**Depression in healthcare workers: results from the nationwide AMADEUS survey.**

Running title: professional and individual factors and depression in healthcare workers

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**Contribution of the Paper**

What is already known on the topic?

- Depression prevalence is high among physicians but little is known for other healthcare workers

- Work environment may impact the risk of depression, but little is known on the role of professional factors, individual factors and health risk behaviour

What this paper adds

- the prevalence of depression was estimated at 30% in a nationwide survey of more than 10000 healthcare workers.

- Depression was associated with professional, individual and health-related risk behaviours

- Preventing, and actively managing, depression in healthcare settings is therefore a priority.

**Abstract**

Background. There is now a wealth of evidence showing that work is a major determinant of physical and mental health. Recent studies have suggested increased rates of depression in healthcare workers (HCWs) in the context of the Covid-19 pandemics, with direct impact on care quality and productivity.

Aim. To determine the rate of clinical depression in a national sample of HCWs in France during the post-Covid-19 area and to identify related factors (professional, individual and health-related risk behaviours) using a structural equation modelling analysis.

Method. A survey comprising of a number of standardized scales was sent to public and private national healthcare facilities through the mail or disseminated through emails from professional associations and social networks.

Results. 10325 participants were recruited; 3122 (30.2%, 95% confidence interval[29.4-31.1]) met likely diagnostic criteria for clinical depression. Professional factors had the largest total effect (β=0.57) (burn-out :β=0.74, sustained bullying at the workplace β=0.48 and decision-making latitude β=-0.47). followed by individual factors (β=0.30) (the main individual factor was recurrent major depression, path coefficient = 0.67).

Professional factors had both direct (path coefficient = 0.38) and indirect (through health risk behaviours, path coefficient = 0.19) effect on depression. Individual factors had a direct (path coefficient 0.21) and indirect (through health risk behaviours (path coefficient = 0.09) effect on depression. Health risk behaviours had a direct effect on depression (path coefficient = 0.31).

Interpretation. These results provide potential explanations for the likely causes of poor psychological health amongst HCWs. We propose several potential interventions related to professional factors and health risk behaviours. Our results suggest that improving organizational issues, reducing exposure to potentially morally injurious events, promoting brief naps at work and provision of evidence-based prevention approaches have been reported to be helpful in supporting the mental health of hospital staff (not only relaxation or stress management but training in leadership aspects, increasing the knowledge and practice of giving efficient performance feedback, reducing conflicting demands and peer support programs such as Trauma Risk Management. Our data suggest that developing caregivers reported experience and outcomes measures (CREMs/CROMs) would be helpful to monitor work environment and its effect on depression in healthcare workers.

**Keywords:** mental health; psychiatry; public health; health services research; depression; depressive disorders.

**1. Introduction**

The World Health Organization recognizes work as a major social determinant of physical and mental health (World Health Organization, 2021a). Job-related factors such as wages, work hours, workload, interactions with co-workers and supervisors, and access to paid leave impact the well-being of workers, their families, and their communities (CDC, 2021).

The Diagnostic and Statistical Manual of mental disorders (5th ed. – DSM-5) outlines the following criterion to make a diagnosis of depression(American Psychiatric Association., 2013). The individual must be experiencing five or more symptoms during the same 2-week period and at least one of the symptoms should be either (1) depressed mood or (2) loss of interest or pleasure. The first-wave Covid-19 pandemics has been followed by a wave of meta-analyses reporting high rates of depression in healthcare workers (Kunzler et al., 2021; Li et al., 2021; Marvaldi et al., 2021; Olaya et al., 2021; Pappa et al., 2020; Salari et al., 2020). Approximately 25% of nurses and 24% of physicians were found to be depressed in a recent survey (Olaya et al., 2021). However, this phenomenon was not new as previous studies already reported increased risks of depression in HCWs. The first concern was raised regarding young physicians/residents who were found to have a depression rate of 20.9% - 43.2% depending upon the measurement tool used (Fond et al., 2021a; Mata et al., 2015). An increase trend of 0.5% per year was reported from 2015 (Mata et al., 2015) associated with increased absenteeism, decreased productivity and quality of care (Evans-Lacko and Knapp, 2016; Johnston et al., 2019; Pranjic and Males-Bilic, 2014; Rost et al., 2004). The authors concluded that this population was at risk of work-induced depression due to specific professional factors. We need now to determine the factors that could help identify the most effective levers to curb this phenomenon.

We know that unfavourable professional factors increase the risk of depression onset. Professional factors have worsened since the 2008 financial crisis due to increased economic constraints(Boyer et al., 2016; Clemens et al., 2014; Fernández Castañer et al., 2018). However, we do not know if the public sector has been affected to a similar level as the private sector(Ervasti et al., 2017). We do however know that work environment (including speed/quantity, complexity/intensity, fragmentation/unpredictability, decision latitude and social support) (Enns et al., 2015; Gi et al., 2011; Huang et al., 2022; Power et al., 2020; Tsutsumi et al., 2001), absenteeism/presenteeism(Dyrbye et al., 2019; Enns et al., 2015), sustained bullying at the workplace (Messiaen et al., 2020), sexual harassment (Duba et al., 2020a) and sexual orientation-based discrimination (Duba et al., 2020b) have also been associated with increased risk of depression in physicians. The role of burnout has been debated with some authors highlighting a causal role in the onset of depression (Karin Anne Peter et al., 2020; Karin A. Peter et al., 2020; Rudman et al., 2020) with overlap between burnout and depression (Bianchi et al., 2015). We don’t know if full-time jobs are at increased risk of depression due to increased exposure to these factors, and if random schedules or working longer than expected may increase the risk of depression. A recent meta-analysis has concluded that night shift work was associated with increased risk of depression in HCWs (Lee et al., 2017). The authors mentioned the need for additional large-scale studies. Since then, two studies have been published concluding to negative results (Angerer et al., 2017; Behrens et al., 2021).

It is likely that individual factors and health risk behaviours also play an important, yet often neglected, role the onset of depression and furthermore it is likely that all HCWs have not the same vulnerability to depression. For instance, other evidence shows that depression is more frequent in women (Morssinkhof et al., 2020) and in family caregivers or people with chronic illness (Irwin et al., 2013; Liew et al., 2019). Having children has been associated with increased turnover in HCWs (Daouda et al., 2021) but its potential association with depression has not been explored in HCWs thus far and we don’t know if the presence of a partner at home may also influence depression risk(Andersson et al., 2022). Chronic illnesses increase the risk of depression(Asselmann et al., 2019; Ervasti et al., 2014; Pan et al., 2012) but are poorly included as explaining or confounding factors in studies including healthcare professionals. Also, while recurrent depressive disorder is classified in the International Classification of Diseases, this psychiatric vulnerability is poorly reported in studies exploring depression in HCWs thus far.

It is now well established that health risk behaviours (including overweight/obesity, tobacco smoking, hazardous drinking, insufficient physical activity and sleep reduction) are associated with increased risk of depression in HCWs (Bourbon et al., 2019; Choi et al., 2019; Fond et al., 2021b; Marvaldi et al., 2021; Pan et al., 2012; Yao et al., 2020). These behaviours need to be evaluated as they may guide prevention and more effective interventions.

Thus, whilst we know that professional, individual factors and health risk behaviours are associated with increased depression in HCWs, but we do not yet know the interdependent relationships among them. This understanding is needed to guide prevention and tailor efficient interventions for depression. We used structural equation modeling (SEM), which is a useful statistical procedure, to test a theory involving non-straightforward relationships and is therefore well suited to the management of cross-sectional data for inferential purposes (Falissard, 2019).

The objective of the present study was to measure the depression prevalence in HCWs in the post-Covid-19 era and to determine its association with professional and individual factors and health risk behaviours.

**2. Population and methods**

**2.1 Study population**

Design. The AMADEUS (« AMéliorer l’ADaptation à l’Emploi pour limiter la soUffrance des Soignants »/ « improve employment adaptation to limit HCWs suffering ») study is a cross-sectional survey carried out in French public and private healthcare facilities at a national level in France between 2021 May 2 and 2021 June 30th. This survey was supported by professional healthcare worker associations and the directions of the healthcare settings in which the survey was disseminated. The detailed protocol has been previously published (Lucas et al., 2021).

*Recruitment and sampling method.* The participants were contacted through public and private facilities and professional associations by professional mailings and through social networks. All professional associations were contacted by email, and all regional health agencies, Territory hospital groups (*Groupements hospitaliers de territoire* /GHT including regional networks of academic and non-academic public hospitals) were contacted by phone to increase participation rates. The recruitment process is described in **Supplementary table 1.**

*Inclusion criteria.* The participants were graduated HCWs currently working in a French public or private health facility. The detailed list of the professions included in the study is presented in Supplementary Table 1.

*Exclusion criteria.* As the purpose was to evaluate work environment, HCWs working in their private office were not included.

**2.2 Collected data**

*Major depression*

The Center for Epidemiologic Studies- Depression Scale (CES-D) (Van Dam and Earleywine, 2011) was used in its French version to determine major depression risk. The CES-D is a 20-item self-reported questionnaire that has been specifically developed to assess self-reported depressive symptoms during the past week in large-scale / non clinical populations. Possible range of scores is zero to 60, with the higher scores indicating the presence of higher depressive symptomatology. A probable depression is defined by a score ≥17 in men and ≥23 in women (Fuhrer and Rouillon, 1989). CES-D has shown satisfactory psychometric properties (sensitivity of .853 and a specificity of .859) and reliability(Morin et al., 2011).

*Professional factors*

The following work characteristics were reported as binary variables: Public sector vs. private sector, Full-time job, Night shift work, Random schedules (defined by the true working schedule being different to the roster over the last two weeks), working longer than expected at least once a week.

Work environment was explored with the Job Content Questionnaire (Niedhammer, 2002). The ten dimensions, explored by 26 items were reported as continuous scores: speed and quantity (3 items), complexity and intensity (3 items), fragmentation and unpredictability (3 items), decision-making latitude (3 items), use of skills (3 items), skill development (3 items), professional support by superiors (2 items), professional support by colleagues (2 items), emotional support by superiors (2 items), emotional support by colleagues (2 items). Higher scores were associated with poorer work conditions except for Decision-making latitude, Use of skills and Skills development. All factor dimensions had a satisfactory Cronbach alpha ≥0.65 (Niedhammer et al., 2006). Convergent validity tests confirmed the expected association with key variables, age, work status, sector of activity, occupation, job satisfaction, perception of job stress, and intent to change job (Niedhammer et al., 2006). Burnout syndrome was defined as a binary variable using the French version of the 22-item Maslach Burnout Inventory (MBI) scale(Maslach et al., 2001). This 22-item scale has shown satisfactory psychometric properties(Langevin, 2012). The Cronbach alpha coefficients for the three dimensions of the MBI are superior to 0.70 (emotional exhaustion (9 items): 0.90, depersonalization (5 items) 0.79, personal accomplishment (8 items) 0.71) (Langevin, 2012). The stability coefficients are 0.82 and 0.80 at respectively 2-4 weeks and one year (Langevin, 2012). Burnout as measured by the MBI was used as a binary variable defined as recommended by the authors by the presence of at least one of the three dimensions of burnout, according to the cut-off scores of each dimension (≥30 for emotional exhaustion, ≥12 for depersonalization and ≥40 for personal accomplishment) (Maslach et al., 2001). Absenteeism was defined using the following question “What is your number of unworked days (except holidays) during the last 12 months?”. The participants reporting ≥8 unworked days (to exclude short-time unworked days due to benign infections or accidents) were classified in the absenteeism group.

History of lifetime sustained bullying at work, sexual harassment and sexual-based orientation discrimination were explored using the definitions of the French law used in our previous studies (Duba et al., 2020b, 2020c, 2020a; Messiaen et al., 2021, 2020) and reported as binary variables.

*Individual factors*

Age was reported as continuous variable (years). The following binary variables were reported: sex, presence of a partner at home, presence of children at home, being a family caregiver (defined as a person who provides regular direct support to another person for self-care, administrative management or other activities of daily living), history of recurrent major depression (defined by history of 3 or more lifetime major depressive episodes including the potential current one), having an ongoing chronic illness (defined by requiring long-term treatment).

*Health risk behaviours*

The following health risk behaviours were reported as binary variables: Overweight/obesity (defined by body mass index ≥25 kg/m2) as a proxy for both poor diet habits, hard smoking (defined by daily tobacco smoking≥20 cigarettes/day), hazardous drinking (defined by a CAGE questionnaire score ≥2 (Rueff et al., 1989)), and moderate to vigorous physical activity using six items of the International Physical Activity Questionnaire (IPAQ) in its French version (Crinière et al., 2011)). IPAQ is the most widely used questionnaire to capture physical activity(World Health Organization, 2021b) with Cronbach's α = 0.73 (Mannocci et al., 2010). In this questionnaire, the weekly duration of physical activity was self-reported by 6 items evaluating the intensity, duration and weekly frequency of 3 levels of physical activity: mild, moderate and intense level)(Mannocci et al., 2010). A weekly duration ≥150 min of moderate-vigorous physical activity was classified as adequate physical activity level based on the World Health Organization recommendations(World Health Organization, 2021b). Mean sleep duration (hours) was reported as a continuous variable using the dedicated item of the Pittsburgh Sleep Quality Index (PSQI) in its French version (Ait-Aoudia et al., 2013). The 10-items PSQI has shown satisfactory validity and reliability with an Cronbach's α = 0.73 and with good convergent validity with emotional problems (moderate-to-large positive correlations with CES-D, r = 0.58) (Blais et al., 1997; Raniti et al., 2018).

Geographical coverage. To ensure correct geographical coverage, the postal code was reported. The postal codes were gathered by region Auvergne-Rhône-Alpes, Bourgogne-Franche-Comté, Bretagne, Centre-Val de Loire, Corse, Grand Est, Hauts-de-France, Ile-de-France, Normandie, Nouvelle-Aquitaine, Occitanie, Pays de la Loire, Provence-Alpes-Côte d’Azur.

**2.3 Statistical analysis**

All variables were presented using measures of means and dispersion (standard deviation) for continuous data and frequency distribution for categorical variables. Comparisons between HCWs with depression and those without were carried out using the chi-square test for categorical variables. All continuous variables were analysed with Student t-tests for normally distributed data. As detailed in the rationale, the present study was hypothesis-driven, no correction for multiple testing has been therefore carried out (Bender and Lange, 2001).

Multivariate logistic regression models were employed to determine which factors were associated with increased risk of depression. The variables associated with depression with a p value <0.20 in the univariate analyses were included in the multivariate model.

A SEM based on a theoretical model was performed to identify the direct, indirect and total effects of associated factors with depression as identified by multivariate logistic regression. We also examined the possibility of omitted pathways using the relatively large modification indices (>80). These modifications were included in a refined model only if they made sense theoretically and if they and did not affect our a priori assumptions. Based on our previous works on medical students (Duba et al., 2020a, 2020b; Messiaen et al., 2020), our hypothesis stated that each factor category (professional factors, individual factors and health risk behaviours) had a direct effect on the risk of depression and that professional and individual factors had an indirect effect through health risk behaviours (the theoretical model is presented in **Supplementary Figure 1**). Because there has been a longstanding debate as to whether burnout is a cause of depression, or a cause of other relevant mental health problems, in HCWs, a sensitivity analysis was carried out excluding burnout from the model to determine if the other estimates were robust. Standardized path coefficients (β) and 95% confidence intervals (CI) were reported. The weighted least squares means and variance adjusted (WLSMV) robust estimator was used since it is recommended for modelling latent factors with both categorical (binary and ordinal) and continuous variables, even if they are not normally distributed. The Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA) and the Standardized Root Mean Square Residual (SRMR) were used to assess the general fit of the models. A CFI and TLI ≥ 0.90, a RMSEA ≤ 0.08 and a SRMR ≤ 0.08 indicate a good model fit (Hu and Bentler, 1999). In addition to the statistical significance of the path coefficients, the strength of the relationship plays a role in determining whether the relationships are weak (<0.2), moderate (0.2–0.5) or strong (>0.5)(Cohen, 1988). This analysis was performed with R software, using Lavaan package (Rosseel, 2012).

**2.4 Ethical considerations**

The study was carried out in accordance with ethical principles for medical research involving humans (WMA, Declaration of Helsinki) and the French Jardé law. Ethical considerations. This survey was approved by the National Ethical Committee (IRB n°C08 / 21.01.06.93911, CNIL). All data was collected anonymously. As this study was voluntary and anonymous, no written informed consent was required and the participants were informed that clicking on the first page of the questionnaire was equivalent to giving their consent to participate. They were also informed that they could stop the survey and remove their participation at any time.

**2.5 Funding**

No funding.

**3. Results**

10,325 HCWs were recruited (1969(19.1%) physicians, 1768(17.1%) health executives, 2819(27.3%) nurses, 847(8.2%) assistant nurses and 2922 (28.3%) other allied health professionals (AHP)). The mean age was 42.3years (standard deviation (SD): 10.84), 1989(19.3%) were men. 3122(30.2%)(95% confidence interval: [29.4%-31.1%]) reported CES-D scores consistent with probable depression with relative consistency across groups (physicians 627(31.8%), health executives 572(32.4%), nurses 825(29.3%), nurse assistants 246(29.0%)). The Cronbach's α coefficient was high for the CES-D (α=0.93), PSQI (α=0.75), as well as for the MBI burnout dimensions (emotional exhaustion α=0.91, personal accomplishment α=0.77, depersonalization α=0.72) and for the three axes of the job environment JCQ scale (psychological demand α=0.77, decision latitude α=0.62 and social support α=0.75). The detailed depression proportions, and the sociodemographic characteristics of each profession are presented in **Table 1**. Most of the depression rates ranked between 18% and 43%. The mean age was relatively homogenous across professions (approximately 40 years+/- 5years, except for health executives and directors who were older (approximately 49-50 years). This age is comparable to the French general population (mean aged 42 years)(INSEE, 2022). All professions had a majority of women except for ambulance drivers consistently with the general sex ratio of healthcare professionals in France(Bessière, 2005).

The geographical coverage of the survey was satisfactory and presented in **Figure 1**. All regional territories were represented with effectives between 251 and 1573, consistently with the demographic repartition of the general population in France.

When the 95% confidence intervals of the adjusted odds ratio are strictly superior to 1, the factor is considered to be significantly associated with an increased risk of depression (with no causal relationship, given the cross-sectional nature of our data). The following variables were included in the multivariate analysis (**Table 2**): Age (years), Sex(man), Public sector vs. private sector, Full-time job, Random schedules, Working longer than expected at least once a week, High psychological demand, Low decision-making latitude, Poor superiors’ and colleagues’ professional and emotional support at work, Burnout, Absenteeism, Sustained bullying at the workplace, Sexual harassment exposure, Sexual orientation-based discrimination, Partner at home, Children at home, Family caregiver, History of recurrent major depression, Having a chronic illness, Overweight/obesity, Hard smoking, Hazardous drinking, Moderate to vigorous physical activity, Sleep reduction. In multivariate analyses, increased risk of depression was associated with professional factors (high complexity/intensity adjusted odds ratio, high fragmentation/ unpredictability, low decision-making latitude, low emotional support by colleagues, random schedules, working longer than expected at least once a week, sustained bullying at the workplace, burnout and absenteeism). No department and no professional category was significantly associated with depression in multivariate analyses (p>0.05, data not shown). Demographic factors associated with increased risk of depression included older age, male sex, absence of a partner at home, being family caregiver and a history of recurrent major depression. Among health risk behaviours, increased risk of depression was associated with heavy smoking, hazardous drinking, moderate to high physical activity and sleep reduction.

The original theoretical model did not provide an adequate fit (χ²(165)=6658.044, p<0.001, CFI=0.710, TLI=0.666, RMSEA=0.06295%CI [0.061-0.063], and SRMR=0.081). Modification indices suggested theoretically relevant associations, and their inclusion, improved model fit (χ²(151)=1834.492, p<0.001, CFI=0.925, TLI=0.905, RMSEA=0.033 95%CI [0.032-0.034], and SRMR=0.046). The SEM model is presented in Figure 2 and the standardized coefficients of the residual covariances that were added to the model based on the modification indices are presented in Supplementary Table 3.

Professional factors had the largest total effect (β=0.57, 95%CI[0.51,0.63], p<0.001) followed by individual factors (β=0.30, 95%CI[0.23,0.37], p=0.005).

All factors included in the model had a direct effect on depression risk with professional factors having the strongest association (professional factor: β=0.38, 95%CI[0.27,0.48], p<0.001, health risk behaviours: β=0.31, 95%CI[0.17,0.45], p<0.001, individual factor: β=0.21, 95%CI[0.13,0.30], p=0.011).

Professional and individual factors had also an indirect effect, with professional factors having again the strongest indirect effect (professional factors: β=0.19, 95%CI[0.09,0.30], p=0.001, individual factors β=0.09, 95%CI[0.04,0.14], p=0.025).

The main professional factors involved were burn-out (β=0.74, 95%CI[0.72,0.76], p<0.001), sustained bullying at the workplace (β=0.48, 95%CI[0.45,0.50], p<0.001) and decision-making latitude (β=-0.47, 95%CI[-0.49,-0.45], p<0.001).

After excluding burnout from the model (χ²(133)=1551.762, p<0.001, CFI=0.921, TLI=0.898, RMSEA=0.032 95%CI [0.031-0.034], and SRMR=0.046), the other estimates remained robust: all factors included in the model had a direct effect on depression risk with professional factors having the strongest association (professional factor: β=0.27, 95%CI[0.15,0.39], p<0.001, Health risk behaviours: β=0.35, 95%CI[0.20,0.51], p<0.001, individual factor: β=0.26, 95%CI[0.17,0.35], p<0.001). Professional and individual factors had also an indirect effect, with professional factors having again the strongest indirect effect (professional factors: β=0.22, 95%CI[0.10,0.34], p<0.001, individual factors β=0.09, 95%CI[0.04,0.15], p=0.001).

**4. Discussion**

This study identified a high rate of depression in all categories of HCWs (between 29 and 32%). Our SEM revealed moderate associations between depression and professional factors (mainly complexity/intensity, fragmentation/unpredictability, decision-making latitude), individual factors (mainly history of recurrent major depression) and health risk behaviours. Individual factors had the strongest effect. We also identified weak, but significant, indirect relationships between respectively professional and individual factors and depression through health risk behaviours. Among professional factors, burnout, sustained bullying at the workplace and low decision-making latitude had the strongest associations with depression, with burnout having the strongest associated. However, all other estimates remained robust after excluding burnout, suggesting that burnout is a distinct risk factor for depression.

Our finding that near one third of HCWs are likely to be suffering from depression, regardless of their role, is somewhat alarming. Based on our results for nurses and physicians, we found higher rates of depression compared to those reported in the most recent meta-analysis published in 2021 (29.3% vs. 24%, for nurses and 31.8% vs 25% for physicians) (Olaya et al., 2021). Whilst the mental wellbeing of HCWs has always been seen as important, this need has been reinforced by the central role of these staff in dealing with the Covid-19 crisis (Arnaez et al., 2020; Azoulay et al., 2021; Kunzler et al., 2021; Li et al., 2021; Stockton et al., 2020). Our results suggest that high rates of depression are likely to continue to impact on healthcare staff’s ability to deliver effective care which is concerning given that the pandemic is far from over. We know that depression has a strong impact on productivity, absenteeism (Asami et al., 2014; Baker et al., 2020; Beck et al., 2011) and quality of patient care. In 2014, a US population-based study already reported 10% of significant medical errors and 6% of suicidal ideations in physicians (Patel et al., 2018).

Our result thus suggests that the deployment of various wellbeing programs in hospitals have not been enough to curb the epidemic of depression among caregivers. Our results may explain in part this phenomenon. Whilst most wellbeing programs target health risk behaviours (e.g. healthy food options, gym membership discounts, on-site exercise facilities, smoking cessation program, personal health coaching, classes in nutrition or healthy living, web-based resources for healthy living and tobacco-free campus) (HPOE, 2016), our results have shown that health risk behaviours have only a moderate effect on depression. Second, these interventions may not be always suitable for HCWs. Providing gym discounts or on-site exercise facilities may not be suitable for exhausted employees, or employees who lack leisure time and already spend a lot of time at the workplace. Time constraints do not always allow HCWs to eat well and collective catering is not always compatible with food quality. Moreover, many healthcare staff will have been discouraged from collective meetings to eat food etc. because of fears of spreading covid when de-masked. Healthy food is expensive and not always suited for employees with low income (such as assistant nurses). Additionally, as yet the effectiveness of tobacco cessation programs in HCWs is poorly evaluated. It is also notable that encouraging staff to take brief naps at work is often absent from these programs despite evidence that this may improve productivity and decrease exhaustion (Martin-Gill et al., 2018).

Some of these interventions have targeted work environment, e.g., enhancing managerial skills of primary care workers’ supervisors, such as training in leadership aspects, increasing the knowledge and practice of giving efficient performance feedback and reducing conflicting demands. These programs are poorly developed and evaluated thus far in France. Moreover, our results suggest that emotional and professional supports from superiors is less likely to decrease depression than the provision of emotional support from colleagues. Targeting inter-colleagues support may therefore be a more effective strategy and peer support programmes such as TRiM (trauma risk management) have been reported to be helpful in supporting the mental health of hospital staff(Flaherty and O’Neil, 2021). This is supported by the findings of previous studies (Aziah et al., 2004; Kojima et al., 2003; Stansfeld et al., 2012).

Our results suggest that improving work organization may have the best effect to prevent depression and thus ensuring that the organization, planning and coordination of care is done to a high standard is likely to help. However, many eventualities cannot be planned for including absenteeism which is very common in this population (Cappelletti and Savall, 2018) and is likely, in part at least, to be due to mental ill-health including depression. Burnout and sustained bullying at the workplace had the strongest associations with depression among professional factors in our results, their high prevalence in HCWs is questionable. Burnout is not recognized as a diagnosis in the current version of the International Classification of Diseases and is not recognized as occupational disease thus far. However, sustained bullying at the workplace is penally punished in France for more than twenty years. A much lower prevalence of sustained bullying at the workplace would therefore be expected. Our previous study also found a prevalence of approximately 40% of sustained bullying at the workplace in residents (Messiaen et al., 2020). Preventing this endemic phenomenon is therefore a crucial point in the prevention and care of depression in HCWs. Our negative results have also yielded important information. For example, our results are in favor of an absence of association between nightshift work and depression (Angerer et al., 2017; Behrens et al., 2021).

It is also likely that providing staff with a mechanism to check on their own mental health may be useful; however, it is unlikely that formal mental health screening for depression amongst the workforce will be effective(Rona et al., 2017). Also, providing easy access to evidence-based care may be one of the most effective interventions to manage depression in HCWs, especially for those with recurrent major depressive disorder. We also identified family caregivers are more vulnerable, yet at a lesser extent. However, depression remains a taboo and HCWs may be afraid of the stigmatization associated with depression (Arnaez et al., 2020; Doty et al., 2021).

We consider that developing caregivers-reported experience and outcomes measures (CREMs/CROMs) is now a priority to monitor work environments and health, following the patient-reported experience and outcome measures (PREMs/PROMs) models (Fernandes et al., 2020). There may also be value in developing personalized psychotherapies (like interpersonal psychotherapy) or group therapies (like mindfulness, resiliency training and self-acceptance interventions) so they can be used with HCWs at risk of depression; however, it is important to evaluate if such interventions are effective (Doty et al., 2021; Niedermoser et al., 2020; Rost et al., 2005; Schramm et al., 2020; Stockton et al., 2020).

*Strengths.* This sample is the largest sample of HCWs recruited in Western countries enabling the inclusion of multiple confounding factors. Our sample was representative of the whole healthcare population in terms of age, sex and geographical distribution. The proportion of women among nurses in France in 2011 was 86% vs. 87% in our study and the mean age 38.9 years in the whole population vs. 39.8 years in our study (Barlet, 2011). Sociodemographic variables have been included in adjustment factors and in the SEM model. The absence of missing data due to the web questionnaire is a strength of the quality of the present variables. This study is the first study combining the association of professional, individual and health risk behaviours factors and exploring the post-Covid-19 depression prevalence in HCWs. The SEM enables us to discriminate direct from indirect factors, confirming the direct association of these factors with depression. The participation bias was limited as the title of the survey did not mention depression, and our rate may be underestimated as employees who were off work were unable to receive the study.

*Limitations and perspectives.* The limits of this study are similar to those affecting other online surveys. With a cross-sectional design, no causal relationship can be drawn. We cannot calculate the accurate participation rate as the study was disseminated by the health directors of each facility and we cannot totally exclude sampling bias. The proportion of participants was not the same in nurses and health executives (health executives : 1486/6725=22.1% vs. nurses 2538 /479,836=0.5% (DRESS, 2022)). The dissemination of the study in nurses and nurse assistants was less effective due to the lack of use of professional mailing in these professions in some facilities. However, to increase geographical exhaustivity, the survey was disseminated through social networks and our geographical coverage seems satisfactory. To limit the selection bias, the title of the study did not mention burnout or depression but work adaptation. On the contrary, we may have underestimated depression as all participants off work for depression, burnout or other causes did not receive the mail by professional mailings. We have disseminated this survey at different timepoints to reach these participants. Some professions were more represented than others and our Table 1 shows that some of them have very insufficient effectives. The private sector was also underrepresented. We estimate that this may be due to lower research culture in private sector, higher lack of time or lower desire to evaluate work conditions in these facilities. However, we found no significant difference in depression in private vs. public sector. The SEM is complex with several variables and relationships and our study needed important sample size to converge. Further studies should replicate these relationships in each professional category. However, our study has one of the largest sample sizes of Western countries in the field. This sample size was sufficient to carry out robust analyses with adjustments for multiple confounding factors, but not sufficient to carry out subgroup analyses. The SEM is complex with several variables and relationships and our study needed important sample size to converge. Further studies should replicate these relationships in each professional category. The daily transport time and the workforce shortage (e.g. patient to staff ratio or hidden rationing) have not been reported and can contribute to work disorganization, exhaustion and sleep disorders. They should be explored in future studies. While CES-D has shown satisfactory psychometric properties, CES-D remains a patient-reported outcome and some cases may have been misclassified. Patient-reported outcomes are known to be associated with higher levels of depression compared to clinician-rated outcomes or structured clinical interviews(Etchecopar-Etchart et al., 2020). In France, we have no direct access to the professional listings and/or mailings, which limits the implementation of surveys. There is thus a need for nationally representative cohorts to monitor the health status of HCWs.

**5. Conclusion**

Despite the evidence looking at depression in HCWs during the Covid-19 first wave, our data shows that high rates of depression appear to be a persistent problem which should be addressed as a public health priority. These results should act as a wake-up call for healthcare policymakers to address the poor health status of HCWs. We propose several interventions to improve this issue: improving organizational/planification issues, reducing sustained bullying at the workplace, reinforcing colleague’s emotional support, promoting napping at work and individual and collective psychotherapies that have proved effectiveness in depression prevention (not only relaxation or stress management). Developing CREMs and CROMs is needed to monitor work environment and its effect on depression in HCWs. Last, there is a need for nationally representative cohorts to monitor the health status of HCWs.

**References**

Ait-Aoudia, M., Levy, P.P., Bui, E., Insana, S., de Fouchier, C., Germain, A., Jehel, L., 2013. Validation of the French version of the Pittsburgh Sleep Quality Index Addendum for posttraumatic stress disorder. Eur. J. Psychotraumatology 4. https://doi.org/10.3402/ejpt.v4i0.19298

American Psychiatric Association., 2013. Diagnostic and statistical manual of mental disorders (5th ed.).

Andersson, L., Chudnovskaya, M., Shahbazian, R., Ghaznavi, C., Ueda, P., 2022. Nationwide study of trends in physician partner choice for childbearing unions. J. Intern. Med. https://doi.org/10.1111/joim.13464

Angerer, P., Schmook, R., Elfantel, I., Li, J., 2017. Night Work and the Risk of Depression. Dtsch. Arzteblatt Int. 114, 404–411. https://doi.org/10.3238/arztebl.2017.0404

Arnaez, J.M., Krendl, A.C., McCormick, B.P., Chen, Z., Chomistek, A.K., 2020. The association of depression stigma with barriers to seeking mental health care: a cross-sectional analysis. J. Ment. Health Abingdon Engl. 29, 182–190. https://doi.org/10.1080/09638237.2019.1644494

Asami, Y., Goren, A., Okumura, Y., 2014. Work Productivity Loss with Depression, Diagnosed and Undiagnosed, among Employed Respondents in an Internet-Based Survey Conducted in Japan. Value Health J. Int. Soc. Pharmacoeconomics Outcomes Res. 17, A463. https://doi.org/10.1016/j.jval.2014.08.1289

Asselmann, E., Venz, J., Pieper, L., Wittchen, H.-U., Pittrow, D., Beesdo-Baum, K., 2019. The role of gender and anxiety in the association between somatic diseases and depression: findings from three combined epidemiological studies in primary care. Epidemiol. Psychiatr. Sci. 28, 321–332. https://doi.org/10.1017/S2045796017000567

Aziah, B.D., Rusli, B.N., Winn, T., Naing, L., Tengku, M.A., 2004. Risk factors of job-related depression in laboratory technicians in Hospital Universiti Sains Malaysia (HUSM) and Kementerian Kesihatan Malaysia (KKM) hospitals in Kelantan. Southeast Asian J. Trop. Med. Public Health 35, 468–475.

Azoulay, E., Pochard, F., Reignier, J., Argaud, L., Bruneel, F., Courbon, P., Cariou, A., Klouche, K., Labbé, V., Barbier, F., Guitton, C., Demoule, A., Kouatchet, A., Guisset, O., Jourdain, M., Papazian, L., Van Der Meersch, G., Reuter, D., Souppart, V., Resche-Rigon, M., Darmon, M., Kentish-Barnes, N., FAMIREA Study Group, 2021. Symptoms of Mental Health Disorders in Critical Care Physicians Facing the Second COVID-19 Wave: A Cross-Sectional Study. Chest S0012-3692(21)00950–8. https://doi.org/10.1016/j.chest.2021.05.023

Baker, V.B., Sowers, C.B., Hack, N.K., 2020. Lost productivity associated with headache and depression: a quality improvement project identifying a patient population at risk. J. Headache Pain 21, 50. https://doi.org/10.1186/s10194-020-01107-4

Barlet, C., 2011. La profession d’infirmière : situation démographique et trajectoires professionnelles 8.

Beck, A., Crain, A.L., Solberg, L.I., Unützer, J., Glasgow, R.E., Maciosek, M.V., Whitebird, R., 2011. Severity of depression and magnitude of productivity loss. Ann. Fam. Med. 9, 305–311. https://doi.org/10.1370/afm.1260

Behrens, T., Burek, K., Rabstein, S., Wichert, K., Erbel, R., Eisele, L., Arendt, M., Dragano, N., Brüning, T., Jöckel, K.-H., 2021. Impact of shift work on the risk of depression. Chronobiol. Int. 0, 1–15. https://doi.org/10.1080/07420528.2021.1962903

Bender, R., Lange, S., 2001. Adjusting for multiple testing—when and how? J. Clin. Epidemiol. 54, 343–349. https://doi.org/10.1016/S0895-4356(00)00314-0

Bessière, S., 2005. La féminisation des professions de santé en France : données de cadrage. Rev. Fr. Aff. Soc. 1. https://doi.org/10.3917/rfas.051.0017

Bianchi, R., Schonfeld, I.S., Laurent, E., 2015. Burnout-depression overlap: a review. Clin. Psychol. Rev. 36, 28–41. https://doi.org/10.1016/j.cpr.2015.01.004

Blais, F.C., Gendron, L., Mimeault, V., Morin, C.M., 1997. [Evaluation of insomnia: validity of 3 questionnaires]. L’Encephale 23, 447–453.

Bourbon, A., Boyer, L., Auquier, P., Boucekine, M., Barrow, V., Lançon, C., Fond, G., 2019. Anxiolytic consumption is associated with tobacco smoking and severe nicotine dependence. Results from the national French medical students (BOURBON) study. Prog. Neuropsychopharmacol. Biol. Psychiatry 94, 109645. https://doi.org/10.1016/j.pnpbp.2019.109645

Boyer, L., Fond, G., Devictor, B., Samuelian, J.-C., Lancon, C., Rouillon, F., Gaillard, R., Zendjidjian, X., Llorca, P.-M., 2016. [Reflection on the psychiatric financial allocation in France]. L’Encephale 42, 379–381. https://doi.org/10.1016/j.encep.2016.03.014

Cappelletti, L., Savall, H., 2018. Le coût caché de l’absentéisme au travail : 108 milliards €. Inst. Sapiens. URL https://www.institutsapiens.fr/le-cout-cache-de-labsenteisme-au-travail-108-milliards-e/ (accessed 9.29.19).

CDC, 2021. Workplace Health Promotion [WWW Document]. URL https://www.cdc.gov/workplacehealthpromotion/index.html (accessed 11.20.21).

Choi, K.W., Chen, C.-Y., Stein, M.B., Klimentidis, Y.C., Wang, M.-J., Koenen, K.C., Smoller, J.W., Major Depressive Disorder Working Group of the Psychiatric Genomics Consortium, 2019. Assessment of Bidirectional Relationships Between Physical Activity and Depression Among Adults: A 2-Sample Mendelian Randomization Study. JAMA Psychiatry 76, 399–408. https://doi.org/10.1001/jamapsychiatry.2018.4175

Clemens, T., Michelsen, K., Commers, M., Garel, P., Dowdeswell, B., Brand, H., 2014. European hospital reforms in times of crisis: aligning cost containment needs with plans for structural redesign? Health Policy Amst. Neth. 117, 6–14. https://doi.org/10.1016/j.healthpol.2014.03.008

Cohen, J., 1988. Statistical power analysis for the behavioral sciences, 2nd ed. ed. L. Erlbaum Associates, Hillsdale, N.J.

Crinière, L., Lhommet, C., Caille, A., Giraudeau, B., Lecomte, P., Couet, C., Oppert, J.-M., Jacobi, D., 2011. Reproducibility and validity of the French version of the long international physical activity questionnaire in patients with type 2 diabetes. J. Phys. Act. Health 8, 858–865. https://doi.org/10.1123/jpah.8.6.858

Daouda, O.S., Hocine, M.N., Temime, L., 2021. Determinants of healthcare worker turnover in intensive care units: A micro-macro multilevel analysis. PloS One 16, e0251779. https://doi.org/10.1371/journal.pone.0251779

Doty, B., Grzenda, A., Hwang, S., Godar, S., Gruttadaro, D., Hauge, K.A., Sherman, B., Clarke, D.E., 2021. An Ecological Study of a Universal Employee Depression Awareness and Stigma Reduction Intervention: “Right Direction.” Front. Psychiatry 12, 581876. https://doi.org/10.3389/fpsyt.2021.581876

DRESS, 2022. Démographie des professionnels de santé | Direction de la recherche, des études, de l’évaluation et des statistiques [WWW Document]. URL https://drees.solidarites-sante.gouv.fr/demographie-des-professionnels-de-sante (accessed 3.12.22).

Duba, A., Messiaen, M., Boulangeat, C., Boucekine, M., Bourbon, A., Viprey, M., Auquier, P., Lançon, C., Boyer, L., Fond, G., 2020a. Sexual harassment exposure and impaired mental health in medical students. The MESSIAEN national study. J. Affect. Disord. 274, 276–281. https://doi.org/10.1016/j.jad.2020.05.100

Duba, A., Messiaen, M., Boulangeat, C., Korchia, T., Lançon, C., Bourbon, A., Viprey, M., Auquier, P., Boyer, L., Fond, G., 2020b. Sexual-orientation based discrimination is associated with anxiety and depression in young physicians. A national study. J. Affect. Disord. 274, 964–968. https://doi.org/10.1016/j.jad.2020.05.155

Duba, A., Messiaen, M., Masson, M., Lançon, C., Boyer, L., Fond, G., 2020c. [Sexual professional violence exposure of young physicians in the hospital: The MESSIAEN national study]. L’Encephale. https://doi.org/10.1016/j.encep.2020.02.001

Dyrbye, L.N., Shanafelt, T.D., Johnson, P.O., Johnson, L.A., Satele, D., West, C.P., 2019. A cross-sectional study exploring the relationship between burnout, absenteeism, and job performance among American nurses. BMC Nurs. 18, 57. https://doi.org/10.1186/s12912-019-0382-7

Enns, V., Currie, S., Wang, J., 2015. Professional autonomy and work setting as contributing factors to depression and absenteeism in Canadian nurses. Nurs. Outlook 63, 269–277. https://doi.org/10.1016/j.outlook.2014.12.014

Ervasti, J., Joensuu, M., Pentti, J., Oksanen, T., Ahola, K., Vahtera, J., Kivimäki, M., Virtanen, M., 2017. Prognostic factors for return to work after depression-related work disability: A systematic review and meta-analysis. J. Psychiatr. Res. 95, 28–36. https://doi.org/10.1016/j.jpsychires.2017.07.024

Ervasti, J., Vahtera, J., Pentti, J., Oksanen, T., Ahola, K., Kivekäs, T., Kivimäki, M., Virtanen, M., 2014. The role of psychiatric, cardiometabolic, and musculoskeletal comorbidity in the recurrence of depression-related work disability. Depress. Anxiety 31, 796–803. https://doi.org/10.1002/da.22286

Etchecopar-Etchart, D., Korchia, T., Loundou, A., Llorca, P.-M., Auquier, P., Lançon, C., Boyer, L., Fond, G., 2020. Comorbid Major Depressive Disorder in Schizophrenia: A Systematic Review and Meta-Analysis. Schizophr. Bull. https://doi.org/10.1093/schbul/sbaa153

Evans-Lacko, S., Knapp, M., 2016. Global patterns of workplace productivity for people with depression: absenteeism and presenteeism costs across eight diverse countries. Soc. Psychiatry Psychiatr. Epidemiol. 51, 1525–1537. https://doi.org/10.1007/s00127-016-1278-4

Falissard, B., 2019. Comprendre et utiliser les statistiques dans les sciences de la vie, Masson. ed. Paris.

Fernandes, S., Fond, G., Zendjidjian, X.Y., Baumstarck, K., Lançon, C., Berna, F., Schurhoff, F., Aouizerate, B., Henry, C., Etain, B., Samalin, L., Leboyer, M., Llorca, P.-M., Coldefy, M., Auquier, P., Boyer, L., French PREMIUM Group, 2020. Measuring the Patient Experience of Mental Health Care: A Systematic and Critical Review of Patient-Reported Experience Measures. Patient Prefer. Adherence 14, 2147–2161. https://doi.org/10.2147/PPA.S255264

Fernández Castañer, M., Salazar Soler, A., Bartolomé Sarvisé, C., Ridao March, M.L., Casado Garcia, M.A., Castilla Fuentes, M., Ortiga Fontgivell, B., García Díaz, A., Corbella, X., 2018. [Impact of the financial crisis on activity and efficiency at a high-technology university hospital]. Rev. Esp. Salud Publica 92, e201808052.

Flaherty, M., O’Neil, V.E., 2021. Psychological peer support for staff: implementing the Trauma Risk Management model in a hospital setting. Nurs. Manag. Harrow Lond. Engl. 1994. https://doi.org/10.7748/nm.2021.e1977

Fond, G., Boulangeat, C., Messiaen, M., Duba, A., Boucekine, M., Auquier, P., Lançon, C., Boyer, L., 2021a. Anxiety and depression in young physicians: Prevalence and associated factors. The MESSIAEN national study. L’Encephale S0013-7006(21)00084–1. https://doi.org/10.1016/j.encep.2021.02.005

Fond, G., Bourbon, A., Picot, A., Boucekine, M., Lançon, C., Auquier, P., Boyer, L., 2021b. Hazardous drinking is associated with hypnotic consumption in medical students in the BOURBON nationwide study: psychological factors explored. Eur. Arch. Psychiatry Clin. Neurosci. 271, 883–889. https://doi.org/10.1007/s00406-020-01122-1

Fuhrer, R., Rouillon, F., 1989. La version française de l’échelle CES-D (Center for Epidemiologic Studies-Depression Scale). Description et traduction de l’échelle d’autoévaluation. [The French version of the CES-D (Center for Epidemiologic Studies-Depression Scale).]. Psychiatr. Psychobiol. 4, 163–166.

Gi, T.S., Devi, K.M., Neo Kim, E.A., 2011. A systematic review on the relationship between the nursing shortage and nurses’ job satisfaction, stress and burnout levels in oncology/haematology settings. JBI Libr. Syst. Rev. 9, 1603–1649. https://doi.org/10.11124/01938924-201109390-00001

HPOE, 2016. Health and Wellness Programs for Hospital Employees: Results from a 2015 American Hospital Association Survey.

Hu, L., Bentler, P., 1999. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct. Equ. Model. Multidiscip. J. 6, 1–55. https://doi.org/10.1080/10705519909540118

Huang, H., Xia, Y., Zeng, X., Lü, A., 2022. Prevalence of depression and depressive symptoms among intensive care nurses: A meta-analysis. Nurs. Crit. Care. https://doi.org/10.1111/nicc.12734

INSEE, 2022. Âge moyen et âge médian de la population | Insee.

Irwin, M.R., Olmstead, R.E., Ganz, P.A., Haque, R., 2013. Sleep disturbance, inflammation and depression risk in cancer survivors. Brain. Behav. Immun. 30 Suppl, S58-67. https://doi.org/10.1016/j.bbi.2012.05.002

Johnston, D.A., Harvey, S.B., Glozier, N., Calvo, R.A., Christensen, H., Deady, M., 2019. The relationship between depression symptoms, absenteeism and presenteeism. J. Affect. Disord. 256, 536–540. https://doi.org/10.1016/j.jad.2019.06.041

Kojima, M., Senda, Y., Nagaya, T., Tokudome, S., Furukawa, T.A., 2003. Alexithymia, depression and social support among Japanese workers. Psychother. Psychosom. 72, 307–314. https://doi.org/10.1159/000073027

Kunzler, A.M., Röthke, N., Günthner, L., Stoffers-Winterling, J., Tüscher, O., Coenen, M., Rehfuess, E., Schwarzer, G., Binder, H., Schmucker, C., Meerpohl, J.J., Lieb, K., 2021. Mental burden and its risk and protective factors during the early phase of the SARS-CoV-2 pandemic: systematic review and meta-analyses. Glob. Health 17, 34. https://doi.org/10.1186/s12992-021-00670-y

Langevin, 2012. Maslach Burnout Inventory (MBI) - Article de revue - INRS.

Lee, A., Myung, S.K., Cho, J.J., Jung, Y.J., Yoon, J.L., Kim, M.Y., 2017. Night Shift Work and Risk of Depression: Meta-analysis of Observational Studies. J. Korean Med. Sci. 32, 1091–1096. https://doi.org/10.3346/jkms.2017.32.7.1091

Li, Y., Scherer, N., Felix, L., Kuper, H., 2021. Prevalence of depression, anxiety and post-traumatic stress disorder in health care workers during the COVID-19 pandemic: A systematic review and meta-analysis. PloS One 16, e0246454. https://doi.org/10.1371/journal.pone.0246454

Liew, T.M., Tai, B.C., Yap, P., Koh, G.C.-H., 2019. Comparing the Effects of Grief and Burden on Caregiver Depression in Dementia Caregiving: A Longitudinal Path Analysis over 2.5 Years. J. Am. Med. Dir. Assoc. 20, 977-983.e4. https://doi.org/10.1016/j.jamda.2018.11.016

Lucas, G., Colson, S., Boyer, L., Inthavong, K., Haller, P.H., Lancon, C., Auquier, P., Gentile, S., Fond, G., 2021. Risk factors for burnout and depression in healthcare workers: The national AMADEUS study protocol. L’Encephale S0013-7006(21)00159–7. https://doi.org/10.1016/j.encep.2021.06.001

Mannocci, A., Thiene, D.D., Cimmuto, A.D., Masala, D., Vito, E., Torre, G., 2010. International Physical Activity Questionnaire: validation and assessment in an Italian sample. https://doi.org/10.2427/5694

Martin-Gill, C., Barger, L.K., Moore, C.G., Higgins, J.S., Teasley, E.M., Weiss, P.M., Condle, J.P., Flickinger, K.L., Coppler, P.J., Sequeira, D.J., Divecha, A.A., Matthews, M.E., Lang, E.S., Patterson, P.D., 2018. Effects of Napping During Shift Work on Sleepiness and Performance in Emergency Medical Services Personnel and Similar Shift Workers: A Systematic Review and Meta-Analysis. Prehospital Emerg. Care Off. J. Natl. Assoc. EMS Physicians Natl. Assoc. State EMS Dir. 22, 47–57. https://doi.org/10.1080/10903127.2017.1376136

Marvaldi, M., Mallet, J., Dubertret, C., Moro, M.R., Guessoum, S.B., 2021. Anxiety, depression, trauma-related, and sleep disorders among healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. Neurosci. Biobehav. Rev. 126, 252–264. https://doi.org/10.1016/j.neubiorev.2021.03.024

Maslach, C., Schaufeli, W.B., Leiter, M.P., 2001. Job burnout. Annu. Rev. Psychol. 52, 397–422. https://doi.org/10.1146/annurev.psych.52.1.397

Mata, D.A., Ramos, M.A., Bansal, N., Khan, R., Guille, C., Di Angelantonio, E., Sen, S., 2015. Prevalence of Depression and Depressive Symptoms Among Resident Physicians: A Systematic Review and Meta-analysis. JAMA 314, 2373–2383. https://doi.org/10.1001/jama.2015.15845

Messiaen, M., Duba, A., Boulangeat, C., Boucekine, M., Bourbon, A., Viprey, M., Auquier, P., Lançon, C., Boyer, L., Fond, G., 2021. [Exposure to professional violence by young physicians in the hospital: MESSIAEN national study]. L’Encephale 47, 114–122. https://doi.org/10.1016/j.encep.2020.05.020

Messiaen, M., Duba, A., Boulangeat, C., Boucekine, M., Bourbon, A., Viprey, M., Auquier, P., Lançon, C., Boyer, L., Fond, G., 2020. Repeated bullying at the workplace in medical students and young doctors: the MESSIAEN national study. Eur. Arch. Psychiatry Clin. Neurosci. https://doi.org/10.1007/s00406-020-01144-9

Morin, A.J.S., Moullec, G., Maïano, C., Layet, L., Just, J.-L., Ninot, G., 2011. Psychometric properties of the Center for Epidemiologic Studies Depression Scale (CES-D) in French clinical and nonclinical adults. Rev. Epidemiol. Sante Publique 59, 327–340. https://doi.org/10.1016/j.respe.2011.03.061

Morssinkhof, M.W.L., van Wylick, D.W., Priester-Vink, S., van der Werf, Y.D., den Heijer, M., van den Heuvel, O.A., Broekman, B.F.P., 2020. Associations between sex hormones, sleep problems and depression: A systematic review. Neurosci. Biobehav. Rev. 118, 669–680. https://doi.org/10.1016/j.neubiorev.2020.08.006

Niedermoser, D.W., Kalak, N., Kiyhankhadiv, A., Brand, S., Walter, C., Schweinfurth, N., Lang, U.E., 2020. Workplace-Related Interpersonal Group Psychotherapy to Improve Life at Work in Individuals With Major Depressive Disorders: A Randomized Interventional Pilot Study. Front. Psychiatry 11, 168. https://doi.org/10.3389/fpsyt.2020.00168

Niedhammer, I., 2002. Psychometric properties of the French version of the Karasek Job Content Questionnaire: a study of the scales of decision latitude, psychological demands, social support, and physical demands in the GAZEL cohort. Int. Arch. Occup. Environ. Health 75, 129–144. https://doi.org/10.1007/s004200100270

Niedhammer, I., Chastang, J.F., Gendrey, L., David, S., Degioanni, S., 2006. [Psychometric properties of the French version of Karasek’s “Job Content Questionnaire” and its scales measuring psychological pressures, decisional latitude and social support: the results of the SUMER]. Sante Publique Vandoeuvre--Nancy Fr. 18, 413–427. https://doi.org/10.3917/spub.063.0413

Olaya, B., Pérez-Moreno, M., Bueno-Notivol, J., Gracia-García, P., Lasheras, I., Santabárbara, J., 2021. Prevalence of Depression among Healthcare Workers during the COVID-19 Outbreak: A Systematic Review and Meta-Analysis. J. Clin. Med. 10, 3406. https://doi.org/10.3390/jcm10153406

Pan, A., Sun, Q., Czernichow, S., Kivimaki, M., Okereke, O.I., Lucas, M., Manson, J.E., Ascherio, A., Hu, F.B., 2012. Bidirectional association between depression and obesity in middle-aged and older women. Int. J. Obes. 2005 36, 595–602. https://doi.org/10.1038/ijo.2011.111

Pappa, S., Ntella, V., Giannakas, T., Giannakoulis, V.G., Papoutsi, E., Katsaounou, P., 2020. Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. Brain. Behav. Immun. 88, 901–907. https://doi.org/10.1016/j.bbi.2020.05.026

Patel, R.S., Bachu, R., Adikey, A., Malik, M., Shah, M., 2018. Factors Related to Physician Burnout and Its Consequences: A Review. Behav. Sci. 8, 98. https://doi.org/10.3390/bs8110098

Peter, Karin Anne, Hahn, S., Schols, J.M.G.A., Halfens, R.J.G., 2020. Work-related stress among health professionals in Swiss acute care and rehabilitation hospitals-A cross-sectional study. J. Clin. Nurs. 29, 3064–3081. https://doi.org/10.1111/jocn.15340

Peter, Karin A., Schols, J.M.G.A., Halfens, R.J.G., Hahn, S., 2020. Investigating work-related stress among health professionals at different hierarchical levels: A cross-sectional study. Nurs. Open 7, 969–979. https://doi.org/10.1002/nop2.469

Power, N., Deschênes, S.S., Ferri, F., Schmitz, N., 2020. The association between job strain, depressive symptoms, and cardiovascular disease risk: results from a cross-sectional population-based study in Québec, Canada. Int. Arch. Occup. Environ. Health 93, 1013–1021. https://doi.org/10.1007/s00420-020-01550-5

Pranjic, N., Males-Bilic, L., 2014. Work ability index, absenteeism and depression among patients with burnout syndrome. Mater. Socio-Medica 26, 249–252. https://doi.org/10.5455/msm.2014.249-252

Raniti, M.B., Waloszek, J.M., Schwartz, O., Allen, N.B., Trinder, J., 2018. Factor structure and psychometric properties of the Pittsburgh Sleep Quality Index in community-based adolescents. Sleep 41. https://doi.org/10.1093/sleep/zsy066

Rona, R.J., Burdett, H., Khondoker, M., Chesnokov, M., Green, K., Pernet, D., Jones, N., Greenberg, N., Wessely, S., Fear, N.T., 2017. Post-deployment screening for mental disorders and tailored advice about help-seeking in the UK military: a cluster randomised controlled trial. The Lancet 389, 1410–1423. https://doi.org/10.1016/S0140-6736(16)32398-4

Rosseel, Y., 2012. Lavaan: an R package for structural equation modeling. J. Stat. Softw. 48, 1–36.

Rost, K., Fortney, J., Coyne, J., 2005. The relationship of depression treatment quality indicators to employee absenteeism. Ment. Health Serv. Res. 7, 161–169. https://doi.org/10.1007/s11020-005-5784-3

Rost, K., Smith, J.L., Dickinson, M., 2004. The effect of improving primary care depression management on employee absenteeism and productivity. A randomized trial. Med. Care 42, 1202–1210. https://doi.org/10.1097/00005650-200412000-00007

Rudman, A., Arborelius, L., Dahlgren, A., Finnes, A., Gustavsson, P., 2020. Consequences of early career nurse burnout: A prospective long-term follow-up on cognitive functions, depressive symptoms, and insomnia. EClinicalMedicine 27, 100565. https://doi.org/10.1016/j.eclinm.2020.100565

Rueff, B., Crnac, J., Darne, B., 1989. [Detection of alcoholic patients using the systematic CAGE autoquestionnaire. In out patients]. Presse Medicale Paris Fr. 1983 18, 1654–1656.

Salari, N., Khazaie, H., Hosseinian-Far, A., Khaledi-Paveh, B., Kazeminia, M., Mohammadi, M., Shohaimi, S., Daneshkhah, A., Eskandari, S., 2020. The prevalence of stress, anxiety and depression within front-line healthcare workers caring for COVID-19 patients: a systematic review and meta-regression. Hum. Resour. Health 18, 100. https://doi.org/10.1186/s12960-020-00544-1

Schramm, E., Mack, S., Thiel, N., Jenkner, C., Elsaesser, M., Fangmeier, T., 2020. Interpersonal Psychotherapy vs. Treatment as Usual for Major Depression Related to Work Stress: A Pilot Randomized Controlled Study. Front. Psychiatry 11, 193. https://doi.org/10.3389/fpsyt.2020.00193

Stansfeld, S.A., Shipley, M.J., Head, J., Fuhrer, R., 2012. Repeated job strain and the risk of depression: longitudinal analyses from the Whitehall II study. Am. J. Public Health 102, 2360–2366. https://doi.org/10.2105/AJPH.2011.300589

Stockton, M.A., Pence, B.W., Mbote, D., Oga, E.A., Kraemer, J., Kimani, J., Njuguna, S., Maselko, J., Nyblade, L., 2020. Associations among experienced and internalized stigma, social support, and depression among male and female sex workers in Kenya. Int. J. Public Health 65, 791–799. https://doi.org/10.1007/s00038-020-01370-x

Tsutsumi, A., Kayaba, K., Theorell, T., Siegrist, J., 2001. Association between job stress and depression among Japanese employees threatened by job loss in a comparison between two complementary job-stress models. Scand. J. Work. Environ. Health 27, 146–153. https://doi.org/10.5271/sjweh.602

Van Dam, N.T., Earleywine, M., 2011. Validation of the Center for Epidemiologic Studies Depression Scale--Revised (CESD-R): pragmatic depression assessment in the general population. Psychiatry Res. 186, 128–132. https://doi.org/10.1016/j.psychres.2010.08.018

World Health Organization, 2021a. Social Determinants of Health - Global [WWW Document]. URL https://www.who.int/teams/social-determinants-of-health (accessed 11.20.21).

World Health Organization, 2021b. WHO guidelines on physical activity and sedentary behaviour [WWW Document]. URL https://www.who.int/publications-detail-redirect/9789240015128 (accessed 11.22.21).

Yao, Y., Xu, Y., Cai, Z., Liu, Q., Ma, Y., Li, A.N., Payne, T.J., Li, M.D., 2020. Determination of shared genetic etiology and possible causal relations between tobacco smoking and depression. Psychol. Med. 1–10. https://doi.org/10.1017/S003329172000063X

Table 1. Proportion of depression and men according to profession (in decreased order of proportion of depression). Only professions with sample size≥20 were presented.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | N | N with MDD | % MDD | Mean age (SD) | N men | % men |
| Pharmacy assistant | 87 | 37 | 42.5% | 37.10(8.81) | 11 | 12.6% |
| Administrative | 295 | 111 | 37.6% | 43.05(9.72) | 24 | 8.1% |
| Laboratory technician | 138 | 49 | 35.5% | 39.38(11.51) | 27 | 19.6% |
| Ambulance driver | 27 | 9 | 33.3% | 42.63(7.53) | 22 | 81.5% |
| Pharmacist | 260 | 86 | 33.1% | 44.15(9.96) | 69 | 26.5% |
| Health executives | 1768 | 572 | 32.3% | 49.10(8.02) | 275 | 15.5% |
| Physicians | 1969 | 627 | 31.8% | 41.29(11.84) | 670 | 34.0% |
| Nursery assistant | 93 | 29 | 31.2% | 39.91(10.25) | 2 | 2.2% |
| Nurse | 2819 | 825 | 29.2% | 39.79(10.05) | 461 | 16.3% |
| Nurse assistant | 847 | 246 | 29.0% | 42.44(10.36) | 103 | 12.2% |
| Speech therapist | 38 | 11 | 28.9% | 44.39(12.56) | 0 | 0.0% |
| Psychologist | 216 | 59 | 27.3% | 39.21(9.72) | 25 | 11.6% |
| Dietician | 99 | 27 | 27.3% | 37.77(11.74) | 6 | 6.1% |
| Occupational therapist | 306 | 83 | 27.1% | 36.72(10.78) | 40 | 13.1% |
| Midwife | 332 | 90 | 27.1% | 38.26(10.17) | 14 | 4.2% |
| Specialized educator | 86 | 23 | 26.7% | 41.52(10.49) | 18 | 20.9% |
| Physiotherapist | 419 | 111 | 26.5% | 41.12(11.29) | 120 | 28.6% |
| Radiology Manipulator | 142 | 36 | 25.4% | 39.58(10.68) | 35 | 24.6% |
| Social worker | 131 | 30 | 22.9% | 39.64(9.73) | 6 | 4.6% |
| Psychomotrician | 93 | 21 | 22.6% | 36.19(10.04) | 10 | 10.8% |
| Hospital director | 21 | 4 | 19.0% | 51.95(6.66) | 6 | 28.6% |
| Director of Care | 105 | 19 | 18.1% | 54.91(6.18) | 29 | 27.6% |

Table 2. Professional and individual factors and health risk behaviours associated with major depression (dependent variable) in 10,325 healthcare workers.

| Characteristics | Univariate model |  |  | Multivariate model |  |
| --- | --- | --- | --- | --- | --- |
|  | No major depression  7203(69.8%) | Major depression  3122(30.2%) | p-value | Adjusted\* odds ratio  (aOR) (95% IC) | p-value |
| Individual factors |  |  |  |  |  |
| Age (years) | 42.13(10.92) | 42.60(10.66) | 0.151 | 1.005(1.001-1.005) | **0.015** |
| Sex(man) | 1265(17.6%) | 724 (23.2%) | **<0.0001** | 1.771(1.539-2.038) | **<0.0001** |
| Partner at home | 49(15.0%) | 41(17.4%) | **<0.0001** | 0.638(0.563-0.723) | **<0.0001** |
| Children at home | 4288(59.5%) | 1764(56.5%) | **0.004** | 0.983(0.563-0.723) | 0.779 |
| Family caregiver | 1188(16.5%) | 688(22.0%) | **<0.0001** | 1.230(1.073-1.410) | **0.003** |
| History of recurrent major depression | 617(6.0%) | 892(8.6%) | **<0.0001** | 2.778(2.407-3.207) | **<0.0001** |
| Chronic illness | 1041(14.5%) | 633(20.3%) | **<0.0001** | 1.078(0.933-1.244) | 0.308 |
| Professional factors |  |  |  |  |  |
| Public sector vs. private sector | 6152(85.4%) | 2764(88.5%) | **<0.0001** | 1.172(0.997-1.378) | 0.089 |
| Full-time job | 5961(82.8%) | 2669(85.5%) | **0.001** | 0.985(0.845-1.149) | 0.849 |
| Night shift work | 442(6.1%) | 206(6.6%) | 0.374 | - | - |
| Job content questionnaire dimensions |  |  |  |  |  |
| Speed and quantity | 8.37(2.00) | 9.36(1.99) | **<0.0001** | 0.973(0.938-1.008) | 0.126 |
| Complexity and intensity | 8.73(1.63) | 9.59(1.60) | **<0.0001** | 1.095(1.048-1.145) | **<0.0001** |
| Fragmentation and unpredictability | 8.47(2.04) | 9.50(1.89) | **<0.0001** | 1.082(1.045-1.119) | **<0.0001** |
| Decision-making latitude | 37.63(6.42) | 33.77(7.55) | **<0.0001** | 0.978(0.969-0.987) | **<0.0001** |
| Use of skills | 17.30(2.91) | 16.44(3.19) | **<0.0001** | 0.992(0.971-1.013) | 0.461 |
| Skill development | 19.70(2.96) | 18.51(3.45) | **<0.0001** | 0.999(0.979-1.020) | 0.922 |
| Professional support by superiors | 5.48(1.66) | 4.64(1.75) | **<0.0001** | 0.937(0.859-1.022) | 0.140 |
| Professional support by colleagues | 6.48(1.11) | 4.64(1.75) | **<0.0001** | 1.037(0.968-1.110) | 0.301 |
| Emotional support by superiors | 5.50(1.72) | 4.65(1.83) | **<0.0001** | 1.000(0.921-1.086) | 0.996 |
| Emotional support by colleagues | 6.45(1.16) | 5.89(1.42) | **<0.0001** | 0.853(0.801-0.909) | **<0.0001** |
| Work schedules characteristics |  |  |  |  |  |
| Random schedules | 3344(46.4%) | 1546(49.5%) | **0.004** | 1.135(1.017-1.267) | **0.024** |
| Working longer than expected at least once a week | 4533(62.9%) | 2245(71.9%) | **<0.0001** | 1.178(1.076-1.384) | **0.013** |
| Burnout | 3088(42.9%) | 2624(84.0%) | **<0.0001** | 4.826(4.291-5.428) | **<0.0001** |
| Absenteeism | 1212(16.8%) | 845(27.1%) | **<0.0001** | 1.440(1.276-1.626) | **<0.0001** |
| Professional violence at the workplace |  |  |  |  |  |
| Sustained bullying at the workplace | 2397(33.3%) | 1712(54.8%) | **<0.0001** | 1.343(1.197-1.506) | **<0.0001** |
| Sexual harassment exposure | 476(6.6%) | 280(9.0%) | **<0.0001** | 1.023(0.835-1.252) | 0.828 |
| Sexual orientation-based discrimination | 406(5.6%) | 248(7.9%) | **<0.0001** | 1.052(0.850-1.304) | 0.640 |
| Health risk behaviours |  |  |  |  |  |
| Overweight/obesity | 2504(34.8%) | 1222(39.1%) | **<0.0001** | 0.976(0.871-1.093) | 0.669 |
| Daily tobacco smoking≥20 cigarettes/day | 113(1.6%) | 134(4.3%) | **<0.0001** | 1.473(1.069-2.031) | **0.018** |
| Hazardous drinking | 1112(15.4%) | 813(26.0%) | **<0.0001** | 1.548(1.356-1.767) | **<0.0001** |
| Moderate to high physical activity | 4714(65.5%) | 1678(53.8%) | **<0.0001** | 0.743(0.666-0.828) | **<0.0001** |
| Sleep duration (hours) | 6.81(1.19) | 6.15(1.35) | **<0.0001** | 0.700(0.669-0.732) | **<0.0001** |

Significant associations (p<0.05) are in bold.

\* Adjusted for all variables associated with major depression with p<0.2 in univariate analyses.

Figure 1. Geographical distribution of the participants.

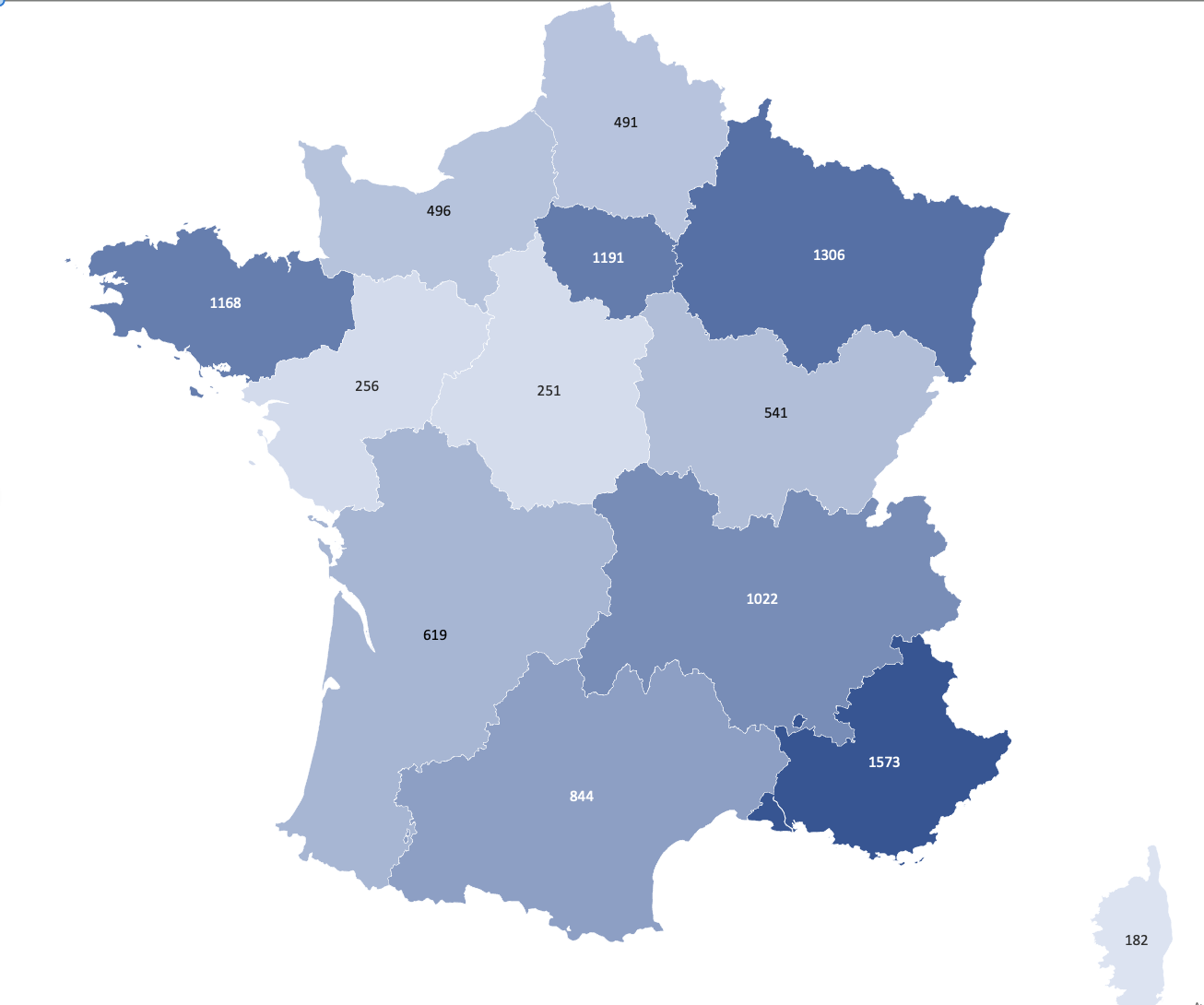


Figure 2. SEM model with standardized path coefficients. Notes: p<0.001\*\*\*; p<0.01\*\*, RMD: recurrent major depressive disorder.



Supplementary Figure 1. Theoretical model for Structural Equation Modeling analysis.



RMD Recurrent Major Depression

Supplementary Table 1. Recruitment process.

The following institutions/facilities actively participated in the dissemination of the study:

-(Regional health agencies) Provence Alpes Côte d'Azur, Brittany, Ile de France;

-(Territory hospital groups including academic and non-academic public hospitals) Alps, Dauphiné, Rhône center, South Drôme, Ardèche, Western Brittany, South Brittany, Upper Brittany, South Corsica, South Val d'Oise, North Hauts-de-Seine, Ile de France, South Vaucluse, Var, Alpes-de-Haute-Provence, Bouches-du-Rhône, Alpes Maritimes, Southern Alps;

-(Academic hospitals): Assistance publique Hôpitaux de Marseille, Assistance publique Hôpitaux de Paris, Hospices civils de Lyon, CHU d 'Amiens, CHU d 'Angers, CHU de Besancon, CHU de Brest, CHRU de Caen, CHU de Clermont-Ferrand, CHU de Dijon, CHU de Grenoble, CHU of Lille, CHU of Limoges, CHU of Martinique, CHU of Montpellier, CHRU of Nancy, CHU of Nantes, CHU of Pointe-à-Pitre/Les Abymes, CHU of Reims, CHU of Rennes, CHU of La Reunion, CHU of Rouen, CHU of Saint-Étienne, CHU of Toulouse, CHRU of Tours;

-(Private hospitals) Institut de cancérologie de l'Ouest, Institut Bergonié, Centre François Baclesse, Centre Jean Perrin, Centre George-François Leclerc; Centre Oscar Lambret; Centre Léon Bérard; Institut Paoli-Calmettes; Centre Antoine Lacassagne, Centre d’Oncologie et de Radio Thérapie 37 (CORT37)

-(Associations) Conseils départementaux de l’Ordre des médecins (Charente-Maritime, Cote-d’Or, Cote d’Armor, Gironde, Deux-Sèvres, Essonnes, Guadeloupe, Guyana, Haute-Saône, Hérault and Loiret) ; French National Association of Occupational Therapists, National Association of Graduate Nurses and Students, French association of dieticians nutritionists, French association of care managers, Professional association of midwives, Committee of agreement of the nursing training and executives, National College of Physiotherapy; Fédération hospitalière de France, Fédération nationale des associations d'aides-soignants, Syndicat national des infirmiers anesthésistes, Syndicat national des infirmiers de bloc opératoire.

Finally, the survey was disseminated through social networks at two timepoint (at the beginning and one month later) to ensure the maximum representativeness of the sample.

Supplementary Table 2. Detailed list of professions listed in the “other professions” group.

|  |  |
| --- | --- |
| Physiotherapist | 419 |
| Midwife | 332 |
| Occupational therapist | 306 |
| Administrative | 295 |
| Pharmacist | 260 |
| Psychologist | 216 |
| Radiology technician | 142 |
| Laboratory technician | 138 |
| Social worker | 131 |
| Director of Care | 105 |
| Dietician | 99 |
| Nursery assistant | 93 |
| Psychomotrician | 93 |
| Pharmacy assistant | 87 |
| Specialized educator | 86 |
| Speech therapist | 38 |
| Ambulance driver | 27 |
| Director of Care / Director | 21 |
| Technician | 9 |
| Adapted physical activity teacher | 8 |
| Hospital service agent | 6 |
| Odontology | 5 |
| Orthoptist | 4 |
| Podiatrist | 2 |

Supplementary Table 3. The standardized coefficients of the residual covariance based on modification indices.

|  |  |  |
| --- | --- | --- |
| **Pathway** | **Standardized estimate (β)** | **95% confidence interval** |
| Professional status ↔ Working longer than expected | 0.557 | 0.524,0.590 |
| Professional status ↔ Age | 0.433 | 0.404,0.461 |
| Professional status ↔ Fragmentation/unpredictability | 0.326 | 0.296,0.356 |
| Professional status ↔ Random schedules | -0.193 | -0.229,-0.157 |
| Age ↔ Being family caregiver | 0.208 | 0.180,0.236 |
| Age ↔ Sleep reduction | -0.125 | -0.144,-0.106 |
| Age ↔ Sustained bullying at the workplace | 0.161 | 0.134,0.188 |
| Age ↔ Colleagues’ emotional support | -0.117 | -0.137,-0.097 |
| Age ↔ Random schedules | -0.125 | -0.149,-0.101 |
| Complexity/intensity ↔ Fragmentation/unpredictability | 0.424 | 0.407,0.440 |
| Working longer than expected ↔ Fragmentation/unpredictability | 0.293 | 0.270,0.317 |
| Working longer than expected ↔ Complexity/ intensity | 0.272 | 0.247,0.296 |
| Working longer than expected ↔ Decision-making latitude | 0.180 | 0.154,0.206 |
| Sex ↔ Hazardous drinking | -0.282 | -0.244,-0.320 |

*Notes:* all standardized path coefficients are p<0.001.