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BASIC RESEARCH ARTICLE

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Risk and protective factors for the possible development of post-traumatic stress disorder among intensive care professionals in France during the first peak of the COVID-19 epidemic

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ABSTRACT

Background: Intensive care units (ICU) are among the healthcare services most affected by the COVID-19 crisis. Stressors related to insecurity, unpredictability, patient death and family distress are significant, and put healthcare workers (HCWs) at high risk of post-traumatic stress disorder (PTSD). The aims of this study were to measure the prevalence of post-traumatic stress disorder in HCWs and to identify risk factors and protective factors during the epidemic in France.

Methods: During the first peak of the epidemic (from 22 April to 13 May 2020), we assessed sources of stress (PS-ICU scale), mental health (GHQ-12) and coping strategies (Brief-COPE). Three months later (03 June to 6 July 2020), PTSD was assessed using the IES-R scale, with additional questions about sources of support. Data were collected using self-report questionnaires administered online.

Results: Among 2153 professionals who participated in the study, 20.6% suffered from potential PTSD, mostly intrusion symptoms. Risk factors for the development of PTSD were having experienced additional difficult events during the crisis, having a high level of psychological distress, a high level of perceived stress related to the workload and human resources issues, the emotional burden related to the patient and family, and stressors specific to COVID-19 during the first peak of the crisis. The use of positive thinking coping strategies decreased the relationship between perceived stress and the presence of PTSD, while social support seeking strategies increased the relationship. Finally, the HCWs preferred to use support from colleagues, relatives and/or a psychologist, and very few used the telephone hotlines.

Conclusion: The epidemic has had a strong traumatic impact on intensive care HCWs. Given the risk of PTSD, we need to consider implementing easily-accessible support services that focus on positive thinking coping strategies, during and after the crisis.

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Stress; PTSD; ICU; healthcare professional; Covid-19

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Estrés; TEPT; UCI; trabajador de salud; Covid-19

关键词
应激; PTSD; ICU; 医护专业人员; COVID-19

HIGHLIGHTS

- The risk of PTSD is high among intensive care professionals.
- Perceived stress and psychological distress during the first peak of crisis increased the likelihood of subsequent PTSD.
- Support for professionals should be easily available and focused on positive thinking strategies.

Factores de riesgo y factores protectores para el posible desarrollo de un trastorno de estrés postraumático en profesionales de cuidados intensivos en Francia durante la primera ola de la pandemia por la COVID-19

Antecedentes: Las unidades de cuidados intensivos (UCIs) se encuentran dentro de los servicios de salud más comprometidos por la crisis de la COVID-19. Los factores estresantes asociados a la inseguridad, la impredecibilidad, el fallecimiento de pacientes y la angustia familiar son considerables y colocan a los trabajadores de salud (TS) en un alto riesgo de trastorno de estrés postraumático (TEPT). Los objetivos de este estudio fueron el determinar la prevalencia del trastorno por estrés postraumático en TS e identificar los factores de riesgo y los factores protectores durante la epidemia en Francia.

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The list of co-investigators in the PsyCOVID-ICU trial is provided in the Supplementary Appendix.
Supplemental data for this article can be accessed here.

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Métodos: Durante la primera ola de la epidemia (del 22 de abril al 13 de mayo del 2020) evaluamos fuentes de estrés (mediante la escala de percepción de factores estresantes en la UCI; PS-ICU en sus siglas en inglés), salud mental (mediante el cuestionario de salud general de 12 ítems; GHQ-12 en sus siglas en inglés) y estrategias de afrontamiento (mediante el inventario de la orientación del afrontamiento ante los problemas experimentados; Brief-COPE en sus siglas en inglés). Tres meses después (del 3 de junio al 6 de julio del 2020) se evaluó el TEPT mediante la escala de impacto del evento (IES-R en sus siglas en inglés) y con preguntas adicionales respecto a las fuentes de soporte. Se recolectó la información mediante cuestionarios de autoreporte realizados en línea.
Resultados: De los 2.153 profesionales que participaron en el estudio, 20,6% padecían un potencial TEPT, predominando los síntomas intrusivos. Los factores de riesgo para el desarrollo del TEPT fueron el haber experimentado eventos difíciles adicionales durante la crisis, el tener un nivel elevado de angustia psicológica, un nivel alto de estrés percibido asociado a la carga laboral y a situaciones asociadas a los recursos humanos, la carga emocional relacionada al paciente y su familia, y los factores estresantes específicos de la COVID-19 durante la primera ola de la crisis. El uso del pensamiento positivo como estrategia de afrontamiento disminuía la relación entre el estrés percibido y la presencia del TEPT, mientras que las estrategias relacionadas con la búsqueda de soporte social incrementaban esta relación. Finalmente, los TS preferían emplear el soporte brindado por sus colegas, familiares y/o un psicólogo, mientras que muy pocos preferían el uso de líneas telefónicas de crisis.
Conclusión: La epidemia ha tenido un fuerte impacto traumático sobre los TS de las UCIs. Dado el riesgo de TEPT, se necesita considerar la implementación de servicios de apoyo de fácil acceso que se enfoquen en el empleo del pensamiento positivo como estrategia de afrontamiento, tanto durante como después de la crisis.

在 COVID-19 疫情第一个高峰期间, 法国重症监护专业人员可能发生创伤后应激障碍的风险和保护因素

背景: 重症监护病房 (ICU) 是受 COVID-19 危机影响最大的医疗保健服务之一。与不安全感, 不可预测性, 患者死亡和家人痛苦相关的应激因素很重要, 并使医护人员 (HCW) 面临创伤后应激障碍 (PTSD) 的高风险。本研究旨在是测量疫情期间法国医护人员创伤后应激障碍的流行率, 并确定风险因素和保护因素。
方法: 在疫情第一个高峰期 (2020 年 4 月 22 日至 5 月 13 日), 我们评估了应激来源 (PS-ICU 量表), 心理健康 (GHQ-12) 和应对策略 (Brief-COPE) 。三个月后 (2020 年 6 月 3 日至 7 月 6 日), 使用 IES-R 量表评估了 PTSD, 并附加了有关支持来源的问题。使用在线管理自我报告问卷收集数据。
结果: 在参与研究的 2153 名专业人员中, 20.6%患有潜在 PTSD, 主要是闯入症状。发展创伤后应激障碍的风险因素包括在危机期间经历了额外的困难事件, 有高度的心理困扰, 与工作量和人力资源问题相关的高度感知应激, 与患者和家人相关的情绪负担, 在危机第一个高峰期特定于 COVID-19 的应激源。积极思考应对策略的使用降低了感知应激与 PTSD 发生之间的关系, 而寻求社会支持的策略则增加了这种关系。最后, HCW 更愿意使用同事, 亲人和/或心理学家的支持, 很少使用电话热线。
结论: 疫情对重症监护医护人员有很强的创伤性影响。鉴于 PTSD 的风险, 我们需要考虑在危机期间和之后实施关注积极思考应对策略的易获得的支持服务。

The rapid spread of the epidemic caused by SARS-CoV-2 virus in France in March 2020 led to unprecedented numbers of patients requiring hospitalization and intensive care management. Prior to the epidemic, there were 5,432 intensive care unit (ICU) beds available in France, whereas during the peak of the epidemic in France, more than 80,000 patients were hospitalized and 13,677 required intensive care (French National Public Health Agency, 2020). This massive and increasing influx of contaminated patients put hospitals, and particularly ICUs, under extreme tension. Consequently, healthcare workers (HCWs) working in intensive care units (ICUs) experienced intense stress (Chen, Zhou, Zhou, & Zhou, 2020), leading to the development of significant psychological distress (Laurent, Fournier, Lheureux, Louis, et al., 2021). This stress was related to their risk of being contaminated or of contaminating others, the shortage of trained staff, and the lack of personal protective equipment. Moreover, the high number of patient deaths, combined with the prohibition or restriction of family visits, generated feelings of frustration and helplessness among HCWs (Azoulay et al., 2020). Finally, questions related to bed availability and the possible need to prioritize some patients over others raised ethical and moral dilemmas within healthcare teams in the ICU setting (Robert et al., 2020).

In the context of the COVID-19 pandemic, a high prevalence of burnout has been observed among ICU professionals (Arabi, Murthy, & Webb, 2020; Azoulay et al., 2020; Gomez et al., 2020; Tsan, Kamalanathan, Lee, Zakaria, & Wang, 2021; Wahlster et al., 2021). Not only does the crisis cause exhaustion among, but it also confronts HCWs with intense emotional situations that may have a traumatic impact and generate post-traumatic stress disorder (PTSD). Indeed, several studies have observed an increased risk of PTSD during previous healthcare crises, such as SARS, MERS, and Ebola (Allan et al., 2020; Greene et al., 2021; Liu

et al., 2012; Salazar de Pablo et al., 2020; Wu, Chan, & Ma, 2005). More recently, during the COVID-19 crisis, peritraumatic dissociation was reported among 32% of ICU professionals during the first epidemic peak in France (Azoulay et al., 2020). More generally, a study by Chen et al. (2021) in a cohort of 12,596 nurses revealed that 13.3% of the participants had symptoms of trauma, and 15.2% among personnel who worked in the ICU. The traumatic impact of the current crisis on HCWs (Greene et al., 2021; Salazar de Pablo et al., 2020) and on the general population has been described (Cénat et al., 2021; Olff et al., 2021; Xiong et al., 2020) at a global level.

When faced with potentially traumatic events, most individuals normally do not remain passive but try to implement defensive strategies to deal with the challenge. During previous epidemics, it was reported that family and social support, colleagues and work hierarchy support, positive thinking about the situation, and planning, were all strategies that could help to increase the resilience of HCWs, and reduce the risk of trauma (Carmassi et al., 2020). In France, a number of measures were implemented to provide assistance to HCWs, including gifts and free services (free meals, massages, relaxation sessions, etc.), public recognition (applause at a fixed time each day), and telephone hotlines providing mental health support (El-Hage et al., 2020).

Health crises such as the current COVID-19 pandemic, are particularly traumatic for HCWs and can severely and durably affect their mental health (Laurent, Fournier, Lheureux, Louis, et al., 2021; Laurent, Fournier, Lheureux, Martin Delgado, et al., 2021). Particular attention should therefore be paid to the potential traumatic effects of the pandemic on ICU HCWs, to better understand how they cope with the situation, and what coping mechanisms they used.

In this context, the present study had three objectives: (1) To assess the frequency of symptoms of potential PTSD after the first peak of the epidemic in France; (2) To investigate the factors associated with greater vulnerability to the development of symptoms suggestive of PTSD, and to explore the moderating role of coping strategies in this relation; and (3) to describe the use of help services put in place to aid HCWs during the first 3 months of the epidemic.

1. Methods

1.1. Study design and oversight

The PsyCOVID-ICU study was conducted in 70 hospitals across France from 22 April to 13 May 2020 for Phase I, and from 03 June to 6 July 2020 for Phase II. The complete list of participating hospitals is provided in the Supplementary Table 1.

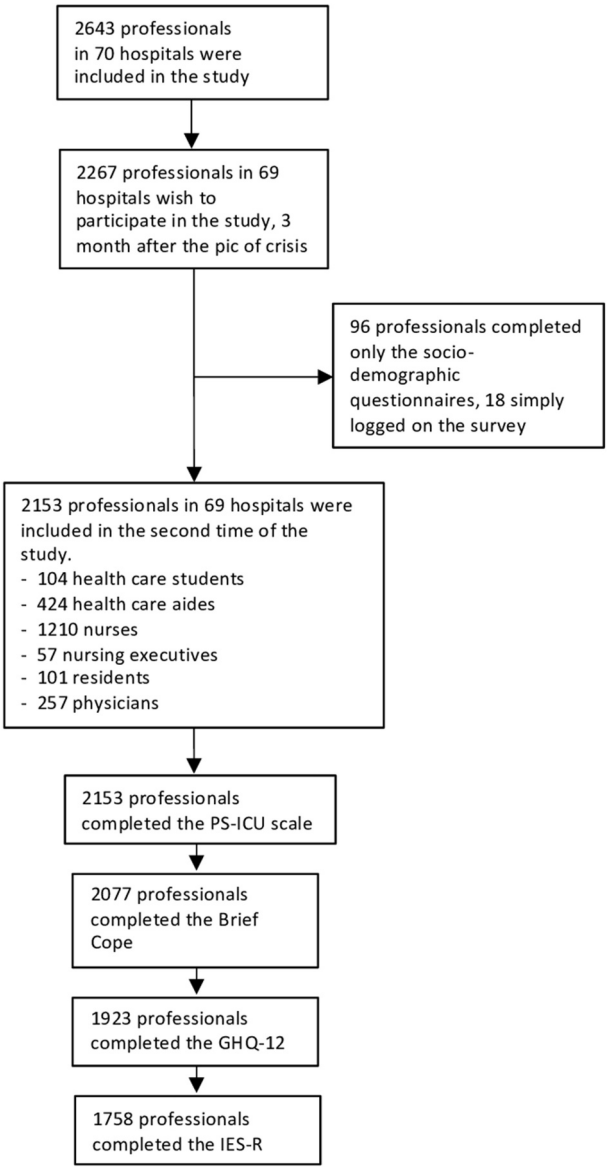

Figure 1. Flowchart of the study population.

This study received approval for all participating centres from the Ethics Committee of the French Intensive Care Society (No. 20-33). The study was overseen by a trial management committee.

1.2. Participants

The study population comprised frontline HCWs directly involved in the diagnosis, treatment, and care of patients with COVID-19 (i.e. physicians, residents, nurses, nurses' aides, students and nursing managers) who consented to participate. Among 2643 participants in Phase I, a total of 2153 (81.46%; median age 20–34 years; 1614 women and 539 men) accepted to respond to the questionnaires in Phase II, 3 months after the first peak of the epidemic (see flowchart of the study population in Figure 1).

Two online questionnaires (one per phase) were administered using the Limesurvey platform. HCWs

were informed orally and via posters in the workplace about the study objectives and procedures. The posters gave the link to access the questionnaire. HCWs were required to read and accept the terms of the study before starting to respond. Responses to the questionnaires were anonymous and confidential.

1.3. Measures in both Phase I (during the first peak of the epidemic) and Phase II (3 months later)

Measures in Phase I. To measure the sources and intensity of stress, we used the PS-ICU scale, a scale specifically developed and validated to measure work-related stress in the ICU context (2021): We also used a 13-item scale of stressors specific the epidemic crisis, developed by Khalid, Khalid, Qabajah, Barnard, and Qushmaq (2016) during the 2015 MERS-CoV outbreak in Saudi Arabia. In total, six dimensions were calculated: 1) Dimension 1 of the Khalid scale: COVID-19-specific stress (α = .87); and 5 dimensions of the PS-ICU scale: 2) Dimension 2: Patient- and family-related emotional load (α = .78); 3) Dimension 3: Complex/at risk situations and skill-related issues (α = .78); 4) Dimension 4: Workload and human-resource management issues (α = .74); 5) Dimension 5: Difficulties related to teamwork (α = .74); 6) Dimension 6: Care provided in sub-optimal or conflictual conditions (α = .66).

Items were rated on a 5-point Likert scale ranging from 0 ('I didn't experience this situation') to 4 ('I experienced this situation, and I was very much stressed').

An overall perceived stress score ranging from 0 to 4 was calculated from the 40 items (α = .91). Next, we assessed coping strategies using the Brief-COPE questionnaire (Carver, 1997). Four types of coping were assessed (social support seeking, problem solving, avoidance and positive thinking) (Baumstarck et al., 2017) that are likely to act as a buffer against stressful events (Kato, 2015). Higher scores reflect a greater tendency to implement the corresponding coping strategy.

To measure the impact of the crisis on the mental health of HCWs, we used the French version of the General Health Questionnaire (GHQ-12) (Salama-Younes, Montazeri, Ismaïl, & Roncin, 2009), which includes 12 items assessing symptoms related to psychological distress and general functioning (Henkel, 2003). It focuses on breaks in normal functioning and not on permanent traits. We used the binary scoring approach (0–0–1–1), which gives a possible score range of 0–12 (Goldberg et al., 1997) (α = .82). A threshold of 3 or more has been used in other studies to identify the presence of distress (Elovanio et al., 2020; Ogundipe, Olagunju, Lasebikan, & Coker, 2014).

Each participant completed a section providing their demographic data (Supplementary Table 1).

Measures in Phase II. Three months after the first peak of the COVID-19 crisis, we assessed PTSD symptoms using the validated French version of the Impact of Event Scale Revised (IES-R) (Brunet, St-Hilaire, Jehel, & King, 2003; Weiss, 2007). The IES-R is a self-report measure of the severity of post-traumatic stress symptoms over the past 7 days, after a traumatic event. In the context of the study, the health crisis was specifically mentioned as the event. The 22 items of the scale are evaluated on a 5-point Likert scale (from 'Not at all' to 'Extremely'). There are three subscales, namely avoidance (α = .86), intrusion (α = .91) and hyperarousal (α = .84). The total score ranges from 0 to 88 (α = .95). More than one month after the potentially traumatic event, a score >33 suggests the presence of PTSD (Creamer, Bell, & Failla, 2003).

We also asked participants to indicate whether they had experienced a difficult life event between Phase I and Phase II, either related to COVID-19 (e.g. they were diagnosed positive for COVID-19 and/or had symptoms of COVID-19; a member of their close family was diagnosed positive for COVID-19 and/or had symptoms of COVID-19) or a life event unrelated to COVID-19.

Finally, among a list of 6 forms of support (support from colleagues, from their hierarchy, telephone hotline, possibility to consult a psychologist, support from family/relatives, signs of recognition (e.g. gifts, free meals, massages, relaxation, public applause)), participants were asked whether they felt they could access each form of support and, if available, whether they had used them between Phase I and Phase II. If the participant indicated that a form of support was available to them and they had used it, then it was coded as 1; if it was available but not used, it was coded as 0, and if it was considered not available, it was coded as −1.

1.4. Definition of epidemic intensity

The intensity of the epidemic for each region was defined according to publicly available data from the French public health agency (French National Public Health Agency (Santé Publique France), 2020). Intensity zones were defined by the ratio of (the maximum number of patients in ICU) to (the maximum number of ICU beds available prior to the crisis). Zones with a ratio >1 were classed high intensity and those with a ratio <1 were classed as low-intensity (Supplementary Table 2).

1.5. Data analysis

Quantitative variables are described as mean ± SD and categorical variables as number (percentage). We compared IES-R and perceived stress scores between

areas with high and low epidemic intensity, using the z test or Welch's F and Tukey statistics, as appropriate.

To identify factors associated with the presence of potential PTSD at 3 months after the first peak of the epidemic, forward stepwise logistic regression analysis was performed with the presence (IES-R > 33) *vs.* absence of PTSD (IES-R ≤ 33) as the dependent variable. All variables likely to influence PTSD score at 3 months were entered into the full model, namely: Variables measured in Phase I, namely: dimensions 1 to 6 of the PS-ICU scale; GHQ-12 score, postponement of days off; having a relative at risk of a severe form of COVID-19; number of night duties; increase in working hours. We also added the variables measured in Phase II: Having experienced a difficult life event related to COVID-19; having experienced a difficult life event unrelated to COVID-19; and socio-demographic variables (sex, marital status, socio-professional category (vs students)).

Then forward stepwise selection was applied. This yields a model considered to be most predictive while also being the most parsimonious, by retaining only variables that increase the proportion of variance explained.

The impact of stress on the severity of post-traumatic stress symptoms depends on the use of specific coping strategies (Kato, 2015). Therefore, we analysed whether the intensity of perceived stress during the crisis (Phase I) affected the possible presence of PTSD symptoms in ICU professionals, as measured by the IES-R score (Phase II), with the effects of stress on PTSD symptoms moderated by the use of the coping strategies measured by the Brief-COPE during the peak of the epidemic (Phase I). We introduced all the coping strategies into the model simultaneously, since any given individual may use one or more coping strategies (Kato, 2015). Moderation was tested by controlling the effect of other predictor variables (variables measured in Phase I: postponement of days off; being a permanent member of ICU staff, living conditions; having a relative at risk of a severe form of COVID-19; number of night duties; increase in working hours; and variables measured in phase II: having experienced a difficult life event related to COVID-19; having experienced a difficult life event unrelated to COVID-19; sex and marital status) as covariates and fixed variables. Hospital affiliation was introduced as a random variable to account for the clustered nature of the data and controlling for sampling heterogeneity. Then, forward stepwise selection was applied.

Finally, we analysed the rate of use of support initiatives by the HCWs. We performed correlation analysis using Pearson's correlation coefficient, to identify associations between perceived stress, and the choice of the form of support (Kato, 2015).

All analyses were performed using R Studio (version 1.4.1103) for Macintosh. The significance threshold was set at $p < .05$.

1.6. Results

1.6.1. Study population

Among 2153 professionals who participated in the study, 788 HCWs were working in low-epidemic-intensity zones, and 1365 in high-intensity zones. The characteristics of the study population are displayed in Table 1. There were 257 physicians, 101 residents, 57 nursing managers, 1210 nurses, 424 nurses' aides, and 104 medical students based in the ICU. More than half were women, and around three quarters (74.08%) were already working in the ICU before the epidemic began.

1.6.2. Impact of the epidemic on the development of PTSD symptoms

At 3 months after the first peak of the epidemic, the mean IES-R score was 19.89 ± 17.65 and 20.60% of ICU HCWs had an IES-R score >33, indicating the likely presence of PTSD. Among those with an IES-R score >33, the mean score was 49.09 ± 11.96 (range 34 to 86). All job categories were affected, notably 24.10% of physicians, 29.68% of residents, 32.78% of nurses, 32.80% of medical students, 34.85% of nursing managers, and 36.36% of nurse's aides. The main symptom was intrusion, which was significantly more frequent than hyperarousal ($p < .001$) or avoidance ($p < .001$).

1.6.3. Factors during the crisis associated with the likely presence of PTSD at 3 months

Multivariable analysis using logistic regression with forward stepwise selection identified 7 factors that were significantly associated with the likely presence of PTSD at 3 months, namely: psychological distress, dimensions 4 (Workload and human resource issues), 2 (Patient- and family-related emotional load) and 1 (items specific to COVID-19) of the perceived stress scale, the fact of having experienced a difficult (non-Covid-related) life event, and being a physician or resident, final regression model $\chi^2(10) = 849.28$; Nagelkerke $R^2 = 0.52$; AIC = 869.28; comparison with full model $\Delta\chi^2(11) = 7.56$ $p = .75$. Being a physician or resident had a protective effect, whereas a high psychological distress score, a high level of perceived COVID-related stress, a strong emotional burden related to patients/families, a high score related to workload or issues with human resources, female sex, and non-COVID-related life events were all associated with a greater risk of possible PTSD.

No other demographic, personal, occupational, or stress-related factors significantly increased the predictive power of the statistical model (Table 2).

Table 1. Sociodemographic data of the study population and according to epidemic intensity.

	Phase I	Epidemic intensity		Phase II	Epidemic intensity	
	Total	Low (%)	High (%)	Total	Low (%)	High (%)
Overall	2643 (100)	942 (35.64)	1701 (64.36)	2153 (100)	788 (36.60)	1365 (63.40)
Number of hospitals	70 (100)	31 (44.29)	39 (55.71)	69 (100)	31 (44.93)	38 (55.07)
Sex						
Women	1920 (72.64)	715 (75.90)	1205 (70.84)	1614 (74.97)	612 (77.66)	1002 (73.41)
Men	723 (27.36)	227 (24.10)	496 (29.16)	539 (25.03)	176 (22.34)	363 (26.59)
Age, y						
20–34	1372 (51.91)	458 (48.62)	914 (53.73)	1061 (49.28)	365 (46.32)	696 (50.99)
35–49	1018 (38.52)	396 (42.04)	622 (36.57)	881 (40.92)	351 (44.54)	530 (38.83)
50–65	248 (9.38)	88 (9.34)	160 (9.41)	207 (9.61)	72 (9.14)	135 (9.89)
> 65	5 (0.19)	0 (0)	5 (0.29)	4 (0.19)	0 (0)	4 (0.29)
Occupational status						
Medical students	143 (5.41)	40 (4.25)	103 (6.06)	104 (4.83)	28 (3.55)	76 (5.57)
Nurses' aides	530 (20.05)	222 (23.57)	308 (18.11)	424 (19.69)	177 (22.46)	247 (18.10)
Nurses	1407 (53.23)	515 (54.67)	892 (52.44)	1210 (56.20)	457 (57.99)	753 (55.16)
Nursing managers	66 (2.50)	27 (2.87)	39 (2.29)	57 (2.65)	22 (2.79)	35 (2.56)
Residents	166 (6.28)	52 (5.52)	114 (6.70)	101 (4.69)	32 (4.06)	69 (5.05)
Physicians	331 (12.52)	86 (9.13)	245 (14.40)	257 (11.94)	72 (9.14)	185 (13.55)
Marital status						
Missing Data	26 (0.98)	7 (0.74)	19 (1.12)	19 (0.88)	7 (0.89)	12 (0.88)
Single/Divorced/Separated/widowed	807 (30.53)	267 (28.34)	540 (31.75)	645 (29.96)	223 (28.30)	422 (30.92)
Married/Living maritally	1810 (68.48)	668 (70.91)	1142 (67.14)	1489 (69.16)	558 (70.81)	931 (68.21)
Increase in working time compared to usual						
Missing Data	122 (4.62)	48 (5.10)	74 (4.35)	83 (3.86)	25 (3.17)	58 (4.25)
No	1204 (45.55)	512 (54.35)	692 (40.68)	1643 (76.31)	643 (81.60)	1000 (73.26)
Yes	1317 (49.83)	382 (40.55)	935 (54.97)	427 (19.83)	120 (15.23)	307 (22.49)
Duration of work experience						
Missing Data	46 (1.74)	15 (1.59)	31 (1.82)	36 (1.67)	12 (1.52)	24 (1.76)
< 5 years	788 (29.81)	243 (25.80)	545 (32.04)	570 (26.47)	184 (23.35)	386 (28.28)
5 to 10 years	734 (27.77)	276 (29.30)	458 (26.93)	614 (28.52)	226 (28.68)	388 (28.42)
>10 years	1075 (40.67)	408 (43.31)	667 (39.21)	933 (43.33)	366 (46.45)	567 (41.54)
Working hours						
Missing Data	45 (1.70)	18 (1.91)	27 (1.59)	55 (2.55)	15 (1.90)	40 (2.93)
Part-time	301 (11.39)	97 (10.30)	204 (11.99)	280 (13.01)	98 (12.44)	182 (13.33)
Full-time	2297 (86.91)	827 (87.79)	1470 (86.42)	1818 (84.44)	675 (85.66)	1143 (83.74)
Pre-COVID position in ICU						
No	707 (26.75)	205 (21.76)	502 (29.51)	558 (25.92)	160 (20.30)	398 (29.16)
Yes	1936 (73.25)	737 (78.24)	1199 (70.49)	1595 (74.08)	638 (80.96)	967 (70.84)

Note: The percentages for high and low epidemic intensity zones were calculated based on the number of participants in each zone; ICU = Intensive care unit

Table 2. Summary of the backward stepwise logistical regression analysis for variable predicting the presence of posttraumatic stress.

Variables	**b** [CI-95%]	*p*	Odds Ratio [CI-95%]	R^2 de Nagelkerke	$\Delta\chi^2$(df)
Initial model AIC = 883.7					
Final model AIC = 869.3				0.52	7.56 (11)
GHQ-12	0.34 [0.28 0.40]	<0.001***	1.41 [1.32 1.51]		
Dimension 1	0.61 [0.34 0.88]	<0.001***	1.85 [1.39 2.45]		
Dimension 4	0.42 [0.18 0.66]	<0.001***	1.52 [1.19 1.93]		
Dimension 2	0.40 [0.17 0.63]	<0.001***	1.50 [1.19 1.87]		
Female	0.22 [−0.02 0.46]	0.060	1.25 [0.99 1.58]		
Other difficult events	0.23 [0.01 0.45]	0.040*	1.26 [1.01 1.57]		
Physicians	−0.93 [−1.62 − 0.24]	0.008**	0.40 [0.20 0.79]		
Residents	−1.26 [−2.34 − 0.18]	0.023*	0.28 [0.10 0.84]		

Note: AIC = Akaike Information Criterion; CI-95% = 95% Confidence Interval; Dimension 1 = COVID-19 stress; Dimension 2 = Patient- and family-related emotional load; Dimension 4 = Workload and human-resources management issues; GHQ-12 = 12-item General Health Questionnaire. Professional categories were compared to students.***$p < .001$; **$p < .01$; *$p < .05$.

1.6.4. Relation between stress intensity, coping strategies during the crisis peak, and the presence of PTSD symptoms at 3 months

The relationship between perceived stress and the likely presence of PTSD at 3 months was significant ($b = 14.03$; 95% CI, 12.49 to 15.57), and was moderated by the use of positive thinking ($b = -2.03$; 95% CI, −3.54 to −0.53) and social support seeking as a coping strategy ($b = 2.03$; 95% CI, 0.23 to 3.83), whereby positive thinking contributed to attenuating the relationship between stress and the likely presence of PTSD, while social support seeking compounded the relationship (final regression model $\chi^2(1372) = 11{,}126$; Nagelkerke $R^2 = 0.43$; AIC = 11,156; comparison with full model $\Delta\chi^2(8) = 14.31$, $p = .07$) (Figure 2).

In addition, being a woman ($b = 2.33$, 95% CI, 1.51 to 3.15), having experienced a difficult life event unrelated to COVID-19 ($b = 2.56$, 95% CI, 1.54 to 3.58), postponement of leave or rest days during the first wave ($b = 0.98$, 95% CI, 0.24 to 1.72), and being

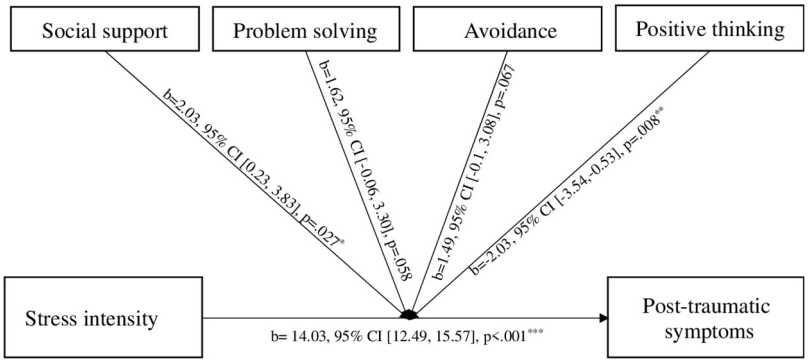

Figure 2. Moderation analysis of coping strategies on the relationship between stress intensity and likely presence of PTSD.

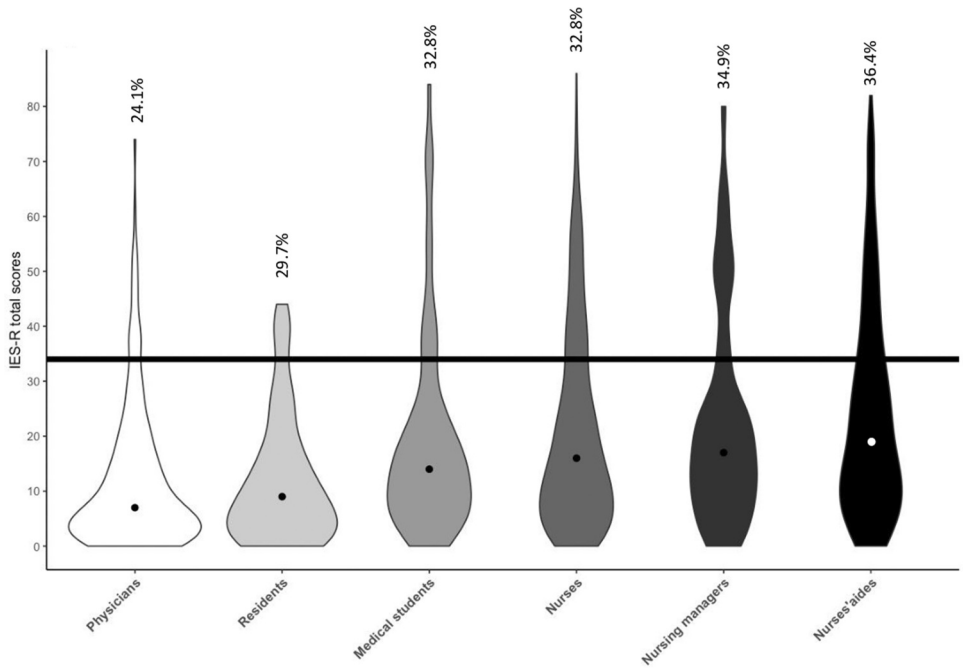

Figure 3. Distribution of IES-R scores according to job category.

a staff member from other departments requisitioned to work in the ICU during the crisis (b = 0.83, 95% CI, 0.01 to 1.67) were associated with an increase in the effect on PTSD of the stress intensity perceived during the first wave (Figure 3).

1.7. Availability and use of support

HCWs preferentially called on their entourage for support (when support was deemed to be available) (78.87%), and less often called on their colleagues (65.97%), volunteers (47.06%), hierarchy (47.06%), psychologist (28.60%) or telephone helplines (2.62%). The majority of HCWs (89.08%) reported that they did not feel the need to call the telephone helpline for support. Support from the hierarchy was the form of support that was felt to be the least available (15.32%) (Table 3).

There was a significant correlation between perceived stress at the first peak of the crisis (Phase I) and seeking support from colleagues (r = .17, p < .001), from family/friends (r = .15, p < .001) and/or from a psychologist (r = .12, p < .001).

2. Discussion

This study underlines the magnitude of the mental health repercussions of the health crisis, three months after the first peak of the epidemic in France. In our study, 20.6% of the HCWs who participated in the study were suffering from the likely presence of PTSD related to the health crisis. The traumatic symptoms were mainly characterized by intrusion symptoms. We observed a high prevalence of likely PTSD across all HCWs affected, when compared with previous reports, which ranged from 13% (11%–16%) (Krishnamoorthy, Nagarajan, Saya, & Menon, 2020) to 21.5% (10.5%-34.9%) (Li, Scherer, Felix, & Kuper, 2021). The World Health Organization estimates that in the general world population, outside of a major healthcare crisis, the rate

Table 3. Perceived availability, and rate of use of various sources of support.

	Not felt to be available (%)	Available, but not used (%)	Available, and used (%)
Support from family/friends	58 (2.81)	378 (18.32)	1627 (78.87)
Support from colleagues	66 (3.19)	637 (30.83)	1363 (65.97)
Volunteers/gifts at work	277 (13.55)	805 (39.38)	962 (47.06)
Support from hierarchy	315 (15.32)	794 (38.62)	947 (46.06)
Psychologist	133 (6.43)	1502 (64.98)	436 (28.60)
Telephone hotline	168 (8.30)	1803 (89.08)	53 (2.62)

of anxiety disorders (including PTSD) is 3.6% (World Health Organization, 2017). In comparison, our findings underline the considerable impact of the COVID-19 pandemic on the mental health of ICU HCWs and should alert to the potential impact on their personal lives and early resignation from ICU work (Mealer, Burnham, Goode, Rothbaum, & Moss, 2009).

An important finding in our study is that the intensity of the epidemic in the area where the HCWs were working during the first peak of the crisis did not influence the development of PTSD. Rather, the PTSD symptoms are related to how the HCWs experienced the first peak of the epidemic. In particular, the intensity of perceived stress and psychological distress contributed to a higher risk of developing likely PTSD. These findings are in accordance with Boals and Schuettler (2009), who emphasize the importance of prevention and support for PTSD patients via measures that do not focus on the objective characteristics of the event itself, but rather on the individual's subjective perception of the event. In the context of the pandemic, it would appear that the stressors affecting HCWs the most, and driving the risk of PTSD, were those related directly to COVID-19 (e.g. contamination, lack of material resources, changing protocols etc), the emotional load (linked to patients and their families), as well as the extra workload and lack of human resources.

In addition, our results highlight that the cumulation of traumatic events related and unrelated to the healthcare crisis puts HCWs at higher risk of developing PTSD. Particular attention should be paid to HCWs who additionally experienced major life events not directly related to COVID-19. Indeed, studies in this area show that patients facing cumulative trauma have significantly higher PTSD severity scores and less improvement following treatment (Priebe et al., 2018).

Finally, female HCWs also appear to be at higher risk of symptoms suggestive of PTSD, which is in line with previous reports (Lai et al., 2020). However, this finding should be interpreted with caution, given that we included a majority of job categories where females are predominant (i.e. nurses and nurses' aides). These specific professions involve a very close relationship with the patient, with prolonged close contact but little decisional capacity regarding management, and may thus be associated with a feeling of performing care procedures or applying protocols that have no meaning (Laurent, Bonnet, Capellier, Aslanian, & Hebert, 2017).

The specificity of the COVID-19 pandemic could explain the strong intensity of symptoms suggestive of PTSD observed in this study, particularly the intrusion symptoms. Indeed, the media infodemic, the uncertainty as to when the crisis might end, and the risk of infection, made it virtually impossible for HCWs to escape from the crisis context and think about other things. The current pandemic is exposing HCWs to a constantly present threat, yet without them having any control over it, leading them to remain permanently in a state of stress and on high alert. This phenomenon as 'continuous traumatic stress', which impairs a person's capacity to keep their bearings and mobilize the psychological resources necessary to cope or deal with additional stressors (Hobfoll et al., 2008; Lahav, 2020). These persons may become especially exhausted and may display post-traumatic symptoms that persist after the event, with pronounced symptoms such as anxiety, powerlessness, somatization, depression and constant worry about the future (Nuttman-Shwartz & Shoval-Zuckerman, 2016).

To prevent the occurrence of these symptoms, a wide range of support systems were put in place during the crisis in France. It should be noted that some of these support options were not used by workers, particularly the telephone hotlines for mental health support. Calling a telephone helpline forces the HCWs to take an active and initiating role in the support process. In addition, the telephone hotline is a faceless, impersonal initiative. Conversely, the HCWs seem to have given precedence to more personal and directly available forms of support, such as support from relatives, colleagues, hierarchy and psychologists in the unit or hospital. However, while the HCWs in our study may have used support that was easily available to them, there is no indication that this was effective in dealing with the crisis. In fact, according to our results, seeking social support, as a coping strategy, does not seem to have enabled them to cope with the traumatic effect of the crisis. Colleagues and family, themselves impacted by the crisis, may not have been able to provide the support necessary to help mitigate the traumatic impact of the crisis. However, our study shows that the HCWs who used positive thinking as a coping strategy (e.g. finding a way to see the situation in a positive light, focusing on the good things, humour) seem to have been more effective in dealing with the traumatic effects of the crisis. This enables them to regulate negative emotions

and transform them into more positive ones (Garnefski et al., 2002). This strategy is usually implemented when the individual finds themselves in a situation that they cannot control. This finding may be especially important in the implementation of support systems for HCWs. Indeed, the experience of positive emotions may promote resilience processes (Garnefski et al., 2002; Tugade & Fredrickson, 2004) and may facilitate the development of certain cognitive abilities such as attention, creativity and cognitive flexibility (Wang, Chen, & Yue, 2017). There does not appear to be any consensus regarding the possible content of programmes to promote resilience, likely due to the complexity of defining and operationalizing the term 'resilience', which encompasses a range of different theoretical fields (Bonanno, 2021; Kunzler et al., 2020; Leppin et al., 2014). Nevertheless, our results highlight the importance of according weight to positive thinking among HCWs as a possible strategy to deal with potentially traumatic events that last a long time and over which no control is possible.

Our study has some limitations. Firstly, it was performed in France only and therefore, the findings may not be generalizable to other countries with different healthcare systems. However, given that the pandemic is affecting the whole world, with a major impact on ICUs everywhere, our results can nonetheless serve as a benchmark underscoring the importance of evaluating PTSD, and treating those affected. Second, all participants in our study volunteered to answer the questionnaires, and this may lead to a risk of bias, since those who responded may have been more particularly concerned by the question of suffering in the workplace. Nevertheless, in view of the observed rates of mental health disorders, it is likely that HCWs in France were markedly affected by the pandemic. Third, the PS-ICU scale used to evaluate stress in the ICU was developed very recently, which limits the possibility of comparison with other studies. It nonetheless enabled us to use an appropriate tool developed specifically for the ICU context, taking account of the unique features of the ICU environment (Laurent et al., 2020). It is also important to note that although the assessment of the traumatic impact was specifically focused on the crisis, the ICU population has long been reported to present a high prevalence of PTSD (Levi, Patrician, Vance, Montgomery, & Moss, 2021; Mealer et al., 2009; Mealer, Jones, & Moss, 2012). Thus, we must remain cautious in interpreting our results regarding the prevalence of PTSD following the health crisis. Further studies are warranted to follow the traumatic impact of this pandemic over the long term. Finally, although we measured the perception of the availability of support and self-reported rate of use, we were unable to evaluate the effect of this support on the HCWs. However, these results are part of an ongoing longitudinal study that in the longer term, will provide further insights into the relevance and efficacy of support solutions put in place during the healthcare crisis.

2.1. Conclusion

At 3 months after the first peak of the epidemic in France, the traumatic impact and intensity of symptoms suggestive of PTSD are high in HCWs working in the ICU, and represent a major risk of interference with the daily personal and professional lives of these HCWs. This is important given the persisting nature of epidemic, and raises the spectre of progressive exhaustion of individual resources in ICU HCWs. Accompaniment for HCWs during and after peaks of the epidemic is of prime importance to prevent these psycho-traumatic disorders from becoming a chronic phenomenon. The findings of our study invite us to focus on easily available forms of support in the ICU, with a view to helping professionals to distance themselves from what they are experiencing, to readjust their emotions and better cope with an intense and lasting traumatic context.

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Disclosure statement

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Ethics approval

This study received approval for all participating centers from the Ethics Committee of the French Intensive Care Society (No. 20-33).

Data availability

https://osf.io/wpq9a/

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