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SITUATIONAL AND PERSONAL PREDICTORS OF MENTAL HEALTH OUTCOMES AMONG HEALTH CARE WORKERS DURING COVID-19: DIFFERENCES BETWEEN NURSES AND PHYSICIANS

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Summary

Background: *Caregivers have been exposed to important stresses during the COVID-19 pandemic leading to important mental health issues. Previous researches showed that nurses were particularly emotionally affected compared to physicians.*

Aims: *To study the differences in psychological symptoms between nurses and physicians during the first wave of the COVID-19 pandemic as well as three months later and to compare the predictors of these symptoms between both professions.*

Method: *An online survey was sent to all nurses and physicians employed by a university hospital in Belgium. It assessed symptoms of post-traumatic stress, anxiety, depression and insomnia induced by the COVID-19 experienced during the peak and at the moment of assessment (3 months after the peak). Sociodemographic and work-related characteristics as well as psychological factors, i.e., emotion regulation habits, coping strategies and personality traits were also evaluated as potential predictors of psychological symptoms.*

Results: *Nurses reported more pronounced psychological symptoms associated to the COVID situation compared to physicians. In nurses, the strongest predictor of psychological symptoms was the level of neuroticism while in physicians it was the work overload.*

Conclusions: *Our study provided essential information which may allow to better orient interventions according to the difficulties and specificities presented by each occupation.*

Keywords: *COVID-19, Mental health, Nurses, Physicians, Neuroticism, Work overload*

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INTRODUCTION

Abruptly exposed to the unprecedented global pandemic of COVID-19, at the onset of spring 2020, hospitals around the world urgently had to absorb increasing patient volumes. Excessive workload, unfamiliar practice environment, elevated risk of infection while the consequences of that infection were not totally known at that time, insufficient and inadequate protection, management of patients in traumatic situations, hospitals healthcare workers (HCWs), at the front line, suddenly had to deal with a number of unfavorable conditions and were applauded as heroes. However, worry about the erosion of their mental wellbeing and the extent of their psychological adjustment quickly raised among affected countries (Lai et al. 2020a, Franza et al. 2020, Ćosić et al. 2020, He et al. 2021). Many studies found that a substantial proportion of HCWs developed symptoms of post-traumatic stress, anxiety, depression, and insomnia during the first wave of the pandemic (for a review see Pappa et al. 2020) with expected and already shown so far enduring effect (Carmassi et al. 2020, Fattori et al., 2023). Several reports (Jackson-Koku 2016, Lai et al. 2020a, Shaukat et al. 2020, Vanhaecht et al. 2020) highlighted a statistically significantly higher incidence of symptoms in nurses compared to physicians (Shaukat et al. 2020). These symptoms are matters of concern for both the risk of deterioration of individual psychological condition and the risk of malpractice conditions and absenteeism. Providing an adequate and appropriate response to psychological pressure on HCWs requires a thorough understanding of both risk and protective factors that may be playing a role in HCWs.

This investigation needs to take into account differences between occupation, as nurses and physicians do not seem to be experiencing exactly the same effects. As raised by the authors in the review of Sriharan et al. (2021a), there is a lack of understanding of psychological consequences in HCWs by occupation type.

Our group conducted an online survey to assess mental health of the HCWs during the first wave of the COVID-19 outbreak period. Part of the results of this survey were already published elsewhere (Mennicken et al. 2022, Santoro et al., 2023). This initial research report emphasized that differences existed in the expression of psychopathological symptoms between nurses and physicians, the former presenting significantly more symptoms of post-traumatic stress disorder, anxiety and insomnia than the latter. The aim of the present study was to provide an in-depth additional analysis of these data and to describe in details 1) the differences in psychological symptoms (i.e. post-traumatic stress, anxiety, depression, insomnia) between physicians and nurses during the first wave as well as three months later and 2) to compare the predictors of these symptoms in both professions. These predictors will include sociodemographic and work-related features as well as individual differences in personality traits, coping styles and emotion regulation strategies.

SUBJECTS AND METHODS

Procedure

All nurses and physicians employed by the Cliniques Universitaires Saint-Luc (Brussels, Belgium) were invited to participate in the study between June 23rd and July 30th 2020. Thus, our study was carried out after the "first peak" of hospital admission, that had happened in March, when admissions had dropped. The invitation was sent by e-mail containing a link to the survey, received by 1639 nurses and 1067 physicians. No exclusion criteria were applied, including those related to mental health diagnoses as no significant differences were found in the COVID-19 psychological impact assessment outcomes between participants with and without such diagnoses. The survey was developed, distributed and managed using REDCap (Research Electronic Data Capture) tools, a web-based software platform hosted at Cliniques Universitaires St-Luc (Harris et al. 2009).

Survey instruments

Survey questions included (1) demographic and work related characteristics related to the COVID context and (2) a comprehensive psychological assessment. Two types of psychological variables were considered. A first series of questionnaires measured psychological factors that were considered as candidate risk factors for developing psychopathological symptoms, namely emotion regulation skills, coping strategies and individual differences in personality traits. A second series of questionnaires measured the psychological symptoms *induced by the COVID*: level of post-traumatic stress, anxious, depressive and insomnia symptoms consecutive to the COVID situation. For these aspects, instructions were as follows: "Here is a list of the difficulties people may experience following a stressful event. Please read each item carefully and indicate how much you have been experiencing each difficulties *during the most pressing moments of the COVID-19*". The study being carried out after the peak of the epidemic and surge of patients in intensive care units, the majority of the questions retrospectively asked about what HCWs experienced during the crisis. However, given our interest for persistent effects, these questions were followed by one question asking about how they evaluate their current (i.e., 3 months after the peak) level of post-traumatic stress, anxiety, depression and insomnia at the time of assessment. In order to respect for the participants' privacy and emotional state during a potentially difficult period, we decided to allow participants skip any questions they found distressing.

Demographic and work related characteristics

This section mainly included the basic information of the participants, such as gender, age, healthcare profession, relationship status and educational background. Participants were also asked about their psychiatric history, i.e., having been exposed to traumatic events in the past, having past or present psychiatric disorder ("Have you ever been diagnosed with a mental health problem by a physician or a psychologist?"). We finally collected information about the work context during the COVID-19 crisis (work with COVID-19 patients or not, changes in work schedules, work overload, personal infection with COVID-19).

PSYCHOLOGICAL FACTORS

Emotion regulation

We assessed emotion regulation with the *Emotion Regulation Questionnaire (ERQ)* (Gross and John 2003, Christophe et al. 2009 for the French version). It is a 10-item, self-report measure designed to measure respondents' habitual use of two emotion regulation strategies to regulate their emotions: cognitive reappraisal (six items) and expressive suppression (four items). Participants were asked to answer each item on a 7-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree). In the study sample, both subscales had a high level of internal consistency, as determined by a Cronbach's alpha of 0.877 for the 6 items related to cognitive reappraisal and .0808 for the four items related to expressive suppression.

Coping style

Coping strategies were measured with the *Brief-COPE* (the abridged version of the COPE inventory) (Carver 1997), a 28 item questionnaire created to measure effective and ineffective ways to cope with stressful events. Each item is rated on a 4-point scale ranging from 1 ("I never do this) to 4 (I always do this) and scales assess 14 different coping dimensions: active coping, planning, using instrumental support, using emotional support, venting, behavioral disengagement, self-distraction, self-blame, positive reframing, humor, denial, acceptance, religion, and substance use. These strategies may be classified in two major types: "approach coping" that are more effective (emotional support use, acceptance, instrumental support use, positive reframing, planning, active coping) and "avoidant coping" that are less effective (self-distraction, venting, denial, substance use, self-blame, behavioural disengagement) that excludes humor and religion (Eisenberg et al. 2012). In the study sample, alphas for the 14 sub-scales ranged from 0.346 to 0.930. The lowest alpha concerned the self-distraction subscale and the highest was found for the substance use subscale. Despite the fact that the scales had only two items each, the alphas for 12 of the 14 sub-scales were >0.5.

Personality traits

Personality was assessed using the *Ten Item Personality inventory (TIPI)*(Gosling et al. 2003), a very short evaluation of the personality according to the Big-5 Model (Goldberg 1990) in 10 items, each rated on a 7-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree). Each dimension of the Big Five (E – Extraversion, A – Agreeableness, C – Conscientiousness, N – Neuroticism and O – Openness) is represented by two items, one stated in a way that represents the positive pole of the dimension and the other stated in a way that represents the negative pole. In the study sample, Cronbach's alpha for each subscales were the following: 0.346 for Extraversion, 0.240 for Agreeableness, 0.428 for Conscientiousness, 0.566 for Neuroticism, and 0.131 for Openness.

RETROSPECTIVE ASSESSMENT OF PSYCHOLOGICAL SYMPTOMS INDUCED BY THE COVID CONTEXT

Post-traumatic stress disorder symptoms

Post-traumatic stress disorder **(**PTSD) symptoms associated with the COVID professional context were assessed by the *Impact of Event Scale – Revised* (*IES-R,* Weiss 2007), French version by Brunet et al. (2003) a 22-item self-report measure that assesses perceived stress caused by traumatic events. Each item is reported using a five-point Likert scale (0 = not at all to 4 = extremely). The results can thus range between 0 and 88 points. It also provides subscores for the principal components of PTSD (intrusion, avoidance, and hyperarousal). Total scores were categorized as established in the literature (normal= 0-23, mild =24-32, moderate =33-36, and severe stress >36) (Creamer et al. 2003). In the study sample, the scale had an excellent internal consistency, as determined by a Cronbach's alpha of 0.935.

Depression and anxiety

The *Hospital Anxiety and Depression Scale (HADS,* Zigmond and Snaith 1983), French version by Lépine et al. (1985) was used to assess the levels of anxiety and depression. It is a 14-item self-assessment questionnaire comprising seven items relating to anxious or depressive symptoms respectively, each scored on a four-point scale from 0-3. Scores for anxiety and depression therefore vary from 0 to 21, depending on the presence and severity of the symptoms. Cut-off points as proposed by the authors were calculated as follows: a score between 0 and 7 indicates the absence of symptoms of anxiety or depression; a score between 8 and 10 indicates the presence of the symptomology at a moderate degree, called doubtful cases; scores greater than or equal to 11 indicates a significant number of symptoms of anxiety or depression

therefore confirmed cases. In the study sample, both subscales had a high level of internal consistency, as determined by a Cronbach's alpha of 0.846 for anxiety items and .0820 for the depression scale.

Insomnia

The severity and effects of insomnia were assessed with the *Insomnia Severity Index* (*ISI*, Bastien et al. 2001), French version by Bayard et al. (2017), a brief self-report instrument that comprises seven items rated using a five-point Likert scale (0 =no problem; 4=very severe problem). It measures the patient's perception of his or her insomnia including its intensity, its consequences on daily work and the degree of concerns or distress caused by the sleep disturbances. The total score ranges between 0 and 28, where 0–7 indicates absence of insomnia, 8–14 indicates subthreshold insomnia, 15–21 indicates moderate insomnia, and 22–28 indicates severe insomnia. In the study sample, the scale had an excellent internal consistency, as determined by a Cronbach's alpha of 0.901.

Evaluation of current psychological symptoms at the time of assessment

Each questionnaire on psychological symptoms cited above was followed by the question: "To what extent the symptoms of post-traumatic stress/anxiety/depression/insomnia are (still) present today? Participants had to choose between the following answers: 1) I have never had any symptoms and still don't have any today (= None), 2) The symptoms are no longer present (= None), 3) The difficulties are a little/sometimes present (= Mild), 4) The difficulties are very present (= High), 5) The difficulties are extremely present (= Severe). This question allowed to categorize the levels of symptoms post 3 months and link them up with the level of reported symptoms experienced 3 months before, during the crisis.

STATISTICAL ANALYSIS

Comparisons of the demographic, work-related and psychological variables between nurses and physicians were conducted using bivariate analyses (Student's t-test or chi-square test, depending on the data distribution). Correlation analyses were then conducted to test the associations between post-traumatic stress, anxiety, depression and insomnia symptoms induced by the COVID context (during the peak of hospitalizations and at the time of assessment) and 1) demographic characteristics (i.e., age, sex, relationship status, education degree), 2) mental health related characteristics (number of past traumatic experience, having past or present psychological disorder), 3) work-related variables (work in dedicated COVID unit or not, changes in work schedules, work overload, personal infection with SARS-CoV-2), 4) emotion regulation skills, 5) coping strategies, and 6) personality traits. These correlations were run for both professions (i.e. nurses and physicians), separately. Linear correlations were determined using Pearson's correlation coefficient and point-Biserial Correlations Coefficient (rpb) were used to measure the associations between continuous-level variables and binary variables, respectively. Given the multiple testing situation, the Bonferroni's correction for multiple tests was used to obtain corrected significance levels (adjusted significance level of $\alpha<.001$). Stepwise multivariate regression analyzes were then used to identify predictive factors of psychological symptoms (post-traumatic stress symptoms, anxious symptoms, depressive symptoms and insomnia symptoms) during the peak of hospitalizations for both occupation, separately. Binomial logistic regression were run to determine whether the presence of psychological symptoms at the time of assessment could be predicted from the correlated factors, also separately for nurses and physicians. We used IBM SPSS 24.0 statistical software for all analyses.

Ethical considerations

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (Lancet 2000). Informed consent was obtained from all patients for being included in the study. They were also informed that participation in this survey was absolutely free, that they were free not to answer any questions and to end their participation at any time. The study was approved by the local ethical committee, code number 2020/15JUI/321.

RESULTS

Participants

542 participants completed the survey, of which 393 were nurses and 149 were physicians.

Differences between nurses and physicians

Demographic and work-related characteristics

Nurses differed in gender (with more women) (χ^2 = 44.4, p<.001) and education degree (with lower level) (χ^2 = 316.9, p<.001) compared to physicians. They also reported having been exposed to a higher number of past traumatic experience during their entire life compared to physicians [t(361.774)=3.29, p=.001]. Concerning the outbreak period, more of them reported work overload (χ^2 = 19.30, p<.001) than physicians while the latter reported more changes in work schedules (χ^2 = 6.07, p=.010). Finally, compared to physicians, nurses were more likely to work in dedicated COVID units (χ^2 = 10.7, p=.001). The sample sizes used in our statistical analyses vary slightly due to unfilled questions. All data may be found in table 1.

Psychological factors

Physicians were found to have a higher recourse to the expressive suppression of emotions compared to nurses [t(326)=2.198, p=.030]. Nurses described themselves as more sympathetic and warm (a sub-dimension of agreeableness), than physicians did [t(321)=2.489, p=.013]. All data may be found in table 2.

Retrospective assessment of psychological symptoms induced by the COVID context

Nurses retrospectively reported a higher magnitude of post-traumatic stress [t(317)=4.50, p<.001], anxious [t(343)=3.48, p<.001], and insomnia symptoms [t(329)=2.28, p=.028] during the peak. All data may be found in table 3.

Table 1. Demographic and work related characteristics of nurses and physicians

	Physicians (N=149)	Nurses (N=393)	p value
Age	42,84±11,27	42,36±12,12	NS
Gender N(%)			
Women	89(61)	334(87)	**p<.001**
Men	57(39)	50(13)	
Relationship status N(%)			
Single	26(17)	97(26)	NS
Having a partner	123(83)	280(74)	
Education degree N(%)			
Undergraduate	0(0)	282(72)	**p<.001**
Master	74(50)	106(27)	**p<.001**
Doctor	75(50)	1(0,3)	**p<.001**
Number of past traumatic experience	1.15±1.39	1.64±1.90	**p=.001**
Reporting present or past psychological disorder N(%)	9(10)	19(7)	NS
Experienced work overload during the coronavirus crisis N(%)	77(52)	281(72)	**p<.001**
Underwent changes in work schedules during the coronavirus crisis N(%)	50(34)	91(23)	**p=.010**
Worked in a dedicated COVID unit during the coronavirus crisis N(%)	59(40)	217(55)	**p=.001**
Having been infected with COVID-19 N(%)	8(9)	28(11)	NS

Table 2. Mean scores (SD) of psychological factors in physicians and nurses and the p values at 95% confidence interval

	Mean(SD)		t	Significance	95% CI of difference	
	Physicians	**Nurses**			**Lower**	**Upper**
Emotion regulation. ERQ						
Cognitive Reappraisal	4.4(1.3)	4.4(1.1)		.890		
Expressive Suppression	3.8(1.3)	3.4(1.3)	2.199	**.030**	-.360	.313
Coping style. Brief COPE						
Approach coping	21.1(5.6)	19.7(5.8)		.064		
Avoidant coping	9.7(3.5)	10.3(3.6)		.204		
Personality-TIPI						
Extraversion	8.3(2.3)	8.6(2.4)		.414		
Extraverted. enthusiastic	4.8(1.3)	4.9(1.4)		.640		
Reserved. quiet	4.4(1.5)	4.2(1.7)		.380		
Agreeableness	10.4(1.8)	10.4(1.9)		.945		
Sympathetic. warm	5.3(0.9)	5.6(0.9)	2.505	**.013**	-.542	-.064
Critical. quarrelsome	2.8(1.4)	3.2(1.5)		.063		
Conscientiousness	11.9(1.5)	11.8(1.7)		.607		
Dependable. self-disciplined	5.9(0.7)	5.8(0.9)		.193		
Disorganized. careless	2.0(1.1)	2.0(1.2)		.849		
Openness	9.3(2.1)	9.8(2.1)		.076		
Open to new experiences. complex	4.7(1.4)	5.0(1.2)		.147		
Conventional. uncreative	3.4(1.5)	3.1(1.6)		.242		
Neuroticism	6.2(2.3)	6.6(2.5)		.255		
Calm. emotionally stable	5.1(1.2)	4.8(1.4)		.195		
Anxious. easily upset	3.4(1.5)	3.5(1.6)		.604		

ERQ = Emotion Regulation Questionnaire. TIPI= Ten Item Personality inventory

Current psychological symptoms at the time of assessment

A statistically significant higher proportion of nurses reported the presence of post-traumatic stress (χ^2=6.2, p=.012) and insomnia (χ^2=2.5, p=.002) symptoms 3 months after the peak. All data may be found in table 4.

Factors associated with psychological symptoms during the peak of hospitalizations: correlational analyses

Nurses

In nurses, the levels of post-traumatic stress (r=.245, p<.001) and anxious (r=.222, p<.001) symptoms were positively associated with the number of past traumatic experience. The magnitude of post-traumatic stress

Table 3. Mean scores (SD) of retrospectively assessed psychological symptoms (posttraumatic stress, anxiety, depression and insomnia) induced during the peak in nurses and physicians and the p values at 95% confidence interval

	Mean(SD)		t	P value	95% CI of difference	
	Physicians	Nurses			Lower	Upper
Posttraumatic stress symptoms. IES-R						
Total score	17.9(16.2)	27.0(15.5)	-4.410	**<.001**	-13.181	-5.018
Intrusion	8.5(7.1)	12.1(6.6)	-4.139	**<.001**	-5.408	-1.910
Avoidance	5.7(5.5)	8.1(5.5)	-3.501	**.001**	-3.748	-1.044
Hyperarousal	4.5(5.3)	6.8(5.4)	-3.501	**.001**	-3.655	-1.026
Anxious symptoms. HADS	6.6(4.1)	8.5(4.5)	-3.622	**<.001**	-2.919	-0.859
Depressive symptoms. HADS	5.2(4.3)	5.9(3.9)		.226		
Insomnia symptoms. ISI	7.6(6.4)	9.3(6.0)	-1.217	**.028**	-3.312	-0.190

IES-R = Impact of Event Scale – Revised. HADS = Hospital Anxiety and Depression Scale. ISI = Insomnia Severity Index

Table 4. Levels of symptoms of post-traumatic stress, anxiety, depression and insomnia at the time of assessment (3 months after the peak) for physicians and nurses N(%)

	Physicians	Nurses	P value
Posttraumatic stress symptoms. post 3 months			
Yes	45(49)	168(63)	**p=.012**
A little/sometimes	35(39)	134(51)	
Very much	8(9)	30(11)	
Extremely	1(1)	4(1)	
Insomnia symptoms. post 3 months			
Yes	24(27)	90(35)	**p=.002**
A little/sometimes	18(20)	76(30)	
Very much	6(7)	11(4)	
Extremely	0(0)	3(1)	
Depressive symptoms. post 3 months			
Yes	26(30)	111(44)	NS
A little/sometimes	21(24)	91(36)	
Highly	5(6)	20(8)	
Anxious symptoms. post 3 months			
Yes	9(10)	63(25)	NS
A little/sometimes	1(1)	43(17)	
Very much	8(9)	18(7)	
Extremely	0(0)	2(1)	

symptoms also positively correlated with avoidant coping (r=.291, p<.001) and depressive symptoms negatively correlated with approach coping (r=-.262, p<.001). Finally, the intensity of all symptoms correlated with the level of neuroticism (post-traumatic stress: r=.393, p<.001, anxiety: r=.431, p<.001, depression: r=.282, p<.001, insomnia: r=.302, p<.001).

Physicians

In physicians, all symptoms were higher for those reporting having experienced work overload during the peak (post-traumatic stress: r_{pb}=.455, p<.001, anxiety: r_{pb}=.407, p<.001, depression: r_{pb}=.398, p<.001, insomnia: r_{pb}=.391, p<.001). The intensity of all symptoms, except for insomnia, correlated with the level of neuroticism (post-traumatic stress: r=.366, p<.001, anxiety: r=.464, p<.001, depression: r=.385, p<.001). Post-traumatic stress symptoms (r=.402, p<.001) and insomnia (r=.381, p<.001) also positively correlated with avoidant coping.

Psychological symptoms during the peak were not statistically significantly associated with gender, age, education degree, relationship status, past psychiatric history, changes in work schedules, working in a dedicated COVID unit, having been infected with SARS-CoV-2, emotion regulation strategies, or coping style neither for nurses nor for physicians.

Table 5. Predictors of psychological symptoms during the peak of hospitalizations identified by multivariate linear regression in nurses and physicians (part 1)

				Nurses			
Variables	**t**	**p**	**β**	**F**	**df**	**p**	**Adj R^2**
Posttraumatic stress symptoms. IES-R							
Overall model				18.489	3	<.001	.198
Neuroticism	4.915	<.001	.317				
Avoidant coping	3.203	.002	.204				
Anxious symptoms. HADS							
Overall model				29.523	2	<.001	.189
Neuroticism	6.870	<.001	.407				
Nb past traumatic experience	1.739	.083	.103				
Depressive symptoms. HADS							
Overall model				13.981	2	<.001	.100
Approach coping	3.479	.001	.220				
Neuroticism	3.182	.002	.202				
Insomnia symptoms. ISI							
Overall model				23.511	1	<.001	.087
Neuroticism	4.849	<.001	.302				

Overall Model (Model = Enter method in SPSS statistics): F = F-statistic (obtained F-value). df = degrees of freedom. Adj R^2= adjusted R Square. Coefficients of the regression model: t = T-statistic. p = probability of obtaining the observed t-value if the null hypothesis is true. β = standardized coefficient.
IES-R = Impact of Event Scale – Revised. HADS = Hospital Anxiety and Depression Scale. ISI = Insomnia Severity Index

Table 5. Predictors of psychological symptoms during the peak of hospitalizations identified by multivariate linear regression in nurses and physicians (part 2)

				Physicians			
Variables	**t**	**p**	**β**	**F**	**df**	**p**	**Adj R^2**
Posttraumatic stress symptoms. IES-R							
Overall model				12.291	3	<.001	.314
Work overload	3.684	<.001	.367				
Avoidant coping	2.540	.013	.269				
Anxious symptoms. HADS							
Overall model				22.117	2	<.001	.343
Work overload	4.210	<.001	.389				
Neuroticism	4.094	<.001	.378				
Depressive symptoms. HADS							
Overall model				17.088	2	<.001	.284
Work overload	4.168	<.001	.402				
Neuroticism	3.080	.003	.297				
Insomnia symptoms. ISI							
Overall model					2	<.001	.245
Work overload	3.462	.001	.352				
Avoidant coping	3.186	.002	.324				

Overall Model (Model = Enter method in SPSS statistics): F = F-statistic (obtained F-value). df = degrees of freedom. Adj R^2= adjusted R Square. Coefficients of the regression model: t = T-statistic. p = probability of obtaining the observed t-value if the null hypothesis is true. β = standardized coefficient.
IES-R = Impact of Event Scale – Revised. HADS = Hospital Anxiety and Depression Scale. ISI = Insomnia Severity Index

Predictors of psychological symptoms during the peak of hospitalizations: linear regression analyses

Nurses

In nurses, multiple regression models run to predict psychological symptoms during the peak from the statistically significantly correlated factors revealed that neuroticism was the most predictive factor of post-traumatic stress symptoms, anxiety and insomnia. It was also the second predictor of depressive symptoms. Avoidant coping was the second predictor of post-traumatic stress and approach coping was the most predictive factor of depressive symptoms.

Physicians

In physicians, the most predictive factor of all symptoms was work overload. Neuroticism was the second predictive factor of symptoms of anxiety and depression and avoidant coping was the second predictor of post-traumatic stress symptoms and insomnia. All data may be found in table 5.

Factors associated with psychological symptoms at the time of assessment: correlational analyses

In these correlations, persistent symptoms were treated as a binary variable, ie., (still) having symptoms/ not having symptoms (anymore). For both nurses and

physicians and for all symptoms, having persistent psychological symptoms was associated with the level of the corresponding psychological symptoms experienced during the peak (post-traumatic stress: nurses: r_{pb}=.475, p<.001, physicians: r_{pb}=.546, p<.001; anxiety: nurses: r_{pb}=.363, p<.001, physicians: r_{pb}=.443, p<.001; depression: nurses: r_{pb} .399, p<.001, physicians: r=.362, p<.001; insomnia: nurses: r=.496, p<.001, physicians: r=.598 p<.001). Moreover, in both nurses and physicians, having persistent post-traumatic stress and depressive symptoms after the peak of hospitalization was associated with the level of neuroticism (nurses: post-traumatic stress: r_{pb}=.364, p<.001, depression: r_{pb}=.321, p<.001, physicians: post-traumatic stress: r_{pb}=.376, p<.001, depression: r_{pb}=.356, p=.001).

Predictors of persistent psychological symptoms: binomial logistic regression analyses

For both nurses and physicians, neuroticism and post traumatic symptoms during the peak were associated with an increased likelihood of exhibiting persistent post traumatic symptoms. Neuroticism and depressive symptoms during the peak were also predictive of an increased likelihood of exhibiting persistent depressive symptoms. In both occupation, increasing anxiety and insomnia symptoms during the peak were associated with an increased likelihood of exhibiting persistent anxiety and insomnia symptoms, respectively. All data may be found in table 6.

DISCUSSION

The present paper aimed at defining the situational and personal factors that account for the intensity of the symptoms experienced by nurses and physicians during the peak of the first wave and at the time of assessment, 3 months later, to test whether differences exist between the two professions, with the aim of tailoring adapted prevention and intervention. Our results showed that nurses reported higher levels of anxiety, insomnia and post-traumatic stress compared to physicians. The difference was noticeable during the peak of hospitalizations but also 3 months after the peak, with higher intensity of insomnia and post-traumatic stress in nurses. Nurses also reported on average more work overload during the outbreak while physicians reported more changes in work schedules. There was also a higher prevalence among the respondent nurses to work in dedicated COVID units during the outbreak. Concerning psychological characteristics that we probed as other hypothetical influencing factors of psychological symptoms, we found that physicians usually have more recourse to expressive suppression in order to deal with negative emotions compared to nurses. This emotion regulation strategy that involves actively inhibiting the observable expression of emotional experience (Gross and Thompson 2007) is generally considered as a dysfunctional mode of emotion regulation associated with negative affective, cognitive, somatic and social consequences (Moore et al. 2008). Conversely, nurses scored higher on the agreeableness scale of the Big-5 compared to physicians (i.e., they described themselves as more sympathetic and warm). Agreeableness dimension describes generous, helpful, warm, altruistic, caring and nurturing persons (Costa et al. 1991). While agreeableness usually preserves against burnout (Zellars et al. 2000), this personality dimension may however be double-edged, and as suggested by (Periard and Burns 2014), some of its facets as exaggerated altruism and compliance, may lead to the overflow of emotional resources. It is conceivable that during the pandemic, nurses with high agreeableness scores were at greater risk of emotional exhaustion particularly in situations where they could not provide adapted cares to patients and were exposed to dehumanizing conditions of care, when for instance, dying patients were not allowed to see their relatives (Kellogg et al. 2021).

When investigating the correlates of psychological symptoms experienced during the peak separately for physicians and nurses, we found that the level of neuroticism was positively associated with the intensity of all symptoms (post-traumatic stress, anxiety, depression and insomnia) in both nurses and physicians, except for the link with insomnia in physicians. In physicians, all symptoms positively correlated with work overload while in nurses, no statistically significant association was found. Avoidant coping was another factor associated with post-traumatic stress symptoms in nurses and physicians. In physicians, it was also associated with insomnia. In nurses, post-traumatic and anxious symptoms also positively correlated with the number of past traumatic experience and approach coping negatively correlated with depressive symptoms.

Interestingly, gender was not statistically significantly associated with the level of symptoms. Differences in symptoms between nurses and physicians thus do not result from gender differences between both occupations, nor from education level differences or from the higher prevalence of nurses working in direct contact with COVID patients in dedicated COVID units. This last result goes against Chinese studies reporting that HCWs directly caring for COVID-19 patients had higher levels of post-traumatic stress, anxiety and insomnia compared to their counterparts involved in secondary roles or working

Table 6. Predictors of persistent psychological symptoms identified by binomial logistic regression in nurses and physicians

Variables	B	SE	Wald	df	p	Exp(B)	95% C.I. for Odds ratio Lower	Upper	Chi-Square	df	p	Nagelkerke R^2	PAC
Nurses													
Posttraumatic stress symptoms. IES-R													
Overall model									70.87	2	<.001	.372	75.0%
Neuroticism	.210	.074	8.095	1	.004	1.233	1.067	1.425					
Post-traumatic stress symptoms during the peak	.085	.015	30.074	1	<.001	1.088	1.056	1.122					
Anxious symptoms. HADS													
Overall model									33.83	1	<.001	.186	75.1%
Anxiety symptoms during the peak	.198	.037	28.918	1	<.001	1.519	1.134	1.310					
Depressive symptoms. HADS													
Overall model									61.34	2	<.001	.298	70.5%
Depressive symptoms during the peak	.234	.043	29.574	1	<.001	1.264	1.161	1.375					
Neuroticism	.221	.062	12.78	1	<.001	1.247	1.105	1.408					
Insomnia symptoms. ISI													
Overall model									63.95	1	<.001	.320	72.7%
Insomnia symptoms during the peak	.205	.030	47.338	1	<.001	1.227	1.158	1.301					
Physicians													
Posttraumatic stress symptoms. IES-R													
Overall model									29.85	2	<.001	.430	75.3%
Neuroticism	.261	.130	4.013	1	.045	1.298	1.006	1.677					
Post-traumatic stress symptoms during the peak	.089	.027	10.787	1	.001	1.093	1.037	1.153					
Anxious symptoms. HADS													
Overall model									18.44	1	<.001	.388	88.9%
Anxiety symptoms during the peak	.439	.133	10.933	1	.001	1.551	1.196	2.011					
Depressive symptoms. HADS													
Overall model									20.83	2	<.001	.325	73.8%
Neuroticism	.276	.138	4.010	1	.045	1.318	1.006	1.728					
Depressive symptoms during the peak	.215	.073	8.680	1	.003	1.240	1.075	1.432					
Insomnia symptoms. ISI													
Overall model									33.66	1	<.001	.461	80.7%
Insomnia symptoms during the peak	.262	.058	20.582	1	<.001	1.300	1.161	1.456					

Overall model: Nagelkerke R2= variance explained by the model. PAC = Percentage accuracy in classification. Coefficients of the regression model: B = B coefficients. SE = standard error. Wald = Wald statistic test. df = degrees of freedom. p = probability of obtaining the observed t-value if the null hypothesis is true. Exp(B) = change in the odds for each increase in one unit of the independent variable. 95% C.I. for Odds ratio = confidence intervals of the odds ratios.
IES-R = Impact of Event Scale – Revised. HADS = Hospital Anxiety and Depression Scale. ISI = Insomnia Severity Index

in other units (Lai et al. 2020b). An explanation could be that realizing how difficult the situation in China had been for the caregivers in COVID units, the later affected countries put in place more preventive support to those caregivers involved directly in the care of COVID patients (offered meals, more staff, psychological support). This strategy left out HCWs that did not work in specialized units but who also suffered from repercussions of the crisis on their practice, such as lack of staff, changes in protocol, changes of teams or units as well as a general increase in the level of fear related to the situation.

Using multivariate linear regressions, we then explored, separately for nurses and physicians, which factors most predicted each psychological symptoms during the peak. We found that nurses and physicians differed in their strongest predictors of psychological symptoms. In physicians, the strongest predictor of all symptoms was the fact of having been work overloaded. Despite the nurses reporting more work overload compared to physicians, this variable was not associated with any psychological symptoms in nurses. In nurses, the strongest predictor was the level of neuroticism. This factor was the most important predictor of all symptoms except for depression for which the coping style was the strongest predictor, before neuroticism. Coping style was also the second predictor of post-traumatic stress. The other two important predictors of symptoms for physicians were the use of avoidant coping and the level of neuroticism.

Finally, analyses on the predictors of the presence of psychological symptoms after the peak showed that beside the level of psychological symptoms experienced during the peak, neuroticism was the only factor that made a statistically significant contribution to the prediction of some symptoms. It was the most important predictor of post-traumatic symptoms in nurses and physicians and of depressive symptoms in physicians and the second predictor of depressive symptoms in nurses.

In sum, the data showed that compared to physicians, nurses crucially experienced more intense psychological symptoms associated to the COVID situation both during the most pressing moments of the crisis and in the longer term. Factors that played a role in the variance in these symptoms were also different between occupation. In nurses, the most important factor determining experienced psychological symptoms was the level of neuroticism while in physicians, it was the work overload.

Neuroticism is a personality trait (the opposite of emotional stability) characterized by a higher propensity to view situations as threatening and that predisposes the person to feeling angry, anxious, depressed or stressed (Costa Jr. and McCrae 2008). People with higher levels of neuroticism tend to employ less adaptive strategies when faced with negative or stressful situations, i.e., strategies based on avoidance and distraction such as escape, withdrawal, and self-blame (Bakker et al. 2006). Numerous studies conducted in the general population during the COVID-19 pandemic have shed light on neuroticism for its psychopathological consequences during such an extreme environmental context, far beyond socio-demographic aspects (Kroencke et al. 2020). In the HCWs context, before the pandemic, researchers had already highlighted the role of individual variables such as personality in the burnout syndrome frequently encountered in HCWs. In line with our results, they revealed a relationship between emotional exhaustion in nursing and the degree of neuroticism (Cañadas-De la Fuente et al. 2015). Interestingly, studies conducted before the COVID context showed a direct effect of neuroticism on psychological harassment in nurses (Fornés-Vives et al. 2019). Even though not specifically investigated in the present study, the pandemic has gone hand in hand with an increase in the exposure of HCWs to discrimination, stigma, violence, and harassment all over the world (Dye et al. 2020). Difficulties to deal with psychological harassment could underlie part of the psychological symptoms reported in nurses of our sample scoring high on neuroticism trait. In any ways, proactive interventions to improve nurses' emotional stability are needed in order to prevent psychological damage of the pandemic. Contrary to what was originally thought, neuroticism temperament may be responsive to some treatments. For example, mindfulness skills acquired through Mindfulness-Based Cognitive Therapy have been found to predict long-term changes in neuroticism (Armstrong and Rimes 2016). Group cognitive behavior therapy for social anxiety disorder (Glinski and Page 2010) or the Unified Protocol for Transdiagnostic Treatment of Emotional Disorders, a cognitive-behavioral intervention developed to address core temperamental processes in emotional disorders (Barlow et al. 2010) have also shown promising results in decreasing neuroticism (Carl et al. 2014). These approaches would be worth being implemented to especially help nurses deal with emotions linked to the COVID situation but also in "normal times" given the prevalence of stress (Lim et al. 2010) and burnout out (Grau-Alberola et al. 2010) ordinarily in nurses and their links with neuroticism. Reaching lower level of neuroticism should also allow for concerned HCWs to ultimately deploy more adaptative coping strategies, another determining factor of psychological symptoms found in our study. The association between personality and greater risk for experiencing psychological distress is indeed hypothesized to be mediated by maladaptive coping style such as avoidant coping (van Berkel 2009). It has been

showed that personality traits predict coping styles (Brow 2008) and determine the coping style individuals implement (van Berkel 2009). In their review on the causes of occupational stress and burnout in health professions during the COVID-19, (Sriharan et al. 2021) found that in 38% of the studies included, HCWs reported they had to manage increased workload during COVID-19 pandemic, without receiving adequate compensation. Outside the COVID context, work overload has been identified as the main contributor to burnout in physicians (Patel et al. 2018) and is negatively associated with quality of care (Shirom et al. 2006). Attempts to decreasing the workload is a complicated challenge in these times of influx of patients to which is added a shortage of staff due to absenteeism resulting from exhaustion or COVID infection. However, governments, human resources and managers have to take measures to take care of the psychological and physical wellbeing of their overloaded workers. That may include access to healthy food and drinks during working time, rest areas for sleep and recovery, especially for individuals on rapid-cycle shifts who live far from to the hospital, assistance with other tasks as childcare needs (Shanafelt et al. 2020). Recognition of the work accomplished and compensation also seem essential.

Limitations of our study include the retrospective aspect of part of the assessment and the fact that we used a brief measure of the Big-Five personality. This implies diminished psychometric properties. Our choice was driven by the very limited time available to caregivers to complete surveys in these times of covid combined with our aims to reach as many participants as possible and be able to question a large array of factors. Despite the low reliability, the 10-item inventory shows adequate levels of 1) convergent validity with widely used Big-Five measures 2) test-retest reliability, 3) patterns of predicted external correlates, and 4) convergence between self and observer ratings (Gosling et al. 2003). Another limitation of our study is that we did not conduct a formal power analysis for sample size, primarily due to practical constraints related to the context of the pandemic. Future research should consider a formal power analysis to enhance result robustness. Additionally, our study granted participants the freedom not to answer all survey questions, especially those they might find emotionally challenging. While this approach was ethically considerate, it led to variability in the sample sizes across different questionnaires, as some questions were omitted by participants. This variation affected the data's completeness and uniformity, posing potential challenges for interpretation. Also, in handling missing data and outliers, we avoided imputation and kept extreme values to preserve our dataset's natural variability. This choice, while maintaining data integrity, could potentially limit the study's generalizability and introduce some bias which should be considered when interpreting our results.

CONCLUSION

In conclusion, our study distinctly highlights the differential psychological impacts experienced by nurses and physicians during two key timeframes: the peak of the COVID-19 pandemic and three months later. Initially, both nurses and physicians faced substantial stress, but our findings reveal that nurses consistently reported higher levels of anxiety, insomnia, and post-traumatic stress than physicians. This disparity was not only evident during the crisis's peak but remained pronounced even after three months, indicating a more prolonged psychological impact on nurses. Furthermore, our analysis showed that the factors influencing these psychological symptoms also varied between the two professions. For nurses, higher neuroticism significantly predicted their psychological distress both during and post the pandemic's peak. Conversely, in physicians, work overload emerged as a more dominant predictor of their stress levels during the pandemic's peak. These time-based differences in psychological impact and influencing factors between nurses and physicians underscore the necessity for tailored psychological support strategies in both immediate crisis situations and their aftermath. Moreover, the insights gained from this study remain relevant beyond the COVID-19 context. They provide a valuable framework for understanding and addressing the unique mental health needs of healthcare professionals in various high-stress environments, potentially guiding future policies and interventions aimed at reinforcing resilience and well-being in the healthcare sector.

Data availability: The authors confirm that the data supporting the findings of the present study are available within the article. Raw data that support the findings of this study are available from the corresponding author, upon request.

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