the pandemic severely affected nurses´ mental health.

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Relevance to Clinical Practice: The COVID-19 pandemic caused a great mental strain on caregivers. This study was able to demonstrate the significant increase in depression and anxiety among nurses during the pandemic. It highlights the urgent need for prevention, screening and support systems in hospitals.

Implications for the Profession: Supportive programmes and preventive services should be developed, not least to prevent the growing shortage of nurses in the health care systems.

Reporting Method: The study adhered to relevant EQUATOR guidelines. The STROBE checklist for cohort study was used as the reporting method.

Patient Contribution: Five hundred and seven nurses completed the questionnaire and provided data for analysis.

Trial and Protocol Registration: The study was registered with the German Clinical Trials Register (https://drks.de/search/en) under the following ID: DRKS00021268.

KEYWORDS
anxiety, COVID-19, depression, health care workers, longitudinal, mental health, nurses, pandemic, prospective

1 | INTRODUCTION

Starting in December 2019, the coronavirus has been plaguing global health. In addition to concerns about physical health, the pandemic has also had a major impact on the mental well-being of the world's population. About one-third of the Asian population showed signs of depression and anxiety at the beginning of the pandemic, as did the European population, but with a lower prevalence of anxiety (Salari, Hosseinian-Far et al., 2020). Significantly higher rates of depression and anxiety after the onset of the pandemic were found in the German general population compared to pre-pandemic data (Beutel et al., 2021; Hettich et al., 2022). The mental health of health care workers (HCW) has been particularly affected by the pandemic and high prevalence rates of depression and anxiety were found (Kunz et al., 2021; Lee et al., 2023; Salari, Khazaie et al., 2020). Among HCWs, nurses were often found to be the most burdened group regarding prevalence rates for depression and anxiety (Kunz et al., 2021; Pappa et al., 2020). The development of depression and anxiety among nurses during the course of the pandemic is therefore of particular interest and needs to be researched in order to provide appropriate support for the nursing staff.

What does this paper contribute to the wider global clinical community?

- This study shows changes in depression and anxiety among nurses over the course of the first 2 years of the COVID-19 pandemic, whereas longitudinal observations in this context have been rare so far.
- This study highlights the vulnerability of nurses to mental illness like depression and anxiety and the great strain the pandemic has placed on them. It emphasises the need to establish changes to unburden nurses both in the short term and in the long term.

2 | BACKGROUND

2.1 | Mental health of health care workers during the COVID-19 pandemic

Viral epidemics and pandemics negatively affect the psychological well-being of HCWs (Cabarkapa et al., 2020). Their mental health is particularly at risk because they work in high-risk environments, subjectively perceive a high level of threat, are under great work stress, and in some cases are not adequately prepared or specially trained (Serrano-Ripoll et al., 2020). Holmes et al., (2020) point out that frontline HCW are a highly vulnerable group during pandemics, e.g. due to feeling fear of infection and lack of available support structures. High subjective burden is probably associated with a high risk of exposure to the virus as well as to the fear of patients, high concerns about the future and a heavy workload (Kramer et al., 2021). In addition, dealing with difficult emotions and witnessing critical end-of-life decisions in patients contribute to symptoms of depression (Azoulay et al., 2020).

Meta-analyses evaluating primarily Chinese data from the first months of the pandemic found pooled prevalence of 23.2% for anxiety and 22.8% for depression among HCW (Pappa et al., 2020) and slightly higher rates of anxiety (25.8%) and depression (24.3%) among those HCW who took care of COVID-19 patients (Salari, Khazaie et al., 2020). A systematic review of European, North

American, and Australian studies found alarmingly high rates of depression and anxiety in areas heavily affected by the first wave, where prevalence rates for depression rose to 57.9% and for anxiety to 65.2% (Kunz et al., 2021). The increase in depression and anxiety following the first wave of the pandemic is also evident in numerous European studies from France (Azoulay et al., 2020), UK (Wanigasooriya et al., 2020), Germany (Morawa et al., 2021; Skoda et al., 2020), Italy (Lasalvia et al., 2020; Rossi et al., 2021) and Spain (Alonso et al., 2022). The meta-analysis of studies published between January 2020 and February 2022 found pooled prevalences of 28.5% for depression and 28.7% for anxiety (Lee et al., 2023).

2.2 | Mental health of nurses during the COVID-19 pandemic

To find out whether different occupational groups among the HCW are experiencing different levels of stress, Kunz et al., (2021) conducted a systematic comparison between nurses and physicians based on studies from Europe ($n=24$), North America ($n=1$) and Australia ($n=2$). Most of the included studies showed higher prevalence rates of depression and anxiety among nurses. Not only in Western countries, but also in Asia, nurses were found to be at higher risk of developing depression and anxiety disorders than physicians (Pappa et al., 2020). A systematic review that included not only the COVID-19 pandemic, but also previous pandemics found nurses to be at higher risk (Cabarkapa et al., 2020). Nurses reported the highest levels of subjective stress and subjective strain (Kramer et al., 2021) and scored the highest on assessments of anxiety and depression among HCWs (Skoda et al., 2020). In one area in Italy hard-hit by COVID-19, nurses showed prevalence rates of 62.8% for anxiety and 32.7% for depression, contrasting with the HCWs in this area in general (anxiety: 50.0%, depression: 26.6%) and 35.0% of the nursing staff were likely to be above thresholds in all three scales for depression, anxiety and post-traumatic distress combined (Lasalvia et al., 2020). In France nurses also showed high prevalence (anxiety 50.0%, depression 31.6%) (Azoulay et al., 2020) and German nursing staff suffered more frequently from depression (21.6%) and anxiety (19.0%) than physicians (depression 17.4%, anxiety 17.8%) (Morawa et al., 2021). The meta-analysis of Al Maqbali et al. (Al Maqbali et al., 2021) detected psychological symptoms in about one-third of the nurses in various countries, emphasising the special burden on this group.

2.3 | Further risk factors for mental health symptoms during the COVID-19 pandemic

In addition to being a nurse, there seem to be other risk factors for developing mental illnesses like depression and anxiety. Many studies have found higher susceptibility in women, both in the general population (Beutel et al., 2021; Hettich et al., 2022; Salari, Hosseinian-Far et al., 2020) and in HCW (Alonso et al., 2022; Azoulay et al., 2020; Cabarkapa et al., 2020; Lasalvia et al., 2020; Luceno-Moreno et al., 2022; Luo et al., 2020; Pappa et al., 2020; Rossi et al., 2021; Serrano-Ripoll et al., 2020; Th'ng et al., 2022; Wanigasooriya et al., 2020). Furthermore, younger age (Alonso et al., 2022; Beutel et al., 2021; Hettich et al., 2022; Luceno-Moreno et al., 2022; Rossi et al., 2021; Salari, Hosseinian-Far et al., 2020; Serrano-Ripoll et al., 2020), pre-existing mental illness (Alonso et al., 2022; Lasalvia et al., 2020; Wanigasooriya et al., 2020) and fear of infection (Luo et al., 2020; Sampaio et al., 2021) were often associated with more symptoms of mental disorders.

2.4 | The course of mental health symptoms among health care workers and nurses during the COVID-19 pandemic

The course of mental symptoms is of particular interest, especially in the highly burdened group of nursing staff. Many studies focus on the first wave of the pandemic, within which a decline in symptoms of mental disorders such as depression and anxiety was observed among both HCW in general (Luceno-Moreno et al., 2022) and nurses (Sampaio et al., 2021). A systematic review of 18 international longitudinal studies reported that most of these studies found a worsening of mental health symptoms among HCWs (Umbetkulova et al., 2023), however, the time to follow-up differed between the studies. Consistent with these findings, Australian HCWs had significantly higher rates of depression and anxiety in the second wave of the pandemic (October–December 2020) than in the first (May–June 2020) (Wynter et al., 2022), and mental health of French HCWs deteriorated significantly within the first year of the pandemic (Lucas et al., 2022). In contrast, some of the studies in the systematic review showed positive trends in mental health (Umbetkulova et al., 2023) as did the study by Alonso et al. (Alonso et al., 2022). Dutch ICU nurses demonstrated no worsening of symptoms of depression and anxiety (Heesakkers et al., 2023). A longitudinal study from Singapore examined HCW for 2 years (Jun 2020, Jun 2021, Jun 2022) and was able to show consistent prevalence for depression (26.2%, 27.5%, 26.2%) but decreasing scores for anxiety (33.1%, 25.0%, 23.7%) among those who responded to the survey on all measuring points (Th'ng et al., 2022). A separate look at nurses shows the same trend (Th'ng et al., 2022).

Considering the indispensable role of HCWs and especially nurses in crises such as the COVID-19 pandemic and the great mental health burden of this group, it seems paradoxical that there is a great lack of longitudinal data on mental health trends. Since nurses have often been identified as the most affected group, they should be a particular focus of research. Not least because symptoms of depression (Schug et al., 2022), like symptoms of anxiety (Tolksdorf et al., 2022), were found to be significant predictors of turnover intention and there is already a nursing shortage in Germany (Bundesministerium für Gesundheit [Federal Ministry for Health], 2021) and globally (International Council of Nurses, 2021).

2.5 | The study

The following study provides unique longitudinal data to examine symptoms of depression and generalised anxiety among nurses in Germany and their course over 2 years during the pandemic. Nurses´ symptoms were compared to those of the general population. The study aims to answer the following questions:

1. What was the prevalence of probable depression and anxiety among nursing staff at each of the four time periods during the COVID-19 pandemic in Germany?
2. How did symptom levels of depression and anxiety among nursing staff change over time during the pandemic?
3. How is the severity of depression and anxiety symptoms of nurses compared to the general population at all four measurement points?

3 | METHODS

3.1 | Study design

The psychosomatic departments of the university hospitals in Erlangen, Bonn, Ulm, Cologne and Dresden conducted the prospective VOICE study. Online platforms and internal staff mailing lists were used to share the online survey among HCW. In addition, several community hospitals and professional associations disseminated the link to recruit participants for the approximately 15-min online questionnaire. The items were slightly adjusted to the current situation during the pandemic at each measurement point. The survey was programmed with Unipark (www.unipark.com) and SoSci Survey (www.soscisurvey.de), two online academic survey tools.

Four measurement time points were available for analysis: 20/04/2020–05/07/2020 (T1), 17/11/2020–07/01/2021 (T2), 28/05/2021–16/07/2021 (T3), 07/02/2022–01/05/2022 (T4). The first survey was conducted during the first wave of the pandemic. The following three measurement time points are approximately consistent with the second, third and fourth wave of infection numbers of the COVID-19 pandemic in Germany.

3.2 | Inclusion criteria

In this paper, we focus exclusively on the group of nurses. Only data from participants who answered the survey at least two measurement time points were included in the analysis. A minimum age of 18 years, employment in health care, residence/workplace in Germany and sufficient knowledge of German language had to be met as inclusion criteria.

3.3 | Ethical considerations

All participants confirmed informed consent of participating in the study. The study was approved by the Ethics Committee of the Medical Faculty of the Friedrich-Alexander University Erlangen-Nürnberg (reference number: 133_20 B) and the other four VOICE university hospitals.

3.4 | Measures

3.4.1 | Depression and anxiety

To assess symptoms of depression and anxiety, the PHQ-4 (Patient Health Questionnaire-4), a validated psychometric test (Löwe et al., 2010), was used in the online survey. As an ultra-short version of the PHQ-D, it consists of four questions, each of which refers to the last 2 weeks and starts with 'Over the last two weeks, how often have you been bothered by…'. The first two questions, also known as PHQ-2, detect depressive symptoms asking the items 'feeling down, depressed or hopeless' and 'little interest or pleasure in doing things'. The other two questions, summarised to GAD-2 (Generalised anxiety disorder), detect symptoms of a generalised anxiety disorder through the items 'feeling anxious, nervous or on edge' and 'not being able to stop or control worrying'. Response options are 'not at all', 'several days', 'more than half the days' and 'nearly every day', scored as 0, 1, 2, 3. Therefore, the PHQ-4 score ranges from 0 to 12, and the sum scores for PHQ-2 and GAD-2 each range from 0 to 6. A cut-off score of ≥3 for PHQ-2 and GAD-2 is considered likely to indicate a clinically relevant depression or anxiety symptoms (Löwe et al., 2010).

3.4.2 | Sociodemographic, occupational and COVID-19 related variables

The following sociodemographic variables were included in the online survey: gender, age, having children (in the household or not in the household or not having children), living alone (or not) and migration background (no migration background if self and parents have German citizenship by birth). Hospital setting, years of professional experience and employment were assessed as occupational characteristics.

COVID-19-related factors such as contact with infected patients, contact with contaminated material, transfer to another department due to the pandemic, sufficient staff for the current workload and working more than before the pandemic were also examined.

3.5 | Statistical analysis

Data analyses were performed with SPSS V28 and R (RCoreTeam, R: A Language and Environment for Statistical Computing, 2023). As a sensitivity analysis showed equal results for inclusion and exclusion of the missing data, missing values were not imputed. Descriptive statistics (absolute and relative frequencies) of the sociodemographic,

occupational and COVID-19 related characteristics of the sample were computed for the four measuring points.

Our analysis was done using linear mixed regression models. To examine time differences between anxiety and depressive symptoms, respectively, we calculated one model with anxiety level as dependent variable and time point as categorical independent variable, and one model with depressive level as dependent variable and time point as categorical independent variable.

The influence of gender was examined in two more mixed regression models, where we used gender and time point as independent variables and anxiety and depressive symptoms, respectively, as dependent variable.

Comparison to the norm value in the German population was performed by one-sample t tests based on the information provided in Wicke et al., (2022).

In all analyses a level of significance of $p < .05$ was defined.

4 | RESULTS

4.1 | Sample size

A total of 507 nurses responded to the online survey on at least two of the four measurement periods and were therefore eligible for inclusion in the sample. The size of the subsamples at the measurement points is presented in Table 1. In total, 378 (74.6%) of the participants answered the survey twice, 102 (20.1%) participated three times and 27 (5.3%) at all four measurements.

4.2 | Sociodemographic, occupational and COVID-19 related characteristics of the sample

Table 2 shows sociodemographic and occupational characteristics of the study sample at the four measurement time points and COVID-19 related variables are demonstrated in Table 3.

In the subsample at T1, nearly 80% of the participants were female and slightly more than half of them were under 40 years old. Less than 10% had a migration background. More than three quarters had over 6 years of work experience. The samples at the other measurement time points (T2–T4) appear comparable concerning the mentioned characteristics (Table 2).

The number of participants who had contact with COVID-19-infected patients (proven by test) ranged from 26.2% to 65.6%, being lowest at T3 and highest at T4. Between 10.2% and 16.0% had to change the department due to the pandemic. The percentage of the study population who disagreed or rather disagreed that there were sufficient staff to handle the current workload increased consistently across the measurement time points, from 24.7% at T1 to 77.5% at T4 (descriptive statistics only due to the sample containing dependent and independent data). While 16.4% agreed or rather agreed at T1 that they were working more than before the pandemic, the proportion increased over T2 and T3 to 53.7% at T4 (Table 3, descriptive statistics only).

4.3 | Prevalence of clinically relevant levels of symptoms of depression and anxiety

The prevalence of clinically relevant depressive symptoms (cut-off score ≥3) was 21.6% at the first measurement time point. At the following evaluation time points, 31.4% (T2), 29.5% (T3) and 33.7% (T4) of participants were above the cut-off score for depression (Table 4).

Anxiety symptoms above the cut-off level (≥3) were seen in 18.5% (T1), 29.2% (T2), 26.2% (T3) and 26.4% (T4) of the nurses (Table 4).

4.4 | Course of symptoms of depression and anxiety during the pandemic

4.4.1 | Depression

When examining how symptoms of depression evolved after the onset of the pandemic, a significant increase in symptoms between the first (Apr-Jul 2020) and second (Nov 2020–Jan 2021) measurement points ($p < .001$) can be observed. As presented in Figure 1, nursing staffs' depression levels remain significantly elevated on the third (May–Jul 2021) and fourth (Feb–May 2022) survey compared to the first (both $p < .001$). The mean score of PHQ-2 was 1.63 ($SD = 1.60$) at the first measurement time point and then increased to 2.08 ($SD = 1.53$) at T2, 2.02 ($SD = 1.60$) at T3 and 2.09 ($SD = 1.52$) at T4.

4.4.2 | Anxiety

As with depression, anxiety symptoms among nurses increased significantly from the first to the second measurement time point ($p < .001$) and remained elevated throughout the study, resulting in significantly elevated symptom scores at the third and fourth assessments compared to the first survey (both $p = .002$) (Figure 2.). At the first survey, the GAD-2 score averaged 1.39 ($SD = 1.47$) and peaked at 1.85 ($SD = 1.57$) at the second measurement time point. The mean score at T3 was 1.76 ($SD = 1.71$) and at T4 1.79 ($SD = 1.64$).

TABLE 1 Subsamples at the four measurement points.

	T1	T2	T3	T4	Total sample (participating in at least two measurement points)
Subsamples, *n*	287	363	244	276	507

TABLE 2 Sociodemographic and occupational characteristics of the study sample at the four measurement time points.

N = 507	T1 *n* = 287	T2 *n* = 363	T3 *n* = 244	T4 *n* = 276
Gender, *n* (%)				
Women	228 (79.4)	285 (78.5)	192 (78.7)	216 (78.3)
Men	59 (20.6)	78 (21.5)	52 (21.3)	60 (21.7)
Divers	–	–	–	–
Age, years, *n* (%)				
18–30	80 (27.9)	103 (28.4)	49 (20.1)	59 (21.4)
31–40	71 (24.7)	76 (20.9)	67 (27.5)	62 (22.5)
41–50	58 (20.2)	77 (21.2)	51 (20.9)	64 (23.2)
51–60	69 (24.0)	95 (26.2)	67 (27.5)	77 (27.9)
>60	9 (3.1)	12 (3.3)	10 (4.1)	14 (5.1)
Children, *n* (%)				
Yes, in the household	96 (33.4)	116 (32.0)	88 (36.1)	94 (34.1)
Yes, but not in the household	32 (11.1)	49 (13.5)	35 (14.3)	49 (17.8)
No	159 (55.4)	198 (54.5)	121 (49.6)	133 (48.2)
Living alone, *n* (%)				
Yes	75 (26.1)	93 (25.6)	59 (24.2)	70 (25.4)
No	212 (73.9)	270 (74.4)	185 (75.8)	206 (74.6)
Migration background, *n* (%)				
Yes	20 (7.0)	27 (7.4)	21 (8.6)	25 (9.1)
No	267 (93.0)	336 (92.6)	223 (91.4)	251 (90.9)
Hospital setting, *n* (%)				
University hospital	268 (93.4)	345 (95.0)	231 (94.7)	255 (92.4)
Non-university hospital	17 (5.9)	17 (4.7)	12 (4.9)	18 (6.5)
Other	2 (0.7)	1 (0.3)	1 (0.4)	3 (1.1)
Years of professional experience, *n* (%)				
<3 years	12 (4.2)	17 (4.7)	6 (2.5)	5 (1.8)
3–6 years	46 (16.0)	54 (14.9)	29 (11.9)	31 (11.2)
>6 years	222 (77.4)	284 (78.2)	195 (79.9)	224 (81.2)
Not involved in patient care	7 (2.4)	8 (2.2)		
Missing	–	–	14 (5.7)	16 (5.8)
Employment, *n* (%)				
Full-time	173 (60.3)	219 (60.3)	137 (56.1)	154 (55.8)
Part-time	114 (39.7)	144 (39.7)	107 (43.9)	122 (44.2)

4.4.3 | Gender effects

No significant effect of gender was found for the symptoms of depression ($p = .089$) as well as for the symptoms of anxiety ($p = .417$).

4.5 | Comparison of depression and anxiety symptoms of nurses with the general German population

As shown in Figures 1 and 2, the mean scores of the PHQ-2 and GAD-2 among the nurses were compared with the German general population. Wicke et al. (Wicke et al., 2022) examined the German general population at two time points (Apr-Jun 2020 and Dec 2020–Feb 2021) consistent with the first and second pandemic wave and calculated mean values for PHQ-2 ($M = .97$, $SD = 1.21$) and GAD-2 ($M = .83$, $SD = 1.21$), which were used for comparison with our study sample. At all four measurement time points, nurses showed significantly elevated symptom levels for both depression and anxiety compared to the general population (all $p < .001$).

5 | DISCUSSION

To the best of our knowledge, the present study is the first to provide longitudinal data including four measurement time points of the mental health of nurses in Germany during the first 2 years of the COVID-19 pandemic.

TABLE 3 COVID-19 related variables of the study sample at the four measurement points.

N = 507	T1 n = 287	T2 n = 363	T3 n = 244	T4 n = 276
Contact with COVID-19-infected patients, *n* (%)				
Yes	140 (48.8)	225 (62.0)	64 (26.2)	181 (65.6)
No	147 (51.2)	138 (38.0)	180 (73.8)	95 (34.4)
Contact with COVID-19-contaminated material, *n* (%)				
Yes	131 (45.6)	182 (50.1)	57 (23.4)	149 (54.0)
No	156 (54.4)	181 (49.9)	187 (76.6)	127 (46.0)
Transfer to another department due to the pandemic, *n* (%)				
Yes	41 (14.3)	58 (16.0)	25 (10.2)	41 (14.9)
No	246 (85.7)	305 (84.0)	219 (89.8)	235 (85.1)
Sufficient staff for the current workload, *n* (%)*				
Do not agree at all	31 (10.8)	105 (28.9)	89 (36.5)	130 (47.1)
Rather not agree	40 (13.9)	52 (14.3)	67 (27.5)	84 (30.4)
Partly agree	36 (12.5)	39 (10.7)	48 (19.7)	30 (10.9)
Rather agree	56 (19.5)	26 (7.2)	23 (9.4)	24 (8.7)
Completely agree	31 (10.8)	12 (3.3)	17 (7.0)	8 (2.9)
Missing	93 (32.4)	129 (35.5)	–	–
Working more than before the COVID-19 pandemic, *n* (%)*				
Do not agree at all	58 (20.2)	33 (9.1)	46 (18.9)	21 (7.6)
Rather not agree	60 (20.9)	44 (12.1)	43 (17.6)	46 (16.7)
Partly agree	29 (10.1)	55 (14.9)	56 (23.0)	61 (22.1)
Rather agree	35 (12.2)	48 (13.2)	58 (23.8)	86 (31.2)
Completely agree	12 (4.2)	55 (15.2)	41 (16.8)	62 (22.5)
Missing	93 (32.4)	129 (35.5)	–	–

*Missing data for the items 'Sufficient staff for the current workload' and 'Working more than before the COVID-19 pandemic' at T1 and T2 resulted because one of the recruiting centres collected additional data and omitted these items for time-saving reasons.

TABLE 4 Prevalence of clinically significant levels of symptoms of depression and anxiety.

	T1 (n = 287)	T2 (n = 363)	T3 (n = 244)	T4 (n = 276)
PHQ-2				
≥3, *n* (%)	62 (21.6)	114 (31.4)	72 (29.5)	93 (33.7)
GAD-2				
≥3, *n* (%)	53 (18.5)	106 (29.2)	64 (26.2)	73 (26.4)

The aim of this study was to investigate the prevalences of depression and anxiety among nurses in Germany and to observe the development of their mental health over the course of four measurement time points during the pandemic corresponding to the four pandemic waves.

5.1 | Changes of depressive and anxiety symptoms in the course of the pandemic

The most important finding of this longitudinal study is the significant increase in depression and anxiety among nurses from the first to the second assessment, and that in the further course, depressive and anxiety symptoms remained significantly elevated compared to the first measurement point. However, when interpreting these results, it must be considered that most of the participants only took part in the survey twice. This means that only limited conclusion can be drawn about the development of depression and anxiety. Nevertheless, the similarity of the samples at the four measurement points allows comparison between the time points.

As mentioned in the introduction, there is a paucity of comparable longitudinal data examining longer time periods during the pandemic. Many studies focus only on the first wave of the pandemic and describe an improvement in symptoms after an initial increase in psychological distress (Luceno-Moreno et al., 2022; Sampaio et al., 2021), presumably due to an adaptation phenomenon (Sampaio et al., 2021).

However, a significant deterioration in the mental health could be observed among Australian nurses between the first and second wave of the pandemic (Wynter et al., 2022), and psychological distress

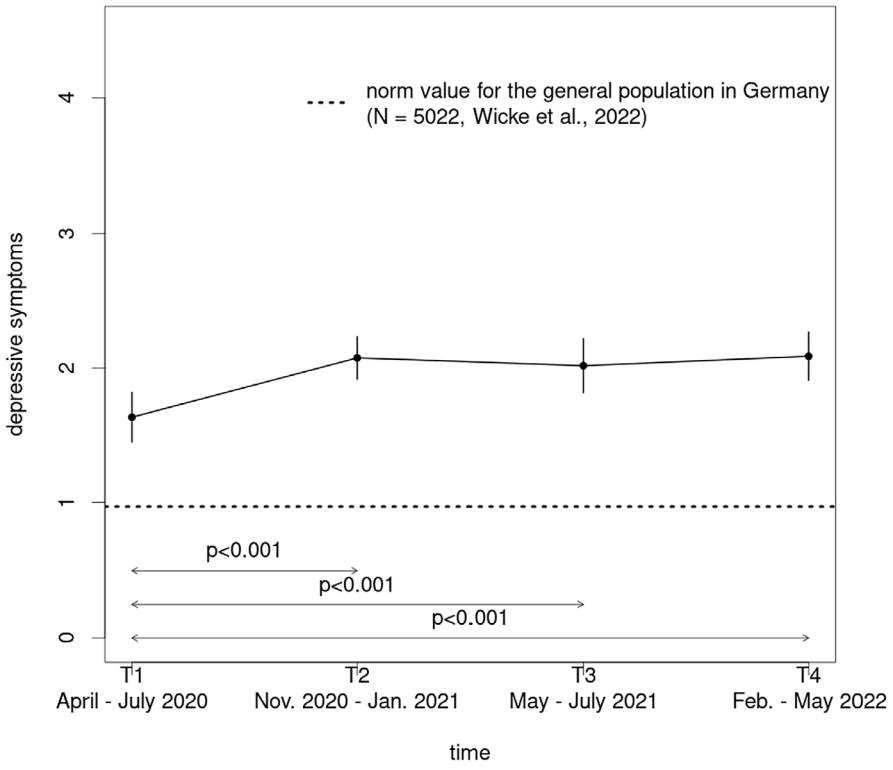

FIGURE 1 Depressive symptoms over the course of the four measurement time points.

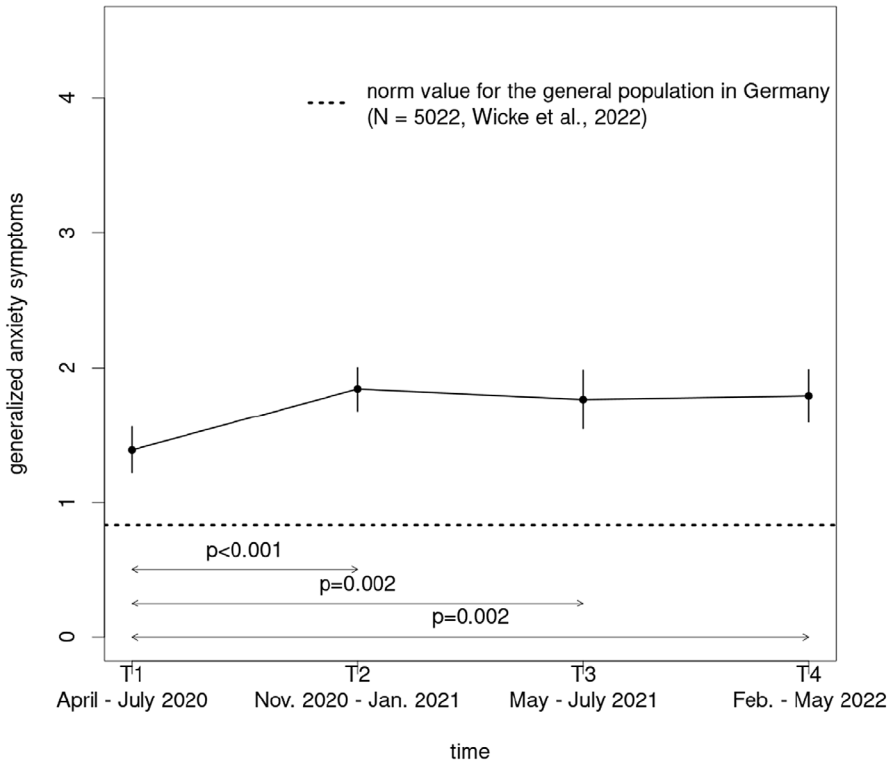

FIGURE 2 Anxiety symptoms over the course of the four measurement time points.

among nurses in Japan remained high at subsequent outbreaks after increasing during the first pandemic wave (Sasaki et al., 2021), which is in line with the data of the present study. When comparing data from different countries, national differences regarding infection and death rates should be taken into account, e.g. considerably less nurses in our study had contact with COVID-19 infected patients on T3, as infection rates were lower in Germany in summer (Statista, n.d.). Similarly, government decisions on the procurement of protective materials, general isolation measures and border closures must be taken into account as they may explain national differences in mental health.

The present findings might be explained following Alonso et al. (Alonso et al., 2022) as they showed that two factors influenced the persistently high number of mental disorders during the first two pandemic waves: for the majority of their participants, the symptoms of psychological distress they had during the first wave persisted during the course, and in addition, 20% of HCWs developed additive mental distress during the second wave. This may be due to the enduring burden of the ongoing pandemic, where HCWs with initial mental health problems may not have had the opportunity to recover, and those who were resilient during the pandemic outbreak may not have been able to withstand the ongoing stress.

Longer observation periods revealed worsening mental health in French nurses between July and August 2020 and July and August 2021 (Lucas et al., 2022). In line with the findings in the present study, Dutch ICU nurses were found to have persistently high symptom levels without further worsening between March to June 2020 and October 2021 (Heesakkers et al., 2023). Th'ng et al. (Th'ng et al., 2022) found an increase in depression but a lower risk of developing anxiety in Singapore nurses in 2021 and 2022 compared with 2020. In contrast to the results of the present study, declining prevalences of depression and anxiety were observed among HCWs in Italy between March and April 2020 and April and May 2021 (Rossi et al., 2021).

The significant increase of mental burden in our sample of nurses in Germany needs to be seen in the following context: In Germany, the number of people infected with COVID-19 rose sharply in late 2020 and early 2021. At the same time, the number of deaths increased dramatically and peaked throughout the pandemic (World Health Organization, 2023). Over 60% of the participants in the present study had contact with infectious patients during the second survey and were directly confronted with the virus. Fear of infection, concern about infecting family and others, confrontation with the not rarely lethal consequences of COVID-19, lack of knowledge about pathophysiology of the virus and heavy workloads might play a role in the significant increase in depression and anxiety at the second survey among the nurses in our study.

The persistently high levels of depressive symptoms during the third and fourth assessment might be related to the repeated outbreaks and new variants of the virus. Insufficient recovery during leisure time (Morawa et al., 2021) was found to be associated with higher risk of depression. Participants in our study increasingly reported across the four surveys that there were not enough staff to handle the workload and that they were working more than they had before the pandemic.

Anxiety levels also remained significantly elevated over the course of the study compared to the first survey but did not show a further increase after the second wave. This stabilisation may possibly be due to increasing knowledge of the virus and its mechanisms, as well as vaccination, which has been available since early 2021 and has enabled HCW to protect themselves from the virus.

5.2 | Prevalence rates

At the first measurement point, we found that about one in five nurses suffered from depression or anxiety, respectively.

Meta-analyses of mainly Asian studies from the beginning of the pandemic show prevalences similar to those in the present study, but slightly higher (Pappa et al., 2020): 23.2% for anxiety, 22.8% for depression; Salari et al. (Salari, Khazaie et al., 2020): 25.8% for anxiety, 24.3% for depression, possibly due to the earlier spread of Sars-CoV-2 in Asia. In contrast to the present research, 62.1% of frontline nurses in a study from France (Azoulay et al., 2020) and 50.1% of HCW in a study from Italy (Lasalvia et al., 2020) showed probable anxiety. These countries were particularly hard hit by the COVID pandemic in terms of infected cases.

In our second assessment, about one-third of participants had probable depression or anxiety. For depression, the prevalence remained about the same while for anxiety, one out of four nurses tested positive in the last two surveys.

Th'ng et al., (2022) conducted three surveys, at similar time points to our first, third and fourth surveys. The prevalences for depression are very similar to those found in the present study, except for higher values at the first measurement time point (27.5%, 29.7%, 32.2%). The reported anxiety prevalences in Th'ng et al., (2022) seem to be higher than those in the present study (34.2%, 28.7%, 38.5%). This could be since Asia was the first continent to be affected by the pandemic.

The studies mentioned above used different measurement instruments than the PHQ-4, which we used in our study (e.g. the Depression, Anxiety and Stress Scale-21 items (DASS-21), the Self-rating Depression/Anxiety Scale (SDS/SAS) or the Patient-Health-Questionaire-9 (PHQ-9) and Generalised-Anxiety-Disorder Scale-7 (GAD-7)), and the results support the findings in our study.

5.3 | Comparison of depression and anxiety among nurses with the general German population

As mentioned above, the mental health of the general population around the world (Salari, Hosseinian-Far et al., 2020) as well as in Germany (Beutel et al., 2021; Hettich et al., 2022) worsened at the beginning of the pandemic. However, even higher prevalences in HCW than in the general population have been found (Wanigasooriya et al., 2020). These results are in line with the findings of the present study: Compared to the German general population, nurses in the present study permanently showed significant higher prevalence for depression and anxiety at all measurement points.

In contrast, some studies describe higher rates of depression and anxiety among the general population than among HCW at the beginning of the pandemic (Luo et al., 2020; Morawa et al., 2021; Skoda et al., 2020). Coping strategies of HCW at the beginning (Cenat et al., 2021), a better level of knowledge and information among HCW about the virus (Skoda et al., 2020) and the feeling of being

able to help might explain these findings. Despite great psychological stress in the general population at the beginning of the pandemic, a decrease in prevalences of depression and anxiety was observed quickly for the general population (Hettich et al., 2022), possibly due to an adaptation phenomenon. In contrast, symptoms of depression and anxiety increased and remained elevated among HCW and especially among nurses, which is in line with our research.

5.4 | Gender effects

Female gender was found to be associated with a higher risk of mental disorders in former studies. In both the general population (Beutel et al., 2021; Hettich et al., 2022; Salari, Hosseinian-Far et al., 2020) and among HCW (Alonso et al., 2022; Azoulay et al., 2020; Cabarkapa et al., 2020; Lasalvia et al., 2020; Luceno-Moreno et al., 2022; Luo et al., 2020; Pappa et al., 2020; Rossi et al., 2021; Serrano-Ripoll et al., 2020; Th'ng et al., 2022; Wanigasooriya et al., 2020), women showed higher symptoms of depression and anxiety. This was not confirmed in our study, as gender had no significant effect on the symptoms of depression and anxiety.

One explanation for this could be the gender distribution in our study sample, in which about 8 out of 10 participants were female resulting in insufficient power to detect small or moderate effects.

5.5 | Strengths and limitations

To the best of our knowledge, this is the first study to provide data on nurses´ mental health over a long period of time during the COVID-19 pandemic in Germany. With four surveys conducted matching the four infection waves of the pandemic in Germany, it is possible to analyse the course of depression and anxiety in nurses over 2 years. An additional strength of our study is the relatively large sample size with 507 nurses, who answered our survey on at least two measurement points.

One limitation of the study is that the study sample is self-selected, so selection bias could be present. Furthermore, not all participants included completed the first measurement point, and not all responded to the survey at all four time points, but the method of analysis chosen allowed including higher number of cases and observations of rare data. There might be a self-report bias due to the self-report questionnaire we used for assessing depression and anxiety which is common in online surveys. Finally, it should be noted that the PHQ-4 is only a screening instrument that indicates the presence of a probable depression or generalised anxiety disorder but cannot provide a diagnosis.

6 | CONCLUSION

Depression and anxiety among nurses increased significantly during the COVID-19 pandemic. Throughout the entire observation period, symptom levels in nurses remained elevated and were higher than in the general population.

The present findings underline that the strain of the pandemic strongly affected the nursing profession.

Public health policies are urgently needed to counteract the workforce shortages and the increasing burden on remaining staff reported by nurses in this study.

These measures are essential not only to reduce the number of individual sufferings associated with mental illness, but also to prevent a worsening of the already existing nursing shortage in Germany.

6.1 | Relevance to clinical practice and future research

Based on this study, longitudinal data and continuous evaluation of mental health trends among nurses are particularly needed, as well as identification of risk and protective factors.

Considering that mental health disorders were more prevalent among HCW and especially nurses compared to the general population, it is very urgent to study nurses' mental health in more detail, also in post-pandemic times. There seems to be a need for concepts for the prevention and handling of mental distress in hospitals. Screening methods to detect symptoms at an early stage and support offers for burdened nursing staff need to be established.

AUTHOR CONTRIBUTIONS

YE, EM, FG, PB and LJB provided conceptualization of this work and YE, EM and WA the methodology. Funding acquisition was conducted by YE, FG, KW and CA. Investigation was conducted by YE, EM, CS, FG, AMB, PB, LJB, KW and CA. CS and AMB did the curation of data and WA performed the formal analysis and data visualisation. YE and EM supervised this work. The original draft was written by LG. All listed authors participated in review and editing and agreed to the version to be published.

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CONFLICT OF INTEREST STATEMENT

All authors declare that no conflict of interest exists.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on reasonable request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

The present study was approved by the Ethics Committee of the Medical Faculty of the Friedrich-Alexander University Erlangen-Nürnberg (FAU) and registered on German Clinical Trials Register (https://drks.de/search/en) (DRKS-ID: DRKS00021268). For each survey an online informed consent was given by all respondents.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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