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The long pandemic wave: depressive symptoms and suicidal thoughts among doctors and nurses during COVID-19 and five years later

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Abstract

Background

Healthcare workers widely reported psychological distress during the COVID-19 emergency. While several pandemic-related workplace hazards have been identified as contributing factors, emerging evidence suggests these challenges were rooted in longstanding workplace conditions that predated the pandemic and continue to affect the workforce today. There is a lack of comparative studies tracking the evolution of these mental health outcomes through to the post-pandemic period. This leaves a critical gap in understanding long-term workforce well-being.

Methods

We conducted a repeated cross-sectional study harmonising independent cohorts (2020 and 2024) from two large multi-country studies (HEROES and MeND), analysing 39,513 participants from the Czech Republic, Italy, the Netherlands, and Spain. Outcomes were assessed using the 9-item Patient Health Questionnaire. Modified Poisson regression models with propensity score weighting were applied to estimate prevalence ratios (PRs) with 95% confidence intervals (CIs).

Results

Post-pandemic (2024–2025) participants exhibited a 50% higher prevalence of depressive symptoms (PR 1.57; 95% CI 1.46–1.69) and more than twice of suicidal thoughts (PR 2.53; 95% CI 2.21–2.91) compared to the pandemic cohort (2020–2021). For both 2020 and 2024, extended daily working hours, managing angry patients and relatives, and physical violence increased the severity of depressive symptoms. Colleague support acted as a strong protective factor, showing an improvement in symptomatology by almost 50% when reported. Dose-response analyses confirmed the robustness of these associations.

Conclusions

The apparent post-pandemic increase in workforce mental health problems, possibly linked to persistent occupational hazards, suggests this crisis is not a transient pandemic effect but an established structural situation, warranting timely organisational intervention.

Background

Robust healthcare systems are the cornerstone of social development and public health; however, these institutions are currently confronting an unprecedented crisis worldwide. The European region expects a critical shortage of approximately 940,000 healthcare workers by 2030, as forecast by the World Health

Organisation (WHO) [1]. While initial hypotheses largely attributed this severe attrition to the acute strain of the COVID-19 pandemic [2], emerging literature indicates that difficulties in staff retention preceded the public health emergency [3, 4]. This strongly suggests that the current health workforce deficit is not a transient consequence of the pandemic, but the manifestation of a structural crisis that had been developing long before [5, 6].

A proposed driver of this structural crisis is the deteriorating mental health status of healthcare workers and its link to adverse working conditions [7]. During the acute phase of the pandemic, evidence highlighted that this sector experienced a greater psychological burden than the general population [8, 9]. At the time, these deleterious mental health outcomes were primarily attributed to the intense, temporary working conditions triggered by COVID-19 [10], which successfully spotlighted the urgent need to protect the healthcare workforce. However, recent European data reveal that a high prevalence of psychological distress persists years after the emergency has subsided, fundamentally threatening healthcare delivery in the medium and long term [11]. Despite the need to identify actionable occupational factors, there is a critical research gap: with the exception of a few studies [12–14], no large-scale longitudinal studies or prospective cohorts extending beyond 2023 currently exist to evaluate these long-term trends, either in Europe or globally.

To address the absence of prospective cohorts with long follow-up periods, we conducted a repeated cross-sectional study with doctors and nurses across four European countries. Our data was drawn from two large multi-country projects: the COVID-19 HEalth caRe wOrkErS (HEROES) study [15] and the Mental Health of Nurses and Doctors (MeND) survey [11]. Our primary objective is to describe the changes in the prevalence of depressive symptoms, suicidal thoughts, and specific working conditions between the acute pandemic (2020–2021) and post-pandemic (2024–2025) periods. As a secondary objective, we also analyse the associations between mental health outcomes and these occupational exposures.

Methods

Study design, participants and setting

We conducted a repeated cross-sectional study using two independent samples of doctors and nurses. Data were collected in Czech Republic, Italy, the Netherlands, and Spain, during 2020–2021 and 2024–2025. The inclusion of these four countries was determined by data availability, as they were the only nations that participated in both the HEROES and MeND surveys. Ethical approval was obtained at all sites for the HEROES study (Ethics Committee of the Azienda Mista Ospedaliero-Universitaria of Cagliari, Italy; Hospital La Paz Ethics Committee in Madrid, Spain; Medical Ethical Boards of the Maastricht University Medical Center and the Amsterdam Medical Center, the Netherlands; Ethics Committee of the Czech Ministry of Health and Ethical Review Board of the University Hospital Motol, Prague, Czech Republic) and centrally at the Ethics Committee of the Universidad Autónoma de Madrid (Identifier: CEI-141-3158) for the MeND survey. Informed consent forms were obtained at all sites in 2020–2021 and

waived in 2024–2025, when no personal data were collected. This report follows STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) guidelines [16].

Data obtained during the COVID-19 pandemic period (2020–2021) come from the HEROES study [15]. HEROES is a prospective cohort study including healthcare workers from pre-selected health facilities in 26 countries, mostly in Latin America, but also in European countries. The information was retrieved through a self-reported online questionnaire based on standardized measures plus ad-hoc items. The recruitment was held from 2020 to 2022; for the present study, a single wave of assessment was used for analysis, collected between March 2020 and February 2021 (see **Supplementary Figure S1** of the Online resource). The four countries included in this analysis used non-probabilistic convenience sampling strategies at the regional and facility levels. The survey was shared via electronic systems in each of the targeted facilities. The total sample size across all countries and healthcare workers reached 32,410 participants [17–21]. Of this total, our sample from the four countries included 18,545 respondents. The study protocol can be consulted elsewhere [15].

The post-pandemic data are derived from the MeND survey in the European Union, Iceland and Norway [11, 22]. This was a cross-sectional study launched by the WHO Regional Office for Europe and delivered through a self-reported online survey. The platform was open for participation from October 2024 to April 2025. Recruitment was performed by six European medical and nursing associations, along with national regulators and unions, which were responsible for sharing the survey link with their members. During the last month, the social media channels of the WHO Regional Office for Europe and of the European and national professional associations were used for dissemination as well. In total 122,048 responses from doctors and nurses were received during the recruitment process, from which 37,562 came from the four countries. Further details on the recruitment and design are available in the study protocol [23].

Measures

Both studies used online surveys developed ad hoc. The surveys included items related to sociodemographic and workplace characteristics, working conditions, and depressive symptoms and suicidal thoughts. For the present study, we looked for items included in both surveys and harmonised them to perform comparable analyses.

Sociodemographic and workplace characteristics included age group, gender, presence of children in the household, and healthcare sector (public or private). Working conditions included daily working hours, dealing with angry patients and/or relatives, physical violence, and colleague support. All of these, except for daily working hours, were offered on a Likert-scale. Item wording, sources and transformations performed for the harmonisation process can be consulted in the Online resource (**Supplementary Table S1**).

Depressive symptoms were measured using the nine-item Patient Health Questionnaire (PHQ-9) [24]. This tool screens for diagnostic criteria from the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders, 5th Edition) [25] to identify cases of probable depressive disorder. Higher scores indicate more severe depressive symptoms, and country-specific validated cut-off scores for probable depression range from 10 to 12 [26–29]. This instrument showed good reliability in our sample (Cronbach's α = 0.89).

The ninth item of the PHQ-9 was used to identify suicidal thoughts (*"Over the last two weeks, how often have you been bothered by thoughts that you would be better off dead or of hurting yourself in some way?"*). Previous studies have demonstrated an increased risk of suicide attempt over one- and two- year periods when responses are different than "no". [30, 31]. For this reason, the original Likert-scale responses were treated as dichotomous for screening for suicidal thoughts, with any positive answer (1 to 3 points in the original item) coded as 1, and any negative answer coded as 0.

Statistical Analysis

We harmonised two large cohorts and used a repeated cross-sectional design because prospective data with large follow-up periods were not available. To emulate such a study (i.e., to maximise between-cohort comparability), we controlled for observed confounding using propensity score weighting (PSW) [32]. PSW models included age group, gender, presence of children in the household, profession, healthcare sector, and country (included as fixed effects). The target estimand was the average treatment effect on the treated – i.e., the 2024–2025 respondents in our first analyses or the respondents exposed to specific working conditions in our secondary analyses.

Our main objective was to assess the change in the prevalence of mental health outcomes between the two years and to analyse the association between working conditions and mental health outcomes at both time points. No sample size calculation was performed, as both studies intended to include as many participants as possible. The number of individuals who received the invitation to participate in either of the two studies could not be estimated with precision; thus, response rates were not calculated. To estimate the country coverage, population distributions stratified by age, profession and gender were retrieved from the joint questionnaire on non-monetary healthcare statistics by the WHO Regional Office for Europe, the Organisation for Economic Co-operation and Development, and Eurostat [33]. These population distributions were used to calculate post-stratification inverse probability weights (IPW) based on the specific year of each study.

We performed descriptive statistics stratified by country, cohort, and profession to inform the proportions of participants within sociodemographic subgroups. Prevalence rates were estimated for the specified working conditions, probable depression and suicidal thoughts. These descriptive statistics are reported as binary variables (see **Supplementary Table S1**). Additionally, we estimated age and gender calibrated proportions using IPW.

We estimated prevalence ratios (PRs) with their 95% confidence intervals (CIs) using multivariable modified Poisson regression models with a log link and robust standard errors. Our main analyses modelled the cohort year as the primary exposure to evaluate its effect on depression, suicidal thoughts and working conditions. Subsequently, secondary models were fitted to examine the specific associations between each working condition and depressive symptoms and suicidal thoughts.

All regression models accounted for the complex survey design and utilised robust variance estimators to compute 95 percent CIs. As a sensitivity analysis, we evaluated dose-response relationships by treating working conditions as ordinal and discrete variables, utilising the continuous scores from the mental health screening tools. Finally, to assess potential effect modification over time, a multiplicative interaction term for the cohort year was introduced in both the primary and dose-response models.

We used complete-case observations for each model. Analyses were executed using R version 4.5.2 [34] and RStudio version 2026.01.0-392 [35]. The full analytical code, along with the packages used is publicly available on GitHub (https://github.com/CCOMS-UAM/mend-heroes-pub).

Results

Our available data comprised 18,545 participants from the pandemic cohort (2020–2021) and 37,562 from the post-pandemic cohort (2024–2025) for the Czech Republic, Italy, the Netherlands, and Spain. Data cleaning was performed to remove participants with more than 90% of missing values, professions other than doctors and nurses, nurses with fewer than 3 years of training, participants not reporting profession or gender, and participants from the second and third waves of the pandemic cohort data. After this process, the pandemic cohort resulted in 5,183 total respondents, while the post-pandemic cohort consisted of 34,330 participants (see the Online resource for exclusion reasons in the **Supplementary Figure S2**).

The sociodemographic characteristics of our sample by cohort and profession are depicted in Table 1. Doctors represented the majority of the pandemic cohort, while nurses constituted most of the sample in the post-pandemic cohort. Most of these professionals were female. Age groups presented a trend towards 31–40 years in the pandemic group and 51–60 in the post-pandemic group, with the latter reporting a higher proportion of children in their households. Working in the public sector was widely reported by all participants. In both years, most participants were working in Italy, followed by Spain. An overview of the sample size and sociodemographic characteristics by country can be consulted in the Online resource (**Supplementary Tables S2** and **S3**). These estimates aligned with those observed after applying post-stratification weights (see Online resource [**Supplementary Tables S4** and **S5**]).

Table 1
Sociodemographic characteristics of the participants, by year and profession.

Characteristic	Pandemic (2020–2021)			Post-pandemic (2024–2025)		
	Overall N = 5 183[a]	Doctor N = 3 242[a]	Nurse N = 1 941[a]	Overall N = 34 330[a]	Doctor N = 13 235[a]	Nurse N = 21 095[a]
Age group						
≤ 30	903 (18%)	509 (16%)	394 (21%)	4 499 (13%)	1 615 (12%)	2 884 (14%)
31–40	1 300 (26%)	841 (27%)	459 (24%)	7 598 (22%)	3 138 (24%)	4 460 (21%)
41–50	1 162 (23%)	670 (21%)	492 (26%)	7 764 (23%)	2 891 (22%)	4 873 (23%)
51–60	1 064 (21%)	621 (20%)	443 (24%)	10 237 (30%)	2 830 (21%)	7 407 (35%)
> 60	609 (12%)	514 (16%)	95 (5.0%)	4 228 (12%)	2 760 (21%)	1 468 (7.0%)
Missing	145	87	58	4	1	3
Gender (Binary)						
Female	3 662 (71%)	2 020 (62%)	1 642 (85%)	25 863 (75%)	8 806 (67%)	17 057 (81%)
Male	1 514 (29%)	1 218 (38%)	296 (15%)	8 419 (25%)	4 402 (33%)	4 017 (19%)
Missing	7	4	3	48	27	21
Children in household (Recoded)	1 594 (39%)	981 (38%)	613 (40%)	19 914 (58%)	7 215 (55%)	12 699 (60%)
Missing	1 109	683	426	34	11	23
Healthcare sector (Recoded)						
Public sector	4 371 (90%)	2 734 (88%)	1 637 (93%)	28 387 (86%)	10 971 (86%)	17 416 (85%)
Private sector	484 (10.0%)	364 (12%)	120 (6.8%)	4 767 (14%)	1 753 (14%)	3 014 (15%)
Missing	328	144	184	1 176	511	665

[a]n (%)

[Table 1]

About one in five doctors and nurses from the pandemic cohort met the cut-off scores compatible with probable depressive disorder on the PHQ-9. Overall, more than 6% of this sample provided a positive answer on item 9 of the screening tool, which is suggestive of suicidal thoughts. The post-pandemic cohort reported higher proportions, with probable depression in one out of four doctors and almost one out of three nurses. Suicidal thoughts also presented a higher prevalence. An overall prevalence of 14% across both professions was estimated (further details are presented in Table 2). The age- and gender-calibrated estimates yielded similar results (see Online resource [**Supplementary Tables S6** and **S7**]).

Table 2
Prevalence rates for depression and suicidal thoughts, and mean and standard deviation for depressive symptoms scores, by year and profession.

Characteristic	**Pandemic (2020–2021)**			**Post-pandemic (2024–2025)**		
	Overall N = 5 183[a]	**Doctor N = 3 242[a]**	**Nurse N = 1 941[a]**	**Overall N = 34 330[a]**	**Doctor N = 13 235[a]**	**Nurse N = 21 095[a]**
Probable depression	837 (19%)	485 (18%)	352 (22%)	8 718 (29%)	2 935 (26%)	5 783 (31%)
Missing	846	522	324	4 461	1 905	2 556
Suicidal thoughts	280 (6.4%)	177 (6.5%)	103 (6.4%)	4 274 (14%)	1 685 (15%)	2 589 (14%)
Missing	840	518	322	4 383	1 876	2 507
Depressive symptoms	6.4 (5.1)	6.1 (4.9)	6.9 (5.5)	8.1 (5.6)	7.8 (5.8)	8.2 (5.5)
Missing	846	522	324	4 461	1 905	2 556

[a]n (%); Mean (SD). Note: Unweighted estimates.

[Table 2]

The primary adjusted models specifying the year of study as an exposure demonstrated the difference in prevalence between the two years (2020 as the reference level). The prevalence of depressive symptoms and suicidal thoughts was significantly higher in 2024–2025, with about 50% higher prevalence for depression (PR 1.57; 95 percent CI 1.46 to 1.69) and more than twice the frequency of suicidal thoughts (PR 2.53; 95 percent CI 2.21 to 2.91). For these models, doctors showed higher prevalence ratios for both mental health outcomes compared to nurses (see Fig. 1). Further information on the crude estimates is available in the Online resource (**Supplementary Figure S3**). Overall PHQ-9 scores increased from the pandemic (Mean = 6.40, Standard Deviation [SD] = 5.14) to the post-pandemic period (Mean =

8.05, SD = 5.63; t = -19.6, p < 0.001). This was consistent across professions, with both doctors (Mean = 6.12 to 7.75, p < 0.001) and nurses (Mean = 6.87 to 8.24, p < 0.001) reporting higher post-pandemic scores.

[Figure 1]

The prevalence of the specific occupational exposures assessed varied between professions and cohorts (see Table 3). The most frequently reported working condition was colleague support, which exceeded 80%. Nurses in the post-pandemic cohort reported the highest prevalence of colleague support. On the other hand, physical violence was the least prevalent, reported by fewer than one out of ten respondents across both years. Overall, nurses presented higher proportions of every working condition except for extended working hours, which were mostly reported by doctors. For weighted prevalence rates and country-level estimates, please refer to the Online resource (**Supplementary Tables S8** and **S9**).

Table 3
Reported proportions of reported occupational exposures, by year and profession.

Characteristic	**Pandemic (2020–2021)**			**Post-pandemic (2024–2025)**		
	Overall	**Doctor**	**Nurse**	**Overall**	**Doctor**	**Nurse**
	N = 5 183[a]	**N = 3 242[a]**	**N = 1 941[a]**	**N = 34 330[a]**	**N = 13 235[a]**	**N = 21 095[a]**
Extended daily working hours	1 486 (36%)	1 140 (43%)	346 (24%)	7 831 (26%)	4 148 (35%)	3 683 (19%)
Missing	1 062	583	479	3 629	1 456	2 173
Angry patients or relatives	415 (8.4%)	253 (8.2%)	162 (8.8%)	14 887 (47%)	4 606 (39%)	10 281 (53%)
Missing	242	141	101	2 986	1 305	1 681
Physical violence	326 (6.6%)	167 (5.4%)	159 (8.6%)	772 (2.5%)	214 (1.8%)	558 (2.9%)
Missing	240	142	98	3 475	1 532	1 943
Colleague support	3 672 (85%)	2 302 (84%)	1 370 (85%)	28 266 (89%)	10 669 (88%)	17 597 (90%)
Missing	842	512	330	2 710	1 162	1 548

[a]n (%). Note: Unweighted estimates.

[Table 3]

The post-pandemic participants exhibited a higher prevalence of dealing with angry patients or relatives (PR 6.30; 95 percent CI 5.67 to 6.99). In line with the crude proportions mentioned before, nurses

displayed the highest PR (7.81; 95 percent CI 6.53 to 9.33) compared to doctors (PR 6.13; 95 percent CI 5.36 to 7.01). Conversely, exposure to physical violence was more prevalent in the pandemic cohort (PR 0.31; 95 percent CI 0.27 to 0.37), being most prevalent among nurses as well (PR 0.55 vs. 0.30 in doctors). Colleague support was similar in 2020 and in 202024-2025. For extended daily working hours, a significant difference was observed only in the pooled analysis of both professions (PR 0.76; 95 percent CI 0.73 to 0.80), but not within the individual categories (see Fig. 2). To see crude estimates, please see **Supplementary Figure S4**.

[Figure 2]

Associations of working conditions with depressive symptoms and suicidal thoughts did not differ in the direction of the effect across years, as displayed in Fig. 3. Exposure to physical violence showed the strongest estimates for association with both outcomes, with a PR up to 2.18 (95 percent CI 1.78 to 2.58) in the post-pandemic cohort for suicidal thoughts. Managing angry patients or relatives had a moderate to strong association, with PR estimates of 1.83 and 1.56 (2020 and 2024, respectively) for depressive symptoms, and 1.58 and 1.43 (2020 and 2024, respectively) for suicidal thoughts. As expected, colleague support proved to be a strong protective factor, with a reduced prevalence of both outcomes by almost 50% across years (PRs 0.51 to 0.55). Extended working hours displayed significant estimates only for the post-pandemic group in both depressive symptoms (PR 1.26; 95 percent CI 1.17 to 1.34) and suicidal thoughts (PR 1.15; 95 percent CI 1.03 to 1.27), but not for the pandemic cohort. Of note, all of these estimates had overlapping confidence intervals; thus, neither year showed a significantly stronger association for any of the models. For crude and profession-stratified estimates, please refer to the Online resource (**Supplementary Figures S5** to **S7**).

[Figure 3]

As a sensitivity analysis, we modelled working conditions as categorical variables to assess dose-response relationships with PHQ-9 scores (**Supplementary Table S10**). While effect directions remained consistent with our primary dichotomous models, this sensitivity analysis revealed significant moderation by the study year. Specifically, the year moderated the dose-response associations of working hours and colleague support with depressive symptoms. This was also the case for the association of colleague support with suicidal thoughts. Visual representations of these models are available in the **Supplementary Figures S8** and **S9**.

Discussion

This multi-country study provides evidence on the prevalence of depressive symptoms and suicidal thoughts among doctors and nurses across four European countries (the Czech Republic, Italy, the Netherlands, and Spain) during and after the COVID-19 pandemic. Over a five-year period (2020–2025), our results reveal that depressive symptoms and suicidal thoughts were significantly more prevalent in 2024–2025 compared to the initial pandemic outbreak in 2020–2021, and that potential risk and protective factors maintained strong associations across both time periods. These findings suggest that

the mental health crisis among healthcare professionals is not a transient pandemic-driven phenomenon but rather reflects persistent, underlying structural deficits in working conditions.

Today, the European region experiences a health workforce crisis characterised by significant shortages and poor working conditions often similar to those initially thought to be circumscribed to the COVID-19 pandemic (e.g., extended working hours, frequent night shifts, exposure to violent threats) [36]. Longitudinal data on the mental health of this population have remained scarce, with the largest existing European follow-up studies extending only through 2022. Such intra-pandemic assessments offer mixed results; some studies documented a cumulative mental health burden with prolonged stressor exposure [37], while others reported short-term reductions in acute psychological distress among healthcare workers following the initial COVID-19 surge [38], or limited change across pandemic waves [39]. In the absence of prospective cohort studies with longer follow-ups, repeated cross-sectional designs are the best choice to explore changes in the prevalence of mental health problems. Using two large, harmonised cohorts, we provide a direct comparison across a five-year span: depressive symptoms and suicidal thoughts increased significantly between 2020–2021 and 2024–2025. Our prevalence estimates are consistent with comparable studies in both time periods [11, 40–42], indirectly supporting our findings.

Our finding that depressive symptoms and suicidal thoughts prevalences have increased in the past five years are compatible with the hypothesis that occupational strain existed before the initial COVID-19 pandemic outbreak. In Europe, turnover intentions increased among nurses in the early 2000s [43] and persistently poor psychosocial work environments existed across the continent before 2020 [44]. In the United States, suicide mortality among nurses –but not doctors– increased between 2008 and 2019 [45]. Turnover intentions, working conditions, and elevated suicide mortality are all strongly linked to mental health problems [46–48]. Collectively, these findings point to a plausible increase in mental health problems during the pre-pandemic period, though this evidence remains indirect and large-scale mental health surveys from that era are unavailable.

The most plausible explanation for the increase in depressive symptoms and suicidal thoughts identified in our study is that what appeared to be pandemic-specific adverse working conditions actually reflected likely pre-existing structural deficits in European healthcare systems. A recent report by the World Health Organisation Regional Office for Europe demonstrated that poor working conditions –including increased working hours, frequent rotating shifts, and workplace violence– remain highly prevalent in the European Union in 2024–2025, driving high rates of turnover intentions and sick leave [11]. These structural deficits were likely amplified by acute pandemic-specific stressors, producing a cumulative occupational burden. The observed mental health prevalence contrast may reflect delayed clinical presentations driven by prolonged trauma exposure and allostatic overload [49] –trajectories previously observed among healthcare workers before [50] and during the COVID-19 pandemic [37].

Beyond the overarching psychological burden, our data reveal a critical temporal shift in the types of workplace hostility healthcare workers face. During the pandemic, our cohort was 60% more likely to

report experiencing physical violence. This aligns with previous literature documenting the high-pressure and panic-driven environment of the COVID-19 emergency [51]. Conversely, managing angry patients and relatives has become substantially more frequent in the post-pandemic era. This transition from physical violence to verbal hostility from patients and relatives is likely rooted in the systemic limitations experienced during the acute phase of the pandemic. Strict infection control measures, particularly visitor restrictions, severely limited families' access to hospitalised relatives. Simultaneously, patient demand frequently exceeded available infrastructure, leaving overburdened healthcare staff struggling to manage unprecedented volumes [52]. This physical separation, combined with the objective strain on care delivery, may have cultivated a perception among families that inadequate effort was being made to save their loved ones. As emerging literature suggests, this persistent strain on healthcare services has contributed to a continuous diminishment of public trust in healthcare professionals [53–55], possibly manifesting today as increased tension and hostility in post-pandemic clinical encounters.

Our findings reveal strong associations between workplace violence and mental health outcomes across both time periods. The prevalence of depressive symptoms increased by between 56% and more than 100% among individuals exposed to angry patients or relatives and physical violence, respectively, and was reduced by approximately 45% for individuals reporting support from colleagues. Associations with suicidal thoughts followed similar patterns, though with smaller effect sizes for workplace violence. Furthermore, while our data capture these specific relational shifts, it is highly probable that other unmeasured stressors, such as frequently working under tight deadlines or workplace bullying, are playing a synergistic role in driving the mental health deterioration observed in the post-pandemic cohort. These robust and stable associations across distinct time periods and gradient effects have two major implications. For research, the consistency of results highlights that these stressors are persistent occupational hazards rather than pandemic artifacts, underscoring the need for future longitudinal studies to establish definitive directional pathways. For policy, the stability of these associations indicates that organisational strategies to mitigate workplace violence and strengthen colleague support should be implemented routinely, not only during public health crises. Notably, colleague support showed the strongest protective effect in the post-pandemic period (2024–2025) compared to the pandemic period (2020–2021), suggesting this may be a particularly valuable lever for intervention in the current times [56–58].

A careful interpretation of our findings requires acknowledging several limitations. First, our repeated cross-sectional approach utilises data from two independent cohorts, which precludes causal inference. While we applied PSW to maximise comparability between cohorts and reduce confounding noise, the distinct contextual factors of each period and cohort may still influence participants' self-reported mental health. Most importantly, PSW does not account for unobserved confounding. Second, we cannot exclude reverse causation; however, models using discrete variables consistently show dose-response effects, demonstrating consistent relationships between exposures and depressive symptoms, partially mitigating this risk. Third, both cohorts utilised convenience sampling, and the absence of data on the distribution of the surveys precludes the calculation of exact response rates. We attempted to address potential selection bias by applying weighted analyses via IPW using stratified national workforce data.

Fourth, participation was voluntary, raising the possibility that doctors and nurses experiencing worse depressive symptoms were more or less motivated to respond. While this could inflate our prevalence estimates, the use of a validated screening tool across all four countries helps mitigate the severity of self-selection bias. Finally, despite performing weighted calibrated sensitivity analyses, the results may not be entirely representative of the broader healthcare workforce in the participating countries.

In summary, this multi-country study provides evidence reinforcing the potential pathways identified at the broader European level for the deterioration of healthcare workers' mental health beyond the acute COVID-19 emergency. By demonstrating highly consistent, dose-response associations between shifting occupational exposures and depressive symptoms, including suicidal ideation, our findings confirm that this crisis is not a pandemic artifact, but rather a symptom of a deeply rooted systemic situation. Moving forward, it is critical to abandon the assumption that the workforce mental health burden will naturally resolve post-crisis. Addressing these vulnerabilities demands a prompt, structural response. Actionable initiatives must proactively optimise modifiable working conditions and prioritise accessible mental health support services for healthcare personnel. Crucially, healthcare systems must complement individual-level interventions with actionable, organisational-level strategies [48, 59]. Evidence-based systemic changes have been proven effective in mitigating occupational stress, and successful adaptations of these frameworks have been implemented in healthcare settings [60, 61]. Ultimately, safeguarding the psychological well-being of the health workforce is not purely an occupational duty, but the foundational requirement for ensuring resilient and sustainable healthcare delivery for the general population.

Abbreviations

CI Confidence interval

COVID-19 Coronavirus Disease of 2019

DSM-5 Diagnostic and Statistical Manual of Mental Disorders, 5th edition

HEROES COVID-19 HEalth caRe wOrkErS study

EU European Union

IPW Inverse Probability Weighting

MeND Mental Health of Nurses and Doctors survey

PHQ-9 Patient Health Questionnaire-9

PR Prevalence Ratio

PSW Propensity Score Weighting

SD Standard deviation

STROBE STrengthening the Reporting of OBservational studies in Epidemiology

WHO World Health Organization

Declarations

Ethics approval and consent to participate

This study was performed in line with the principles of the Declaration of Helsinki. Approval for the HEROES study was granted by the Ethics Committee of the Azienda Mista Ospedaliero-Universitaria of Cagliari, Italy; the Hospital La Paz Ethics Committee in Madrid, Spain; the Medical Ethical Boards of the Maastricht University Medical Center and the Amsterdam Medical Center, the Netherlands; and the Ethics Committee of the Czech Ministry of Health and Ethical Review Board of the University Hospital Motol, Prague, Czech Republic. Approval for the MeND survey was granted by the Ethics Committee of the Universidad Autónoma de Madrid (Identifier: CEI-141-3158).

Informed consent was obtained from all individual participants at all sites for the HEROES study. The requirement for formal written informed consent was waived by the Ethics Committee at the Universidad Autónoma de Madrid (Spain) for the MeND survey as the study consisted of an anonymous online questionnaire.

Consent for publication

Not applicable.

Competing interests

All authors certify that they have no affiliations with or involvement in any organisation or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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Author Contribution

VA-G: Conceptualisation, Data curation, Formal analysis, Investigation, Methodology, Software, Visualisation, Writing – original draft. DC, NS, MFM, JS, GMA, EV, MGC, IM-M, BM-K: Investigation, Resources, Writing – review & editing. TZ: Resources, Supervision, Writing – review & editing. LL: Funding acquisition, Resources, Supervision; CR: Investigation, Project administration, Resources, Writing – review & editing; ML: Investigation, Project administration, Resources, Writing – review & editing; CV: Data curation, Writing – review & editing; PA: Writing – review & editing. JLA-M: Funding acquisition, Resources, Writing – review & editing. RM: Conceptualisation, Methodology, Validation, Investigation, Resources, Data curation, Writing – review & editing, Supervision, Project administration, Funding acquisition.

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Data Availability

The data cannot be shared publicly due to the sensitive nature of the context in which they were collected. Reduced, anonymised versions of the datasets will be made available by the corresponding author upon reasonable request. The statistical analysis code is available on GitHub (https://github.com/CCOMS-UAM/mend-heroes-pub).

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Figures

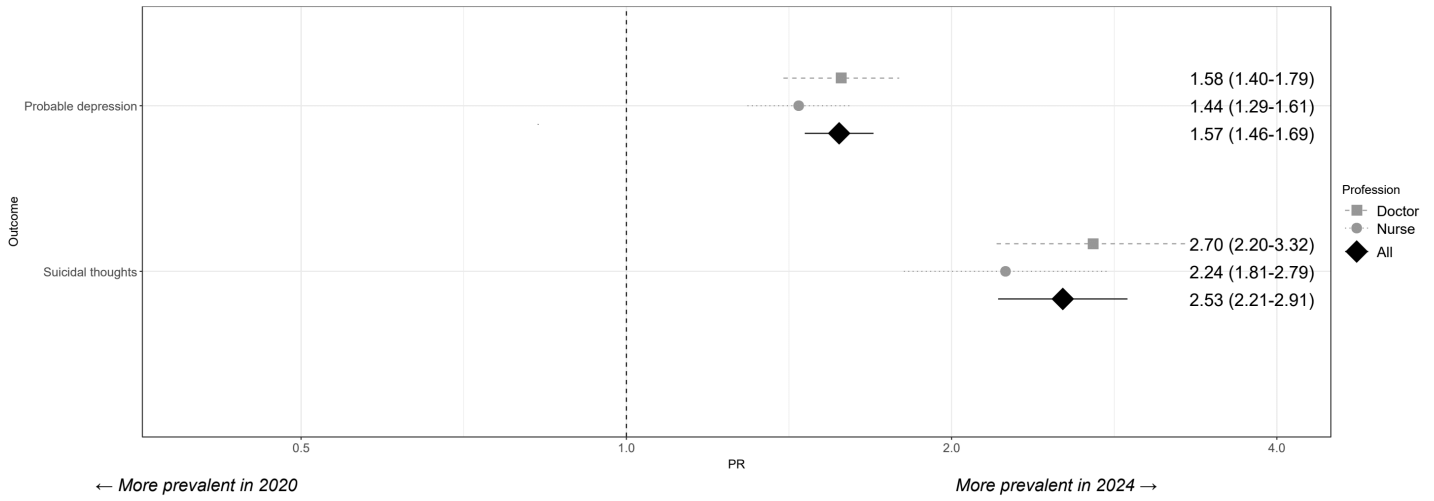


Figure 1

Prevalence of depressive symptoms and suicidal thoughts over time. Prevalence Ratios (PRs) and 95 percent confidence intervals obtained from modified Poisson regression models adjusted for country (fixed effects), age group, gender, profession, presence of children in the household, and healthcare sector. PRs < 1 indicate higher prevalence rates in the pandemic cohort and PRs > 1 indicate higher prevalences in the post-pandemic cohort.

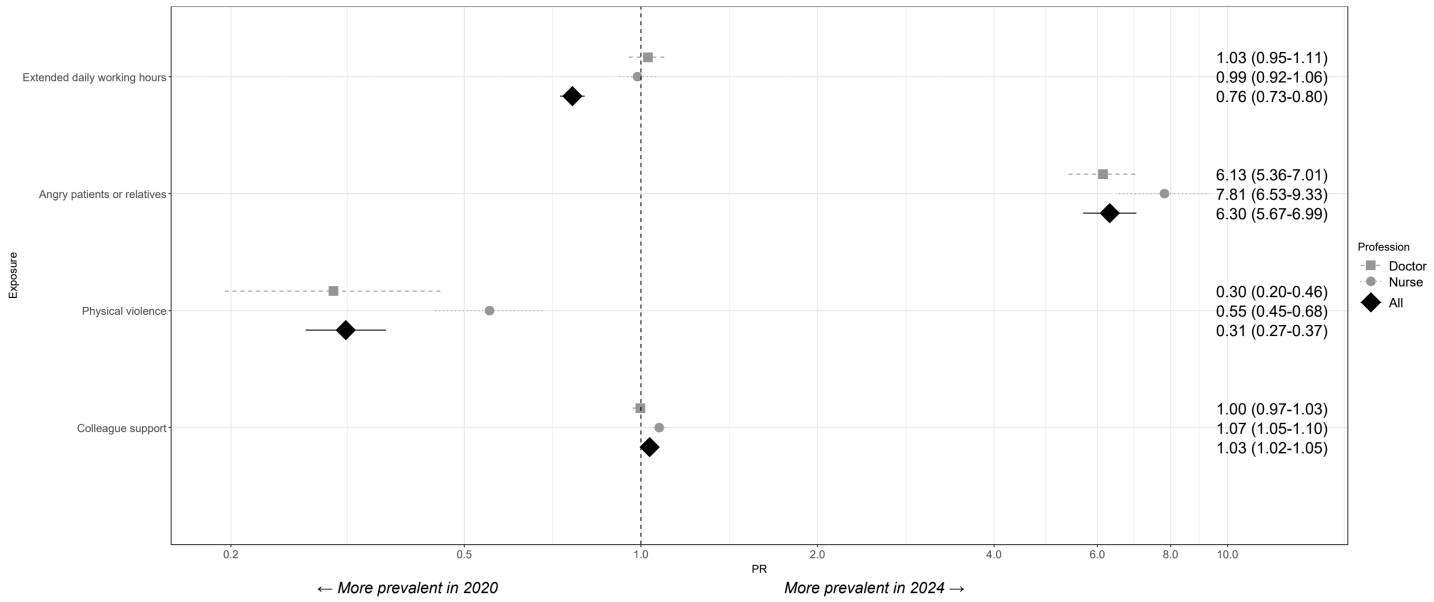


Figure 2

Prevalence of reported working conditions over time. Prevalence Ratios (PRs) and 95 percent confidence intervals obtained from modified Poisson regression models adjusted for country (fixed effects), age group, gender, profession, presence of children in the household, and healthcare sector for daily working hours and colleague support, and for country (fixed effects), age group, gender, profession, and healthcare sector for angry patients or relatives and physical violence. PRs < 1 indicate higher

prevalence rates in the pandemic cohort and PRs > 1 indicate higher prevalence rates in the post-pandemic cohort.

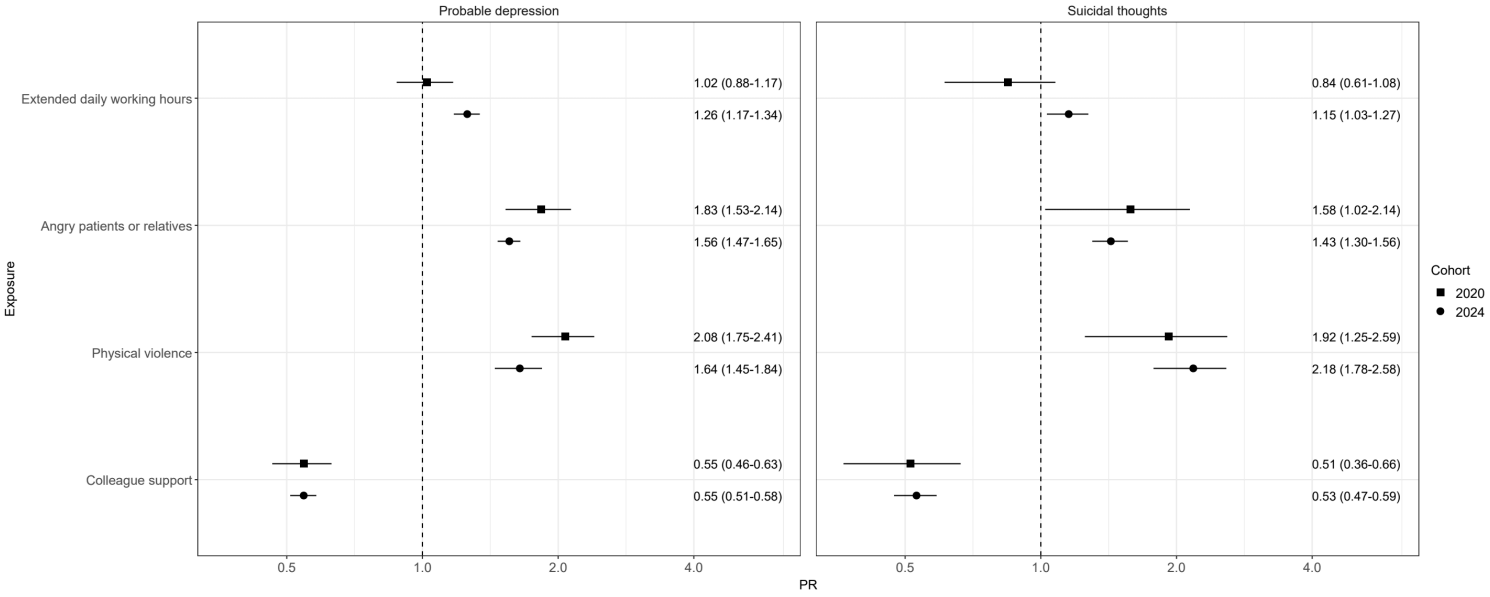


Figure 3

Associations between working conditions and depressive symptoms and suicidal thoughts. Prevalence Ratio (PR) estimates and their 95 percent confidence intervals for both professions from exposure-outcome association models, stratified by year. Models were adjusted for country (fixed effects), age group, gender, profession, presence of children in the household, and healthcare sector for daily working hours and colleague support, and for country (fixed effects), age group, gender, profession, and healthcare sector for angry patients or relatives and physical violence.

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