



Article

Prevalence of post-traumatic stress disorder (PTSD) in healthcare workers following the first SARS-CoV epidemic of 2003: A systematic review and meta-analysis

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Abstract: Past epidemic can inform us on psychological consequences in healthcare workers (HCWs). Therefore, we conducted a systematic review and meta-analysis on the prevalence of post-traumatic stress disorder (PTSD) in HCWs following the first epidemic of severe acute respiratory syndrome coronavirus (SARS-CoV) in 2003. PubMed, Embase, Google Scholar, Psychinfo and Web of Science were searched until July 2022. Random-effects meta-analysis were stratified by time of follow-up. We included 14 studies: 4842 HCWs (32.0 years old, 84% women). Overall prevalence of PTSD was 14% (95CI 12 to 21%). Prevalence of PTSD was 16% (8 to 24%) during the epidemic, 19% (16 to 22%) within the 6 months after the epidemic, and 8% (4 to 13%) more than one year after the end of the epidemic. The longest follow-up was three years after the epidemic, with 10% of HCWs in PTSD. Nevertheless, the prevalence of PTSD was significantly lower more than one year after the end of the epidemic than the first six months after the epidemic (Coefficient -10.4, 95CI -17.6 to -3.2, $p=0.007$). In conclusion, prevalence of PTSD in HCWs was high during the first epidemic of SARS-CoV in 2003 and remained high in long term. Lessons from SARS-CoV-1 epidemic may help to prevent a wave of PTSD following the Covid-19 pandemic.

Keywords: Public health; mental health; occupation; infection; predictive strategy

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1. Introduction

Post-traumatic stress disorder (PTSD) is a public health problem, increasing risk of suicide and other psychiatric disorder.[1–3] Healthcare workers (HCWs) are in front line in the care of patients in any epidemic[4] and are at risk of PTSD.[5] The current context of global pandemic caused by SARS-CoV-2 is putting health staff to the test physically and psychologically.[4] A tsunami of PTSD may follow the SARS-CoV-2 pandemic.[6] Exploring prevalence of PTSD following previous epidemics may inform us on the psychological consequences of the SARS-CoV epidemic.[7–9] In 2003, the first SARS-CoV epidemic limited its spread mostly to Southeast Asia and Canada.[10] Despite some studies

attempted to describe PTSD in the HCWs who took care of patients during the first SARS-CoV epidemic,[11–13] no robust conclusions were made on the prevalence of PTSD in those HCWs. Several questionnaires have been proposed to assess symptoms of PTSD, such as Impact Event Scale (IES)[14,15] or its latest revised edition (IES-R),[16] and Distress Tolerance Scale (DTS).[17,18] The occurrence of PTSD increases over the first year following a stressful event.[19] PTSD can also be a chronic disease that evolves with time and treatment,[2,3] however long-term consequences of the first epidemic of SARS-CoV is under debate. Although never demonstrated in HCWs in contact with SARS-CoV patients, it seems that dose-response can be applied to PTSD.[20,21] Some sociodemographic also happen to be predictive of people at risk of PTSD, such as being a women.[2,3,22]

However, HCWs the most at risk of PTSD during an epidemic is not well known. Therefore, we aimed to conduct a systematic review of the literature and meta-analysis on the prevalence of PTSD in HCWs. Secondary objectives were to assess if the time from the epidemic impacted on prevalence, and to determine whether direct contact with SARS-CoV patients affected the prevalence of PTSD, and to identify sociodemographic that may contribute to the risk of PTSD in HCWs.

2. Materials and Methods

Literature search

We reviewed all studies involving all psychological and psychiatric issues in HCWs following the first SARS-CoV epidemic of 2003. The main databases (PubMed, Embase, Psycinfo, Web of Science and Google Scholar) were searched using the following keywords: (« Health care workers » OR “Healthcare workers”) AND (« Psychological disorder » OR « Psychiatric disorder ») AND («SARS-CoV» NOT « SARS-CoV-2 » NOT « COVID ») until September 2022 (details of the search strategy are listed in [Appendix 1](#)). To be included, studies had to describe our main primary outcome i.e. to describe PTSD in HCWs population during or following the first SARS-CoV epidemic of 2003. We excluded studies that assessed PTSD in patients or other psychological disorder. All articles compatible with our inclusion criteria were included, independently of years of publication. We limited our search to articles written in English. We imposed no limitation on regional origin. Studies needed to be primary research. In addition, reference lists from all publications meeting our inclusion criteria were manually searched to identify any further studies that were not found with the electronic search. Ancestry searches were also completed on previous reviews to locate other potentially eligible primary studies. The search strategy is presented in [Figure 1](#). Two authors (Bastien Alberque and Rez Bagheri) conducted the literature searches, reviewed the abstracts and articles independently, checked suitability for inclusion, and extracted the data. When necessary, disagreements were solved with a third author (Frédéric Dutheil).

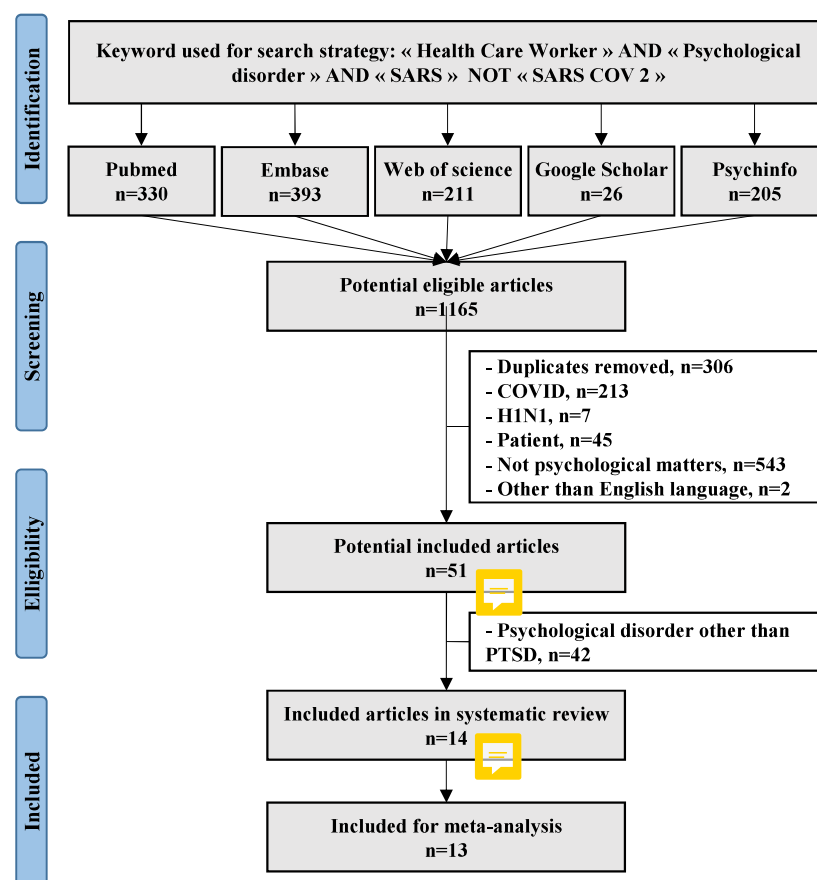


Figure 1. Flow chart.

Data extraction

The primary endpoint was the analysis of PTSD in HCWs population during the SARS-CoV epidemic of 2003. The data collected included first author's name, publication year, study design, main and secondary outcome of each study, as well as inclusion and exclusion criteria, sociodemographic (sample size of HCWs, age, percentage of males, marital status, number of HCWs having children, seniority and occupation), and the measures and prevalence of PTSD (number of PTSD, tool assessment and related scores, time from the epidemic, working in department with high or low contact with patients infected by SARS-CoV-1).

Quality of assessment

We used two grids to check the quality of included articles.[23,24] For the Newcastle-Ottawa Scale (NOS), each item was assigned a judgment of “Yes” (1 point), “No” (0 point), or “Can’t say” (0 point) (Figure 2 and Appendix 2). We also used the “STrengthening the Reporting of OBservational studies in Epidemiology” (STROBE – 32 items/sub-items).[25,26] The STROBE Statement is a checklist related to the title, abstract, introduction, methods, results and discussion sections of articles (Appendix 2). For both the NOS and STROBE checklists, we attributed one point per item or sub-item, then converted into an overall percentage reflecting the quality of each article.

Statistical considerations

We used Stata software (v16, StataCorp, College Station, US) for the statistical analysis. Main characteristics were synthesized for each study population and reported as mean

± standard deviation (SD) for continuous variables and number (%) for categorical variables. When data could be pooled, we conducted random effects meta-analyses (DerSimonian and Laird approach) to assess the prevalence of PTSD in HCWs. We stratified our results by time from the epidemic (during the epidemic, 1 to 6 months after the end of the epidemic, and more than one year after), and by contact (low and high) of HCWs with patients infected by SARS-CoV-1. We evaluated heterogeneity in the study results by examining forest plots, confidence intervals (CI) and I-squared (I^2). I^2 is the most common metric to measure heterogeneity between studies, ranging from 0 to 100%. Heterogeneity is considered low for $I^2 < 25\%$, modest for $25 < I^2 < 50\%$, and high for $I^2 > 50\%$. We also searched for potential publication bias by examining funnel plots of these meta-analyses. We verified the strength of our results by conducting further meta-analyses after exclusion of studies that were not evenly distributed around the base of the funnel. When possible (sufficient sample size), meta-regressions were proposed to study the relationship between prevalence of PTSD, and time from the epidemic, contact with SARS-CoV-1 patients, and sociodemographic (age, sex, marital status, children, seniority, and occupation). A particular attention was paid for the scale used to assess prevalence and symptoms of PTSD. Results were expressed as regression coefficients and 95% CI. P-values less than 0.05 were considered statistically significant. Finally, we repeated all meta-analyses and meta-regressions on scores of PTSD, for each dimension of the IES: IES-total, IES-intrusive, and IES-avoidance.

3. Results

An initial search produced a possible 1165 articles (Fig 1). Removal of duplicates and use of the selection criteria reduced the number of articles reporting PTSD in HCWs to 14 articles for the systematic review[11–13,28–38] and 13 articles for the meta-analysis – we excluded one study because there was no number or scores of PTSD.[33] All included articles were written in English. Descriptive characteristics of included articles are summarized in Table 1.

Study designs of included studies

Included studies were published from 2004[28,30,35,37] to 2009.[11] All studies were cross sectional except two cohort studies,[13,31] and all studies were conducted in South-East Asia except two studies in Canada.[13,32]

Quality of articles

Using the NOS criteria, quality of included studies was good with a mean score were $75.0 \pm 28.0\%$, ranging from 25%[37] to 100%[11,13,28,29,34,36] and thus heterogeneity between studies. They performed worst in controlling for confounders, as well as in lack of details surrounding the exposure (Figure 2 and Appendix 2). Using STROBE, scores were $62.8 \pm 7.2\%$, ranging from 56.3%[28] to 71.9%.[31] Most studies performed less in transparency regarding and addressment of missing data, the absence of flow chart, bias description and description of statistical analyses (Appendix 2). All studies mentioned ethical approval, except four.[28–30,35]

Study	Country	Design	Category of HCWs	Contact High/Low	Hospital departement	n	Age, years	Sex, % men	PTSD		Measurement Time			
									n	Scale				
Chan 2004	Singapour	Cross-sectionnal	Doctors/Nurses	High	SARS unit	106	n per age group	-	20	IES	2 months after epidemic			
			Doctors/Nurses	Low	Non SARS unit	555			107					
Chen 2005	Taiwan	Cross-sectionnal	Nurses	High	Sars unit	86	26.5 ± 3.1	0	-	IES	During the epidemic			
				Low	Non SARS unit	42								
Chong 2004	Taiwan	Cohort	All	High/Low		1257	31.8 ± 6.43	18.9	-	IES				
Lancee 2008	Canada	Cohort	All	High	ED, SARS unit,	448	41.3 ± 10.2	14	4	IES	1 year after epidemic			
					ICU	139	45.0 ± 9.6	13	2		2 years after epidemic			
Lin 2007	Taiwan	Cross-sectionnal	All	High	ED	66	33.5	7.6	13	DTS-C	1 month after epidemic			
				Low	Psychiatry	26	34.5	11.5	5					
Lu 2006*	Taiwan	Cross-sectionnal	Medical doctors	High	SARS unit	24	36.5 ± 6.7	100	-	-	During the epidemic			
			Nurses			49	31.6 ± 5.5	6.1						
			Other HCWs			54	31.1 ± 7.6	48.1						
Maunder 2006	Canada	Cross-sectionnal	All	High	SARS unit	587	n per age group	14	81	IES	1 year after epidemic			
				Low	Non SARS unit	182		10.4	15					
McAlonan 2007	Hong-Kong	Cohort	All	High		106	n per age group	29.2	-		During the epidemic			
				Low		70		24.3						
				High		71		33.8			IES-R	1 year after epidemic		
				Low		113		37.1						
			Physiotherapist	Low	Rehabilitation unit	18	n per age group	-	2	IES				
Sim 2004	Singapour	Cross-sectionnal	Occupationnal therapist			13		2	During the epidemic					
			Speech therapist			3		1						
Su 2007	Taiwan	Cohort	Nurses	High	SARS ICU	26	31.5 ± 6.2	0	10	DTS-C	During the epidemic			
				High	Regular SARS unit	44	29.8 ± 7.6		13					
					ICU	17	32.7 ± 4.3		2					
				Low	Neurology	15	25.4 ± 3.7		4					
Tham 2004	Singapour	Cross-sectionnal	Doctors	High	Emergency	38	31.6 ± 4.4	65.8	5	IES	6 months after epidemic			
			Nurses			58	32.1 ± 9.2	8.6	12					
Verma 2004	Singapour	Cross-sectionnal	General practitioner	High		32	45.0 ± 11.2	60.6	-	IES	During the epidemic			
			Traditionnal Chinese Medicine	Low		682	50.1 ± 9.0	59						
				High		1								
Wu 2008	China	Cross-sectionnal	All	High		549	n per age group	23.5	55	IES	3 years after epidemic			
Wu 2009	China	Cross-sectionnal	All	High	SARS unit	135	n per age group	23.5	26	IES-R	3 years after epidemic			
				Low	Non SARS unit	414			29					

Table 1. Characteristics of included studies

Risk of bias summary

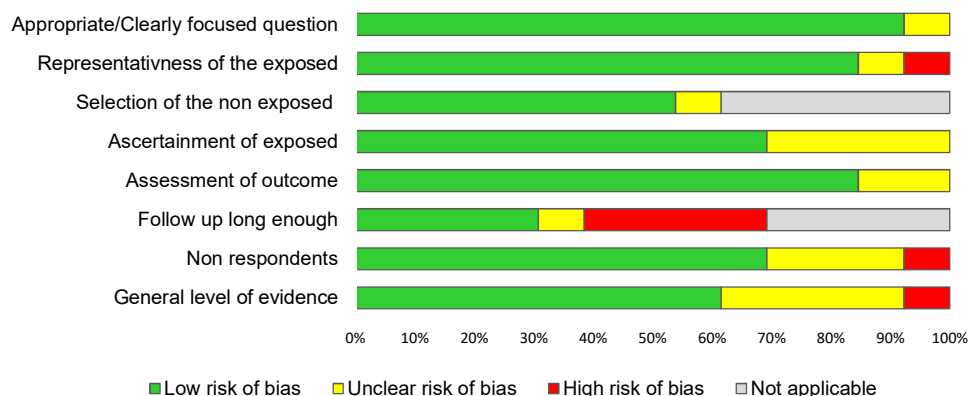


Figure 2. Summary of risk of bias.(SIGN.

Aims of included articles

All studies shared the main objective of assessing psychological or psychiatric impact of the SARS-CoV-1 epidemic of 2003 in HCWs, except one study that had the main objective of assessing the alcohol use in HCWs exposed to the SARS-CoV-1 outbreak.[38] More specifically, six studies aimed to assess psychological impact and symptom of distress,[11–13,28–30,35] four studies assessed the psychiatric morbidity of the 2003 epidemic,[31,32,36,37] and one study was on perceived stress during and after the epidemic.[34] Twelve of the thirteen included studies mentioned secondary objectives: to evaluate the impact of the epidemic on HCWs life in six studies,[12,28,30,31,35,37] to search for factors associated to distress in five studies,[13,29,32,34,36] and to search for a relation between PTSD and alcohol abuse in one study.[38] In total, only two studies directly named PTSD, but only in their secondary objectives.[34,38]

Inclusion and exclusion criteria of included studies

All included studies were on HCWs and on voluntary basis. All studies were conducted on hospital ground, either monocentric[11,12,28–31,35,36,38] or multicentric,[13,32,34] except one study that was conducted outside an hospital.[37] Occupations included differed between studies: only nurses,[29,36] only doctors,[37] nurses and doctors,[28,31] and all HCWs with[11,30,35,38] or without administrative staff.[12,13,32,34] Only two studies had exclusion criteria: no comprehension of the questionnaire or no contact with SARS-CoV-1 patients,[31] and a psychiatric history or whether HCWs contracted the virus.[34]

Population

Sample size ranged from 47[35] to 1257[30] HCWs, for a total of 4842 HCWs. Age was reported in all studies. The mean age of HCWs was 32.0 (95CI 29.2 to 34.7). Sex was reported in all studies except two.[28,35] The proportion of men was 16% (95CI 13 to 18%), ranging from 0[29,36] to 60.6%.[37] Marital status was described in eleven studies.[11–13,28–31,33,35,36,38] HCWs having children or not was described in three studies[13,29,36] Other parameters were described in few studies like religion,[31] ethnicity,[28,35,37] education,[11,33,34,38] previous psychological distress[32] and seniority.[29–32,36]

Assessment of PTSD

Among the thirteen included studies, eleven studies assessed PTSD with the IES scale,[11,13,28–32,34,35,37,38] and two with the DTS scale.[12,36] All studies reported prevalence of HCWs with PTSD, except four that reported only scores using the IES scale.[30,34,37]

The IES was initially a questionnaire or self-questionnaire of 15 items (IES), that was used in seven of included studies,[13,28–32,35,38] then revised in a version with 22 items (IES-R), used in four studies.[11,34,37,38] All items were scored on a 5-point Likert scale ranging from 0 to 4 (0=not at all, 4=extremely), for a total score ranging from 0 to 60 for the IES,[14,15] and from 0 to 88 for the IES-R.[16] The IES assesses two dimensions: the IES intrusive that represents the ideas that disturb the normal thinking of a person, and the IES avoidance that represents action a person would take to avoid a situation. The IES-R added a third dimension: the IES hyperarousal that assesses trouble concentrating, anger, irritability, and hypervigilance. IES score represents the risk of PTSD: the higher the score, the higher the risk. The cut-off for symptomatic PTSD on IES score is under debate. Consequently, cut-offs varied between our included studies: IES>20,[11,38] IES>25,[13,31] IES>30[28,35] and IES>35.[29] Four studies did not report the cut-off used.[30,32,34,37]

The DTS is a self-report 17-item Likert-scale assessing the 17 symptoms of PTSD listed in the DSM-IV.[17] All items evaluated frequency and severity of symptoms, each scored on a 5-point Likert scale ranging from 0 to 4 (0=never/no stress, 4=every

day/extremely stressed), for a total score ranging from 0 to 136 (0 to 68 for severity and 0 to 68 for frequency). Similarly to IES, the higher the score, the higher the risk of PTSD. Despite both frequency and severity scores can be determined, the two studies that used the DTS scale reported only prevalence.[12,36] They used the Chinese version (DTS-C) that was developed for Chinese-speaking individuals,[18] also including 17 items on two Likert scales (frequency/severity) from 0 to 4. The most common cut-off for PTSD is a DTS score >40/138.[17] In our meta-analyses, one study used a cut-off >23[36] and one >40.[12]

Characteristics of exposure

Time from the epidemic was reported in all studies: during the epidemic in six studies,[29,30,34–37] 1 to 6 month after the epidemic in three studies,[12,28,31] and more than one year after the epidemic in five studies.[11,13,32,34,38] The longest follow-up in included studies was 3 years.[11,38] Contact with the SARS-CoV-1 was reported in all included studies. We defined as “high contact” the HCWs who took care of patients affected by SARS-CoV-1 or who were working in SARS departments, and as “low contact” other HCWs. Twelve studies described HCWs in high contact with the virus,[11–13,28–32,34,36–38] seven studies compared “high contact” and “low contact” HCWs,[11,13,28–30,36,37] and one study included only “low contact” HCWs.[35]

Meta-analysis of prevalence of PTSD in HCWs population

The overall prevalence of PTSD was 14% in HCWs (95CI 12 to 17%). More specifically, the prevalence was 16% (8 to 24%) during the epidemic, 19% (16 to 22%) between 1 to 6 months after the end of the epidemic, and 8% (4 to 13%) more than 1 year after the epidemic. On the overall timeline, HCWs with high contact with the virus had a prevalence of PTSD of 15% (10 to 19%) and those with low contact with SARS-CoV1 had a prevalence of 12% (7 to 17%). Stratified meta-analysis by time and by contact with SARS-CoV1 showed a prevalence of PTSD of 22% (11 to 33%) in HCWs with high contact and 9% (2 to 17%) in those with low contact during the epidemic, 18% (14 to 23%) and 19% (16 to 23%) in high and low-contact HCWs between 1 to 6 months after the end of the epidemic, and 9% (3 to 14%) and 7% (5 to 9%) more than 1 year after the epidemic. Most I^2 were high (>80%) highlighting heterogeneity between results (Figure 3 and Figure 4).

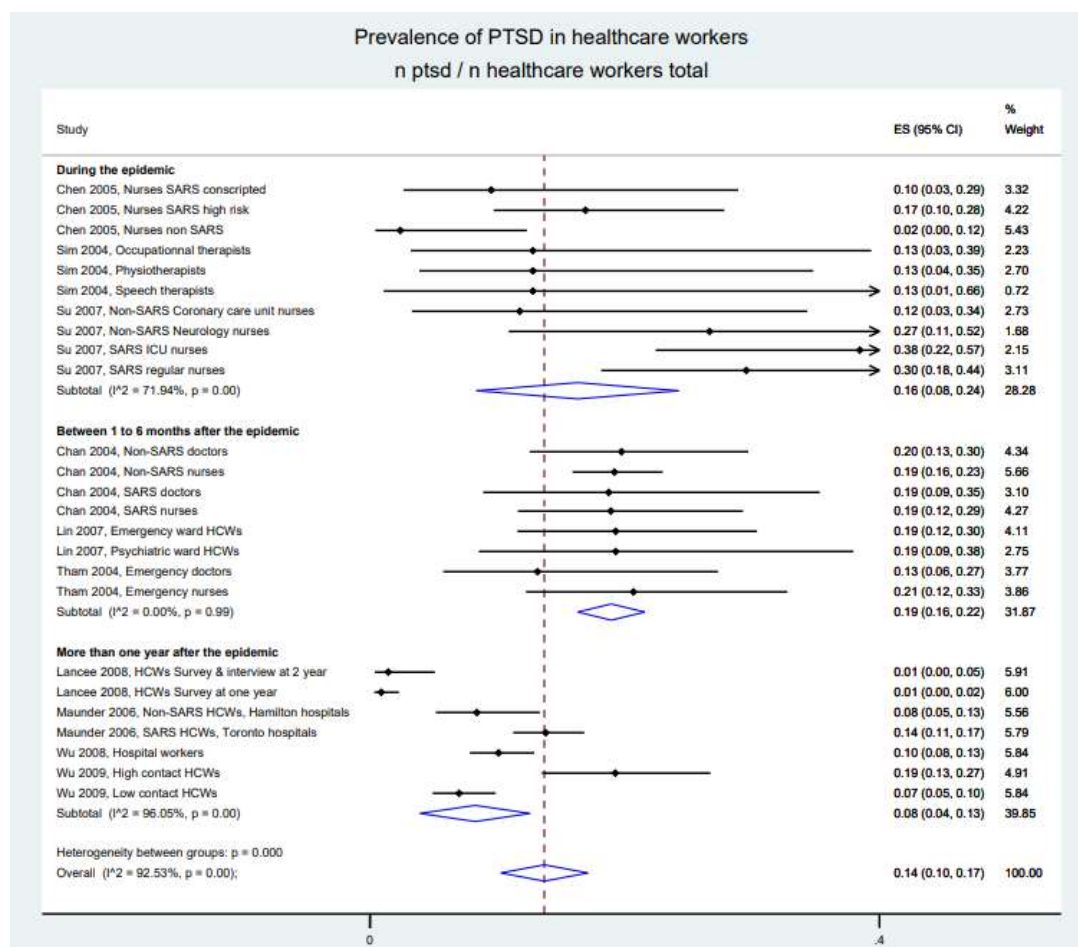


Figure 3. Meta-analysis on prevalence of post-traumatic stress disorder following the SARS-CoV-1 epidemic of 2003, by period of follow-up.

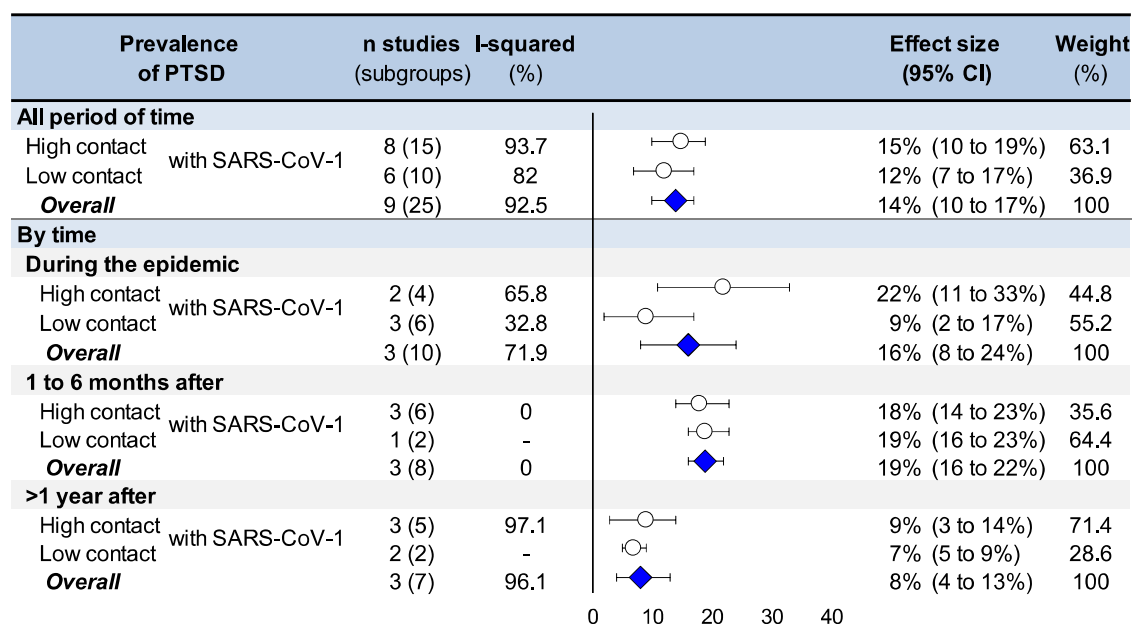


Figure 4. Summary of meta-analysis on prevalence of post-traumatic stress disorder following the SARS-CoV-1 epidemic of 2003, by contact with SARS-CoV-1 (high or low contact) and by time (follow-up).

Meta-analysis of IES score in HCWs population

IES total score was 10.5 (95CI 6.4 to 14.6): 20.0 (17.7 to 22.3) in HCWs with high contact and 8.2 (2.9 to 13.6) in HCWs with low contact with the SARS-CoV1. More specifically, IES total was 15.1(7.2 to 23) during the epidemic: 20.8 (17.9 to 23.8) in high contact and 7.7 (2.2 to 13.2) in low contact HCWs; and 12.6 (4.4 to 20.8) between one to six months after the epidemic: 18.0 (11.7 to 24.4) in high contact and 15.7 (-5.1 to 36.5) in low contact HCWs.

IES avoidance score was 5.0 (95CI 2.7 to 7.3) over the whole timeline: 8.8 (4.0 to 13.6) in HCWs with high contact and 3.9 (1.3 to 6.5) in HCWs with low contact with the SARS-CoV1. More specifically, IES avoidance was 6.3 (2.7 to 9.9) during the epidemic: 11.7 (3.7 to 19.7) in high contact and 4.7 (1.0 to 8.5) in low contact HCWs; and 7.4 (2.1 to 12.7) between one to six months after the epidemic: 7.2 (1.2 to 13.1) in high contact and 8.4 (-3.2 to 20.0) in low contact HCWs.

IES intrusive score was 6.2 (95CI 3.7 to 8.7) over the whole timeline: 6.5 (3.0 to 10.1) in HCWs with high contact and 5.9 (2.4 to 9.3) in HCWs with low contact with the SARS-CoV1. More specifically, IES intrusive was 7.1 (3.8 to 10.4) during the epidemic: 13.2 (5.6 to 20.8) in high contact and 5.7 (2.0 to 9.3) in low contact HCWs; and 4.7 (0.7 to 8.7) between one to six months after the epidemic: 5.1 (1.4 to 8.8) in high contact and 7.2 (-2.7 to 17.2) in low contact HCWs.

Most I^2 were low (<15%) for IES total, IES avoidance and IES intrusive. IES arousal was never reported, and other IES scores were never reported more than one year after the end of the epidemic (Appendix 3 and Appendix 4).

Meta-regression and influencing factors

The prevalence of PTSD was lower than one year after the end of the epidemic compared to 1 to 6 months after the epidemic (Coefficient -10.4, 95CI -17.6 to -3.24, $p=0.007$), and tended to be lower compared to during the epidemic (-6.63, -14.2 to 0.96, $p=0.084$). HCWs with children were more at risk of PTSD (0.85, 0.27 to 1.42, $p=0.13$). There was no significant effect of contact with the virus (high vs low) or sociodemographic (age, sex,

marital status) (Figure 5). No factors influencing IES scores (total, avoidance, intrusive) were significant (Appendix 5).

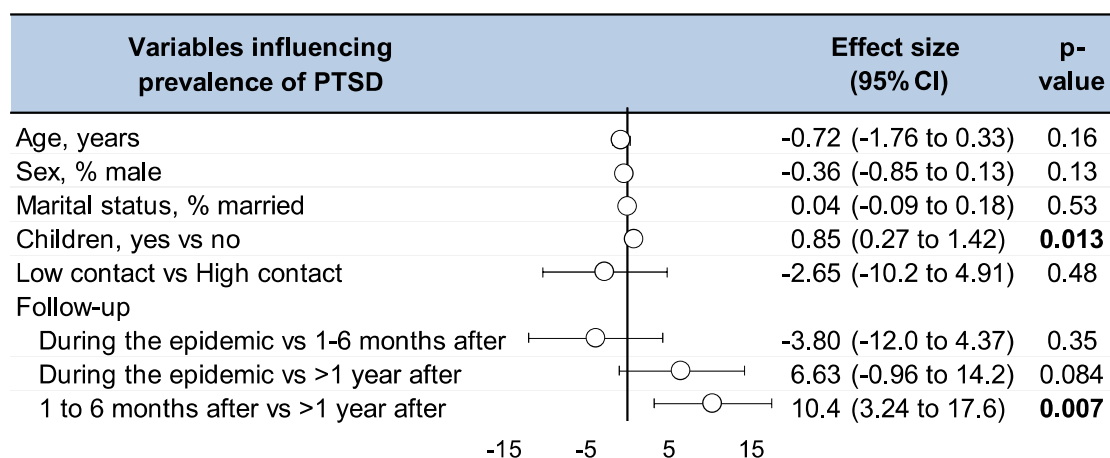


Figure 5. Factors influencing (meta-regressions) the prevalence of post-traumatic stress disorder following [Table 1](#) epidemic of 2003.

4. Discussion

The main findings were that the prevalence of PTSD for the first SARS epidemic in 2003 among HCWs is high, around 14%. Prevalence seems to remain high even more than one year after the end of the epidemic. All HCWs were at risk of PTSD and not only those working in SARS-CoV unit. Among personal risk factors, only having children may seem to increase the risk of PTSD.

PTSD in healthcare workers: a public health issue

The high prevalence of PTSD in HCWs during the first epidemic of SARS-CoV-1 in 2003 is a problem that needs to be considered, particularly giving the actual context of the COVID-19 pandemic.[6] In the current pandemic, HCWs are psychologically and physically put to the test.[4] PTSD could increase risk of suicide in HCWs, already at higher risk by their work.[39] Some studies also reported an increase in medical errors in HCWs suffering from burnout, suicidal ideation, and PTSD.[40,41] Thus, poorer quality care may be a consequence of PTSD in HCWs.[42] Moreover, PTSD is also linked with oxidative stress, metabolic disorders, stroke and cardiovascular disease, even in young HCWs.[43–46] Since the intensity of the epidemic of SARS-CoV-2 is a way bigger than SARS-CoV-1, the number of PTSD in HCWs may be very high following the actual pandemic.[6] COVID-19 associated with insufficient staff and exhaustion may increase sick leave, turnover,[47] and even resignation of HCWs.[30,32] Health system in multiple countries may be at risk.[48,49] Preventive strategy for mental health of HCWs is urgently needed.[29,36] A previous meta-analysis was conducted on psychological consequences of the SARS-CoV-1 but did not assess the prevalence of PTSD and did not study putative influencing factors such as contact with virus, time effect, or the importance of some sociodemographic.[50]

Long-term PTSD

We demonstrated a greater prevalence of PTSD (19%) within the six months after the end of the SARS-CoV-1 epidemic, with still preoccupying long-term prevalence (8%) despite a decrease after one year.[32,36] No study evaluated PTSD more than three years after the end of the epidemic.[11,38] Prevalence of PTSD up to 44% were reported in SARS patients four years after their infection,[51] and prevalence may remain high even decades after a traumatic event.[52] PTSD could become a lifetime disorder[2] in some HCWs. Considering very long-term consequences of PTSD and considering that recurrence of a

traumatic event can worsen an existing PTSD,[11] workplace intervention should focus on prevention of PTSD in HCWs. Some of the symptoms could be manage with proper treatment and psychological help.[2,34] With appropriate training, HCWs can improve their coping strategy, with better understanding of transmission process.[11,29] Interestingly, one study described lower number of PTSD in HCWs working in low contact wards but PTSD was a way more symptomatic with time.[29] HCWs from low contact wards had more intrusive thoughts after the epidemic, maybe because they didn't cope during the epidemic.[29]

Contact with patient with SARS: a risk factor for PTSD

Despite a prevalence of PTSD at 22% in HCWs in high contact SARS-CoV-1 wards and a prevalence at 9% for those working in a low contact ward, we failed to demonstrate a significant higher proportion of PTSD. Only one study demonstrated a greater prevalence of PTSD in HCWs directly in contact with SARS-CoV-1 patients.[36] HCWs in SARS wards may fear for themselves and their families since they could bring home the virus.[28,30] Media put pressure on HCWs working in SARS ward describing them as "Heroes", but also as "infection vector".[30] HCWs could also become patients increasing stress and causing a psychological stigma such as it was demonstrated with Ebola epidemic.[9] Moreover, HCWs in SARS ward are often understaffed, meaning they are doing more hours and taking care of more patients that they usually do during a health crisis, increasing work-stress and anxiety.[30] Facemasks and other protective measures could also be perceived as hard to work with, increasing difficulties to communicate and to socialise.[12,34,35] On the opposite, such protective measures were already part of work of some HCWS, such as for emergency or intensive care unit workers, [29,31] that may therefore have attenuated their stress of the epidemic. Prevalence of PTSD between physicians, nurses, and other caregivers were not assessed. Identifying caregivers the most at risk of PTSD as well as determining factors influencing the risk of PTSD is necessary.[31,35,53]

Other influencing factors for PTSD

Besides time effect, the only other significant factor influencing the prevalence of PTSD was the number of children. Two hypotheses may explain the increased risk of PTSD for HCWs with children. Some HCWs may have intrusive thoughts of fear to spread the virus to their families and children, that may lead to avoidance behavior.[33,37,54] Moreover, as previously demonstrated for other outcomes, HCWs are mostly women and they still have more at-home responsibilities than men in most countries.[55] Education of children, nursing, and household care can be hard to combine with a full-time job.[39] Even if we did not demonstrate that women were more at risk than men HCWs, women may be more at risk of PTSD[2,3] by the additional strain imposed on them because of their social roles.[39] Some studies showed that young adults may be at higher risk of PTSD.[56] Lack of experience[32,36] may be compensate by organising team work between the older and younger HCWs.[29] Because of lacking data, meta-regressions on education levels were impossible. However, some studies showed that HCWs with low education may be more at risk of PTSD, putatively in relation with their awareness of the situation.[11,12] Being married showed contradictory results in the literature: it may help HCWs to cope with the stress of epidemics,[33] but it may also increase fear to infect their loved ones and thus risk of PTSD.[11,12] Personality could be a risk factor of PTSD.[57] HCWs with psychiatric background might be more at risk since their psyche is already labile.[32] An interesting factor that can influence the risk of PTSD in HCWs could also be their willingness to be in contact with virus.[29]

Limitations

Our study has some limitations. Meta-analyses inherit the limitations of the individual studies of which they are composed: varying quality of studies and multiple variations in study protocols and evaluation.[58,59] The literature search and selection procedure may have introduced biases, since only studies written in English were used. However, the use of broader keywords in the search strategy limits the number of missing studies.[60] We conducted the meta-analyses on only published articles, therefore they were theoretically exposed to publication bias. The sample size may seem low but the first epidemic of SARS-CoV-1 was geographically localized.[10] Consequently, generalizability of our results is deemed impossible as the first SARS-CoV-1 epidemic was mostly in South-East Asia and in Canada.[10] All included studies were based on self-report questionnaires that may lack of standardized interviews; however self-report questionnaires enable comparisons between studies. Percentage of respondents within those studies may seem low, from 15% [35] to 75%,[37] however the response rate was higher than usual.[61,62] Questionnaires are also subject to declarative bias.[63] Even if almost all studies used the same scale (IES/IES-R), different score were used for the diagnosis of PTSD that may explain the high heterogeneity between studies for prevalence of PTSD and the low heterogeneity for IES scores. Only one study questioned the HCWs about previous psychiatric disorders,[32] and our meta-analyses may lack of control for confounding factors. As most HCWs are female, selection bias is more likely to arise. Data collection and inclusion/exclusion criteria were similar but not identical between studies, which may have affected our results. Almost all studies were cross-sectional, giving us an image at a given time. The lack of data for long-term prevalence for PTSD suggest implementing cohort studies for several years to assess psychological impact on long term.

5. Conclusions

The HCWs had a high psychological impact of the first epidemic of SARS-CoV in 2003. Prevalence of PTSD in HCWs was high (21%) during the first epidemic and remained high in long term (13% more than one year after the end of the epidemic). PTSD in HCWs seemed to be higher in HCWs working in departments with high contact with SARS-CoV. Younger HCWs as well as women HCWs seemed the most impacted by PTSD. Lessons from SARS-CoV-1 epidemic may help to prevent a public health issue in HCWs, with a wave of PTSD that may follow the Covid-19 pandemic.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix 1. Detailed search strategy.

("healthcare worker" OR "Health worker" OR "health care worker" OR "Health workers" OR "health care workers" OR "hospital workers" OR "hospital worker" OR "hospital employees" OR "hospital employee" OR "hospital staff" OR "hospital staffs" OR "personnel hospital" OR "hospital personnel" OR "healthcare provider" OR "health personnel" OR "health care providers" OR "nurses" OR "nurse" OR "nursing personnel" OR "nursing field" OR "discipline of nursing" OR "nursing profession" OR "personnel nursing" OR "paramedical practitioners" OR "assistant healthcare" OR "healthcare support worker" OR "professional allied health" OR "assistants healthcare" OR "healthcare assistant" OR "healthcare assistants" OR "professionals allied health" OR "paramedics" OR "health professionals allied" OR "healthcare support workers" OR "allied health professionals" OR "allied health professional" OR "population program specialists" OR "allied health personnel" OR "therapists physical" OR "therapist physical" OR "physical therapist" OR "physiotherapists" OR "physical therapists" OR "physiotherapist" OR "physicians" OR

"doctor" OR "medical practitioner" OR "physician" OR "assistant nursing" OR "personal care assistant" OR "nursing assistant" OR "Nursing Assistants" OR "assistants nursing" OR "provider health care" OR "healthcare professional" OR "health professional" OR "personnel health" OR "provider healthcare" OR "healthcare providers" OR "care personnel" OR "field workers" OR "providers health care" OR "health profession" OR "worker field" OR "providers healthcare" OR "health care provider" OR "healthcare workers" OR "health care personnel" OR "fieldworker" OR "field worker" OR "primary care provider" OR "workers field" OR "nursing staff hospital" OR "hospital nursing staffs" OR "hospital nursing staff" OR "hospital registrars" OR "hospital registrar" OR "medical staffs hospital" OR "hospital medical staff" OR "medical staff hospital" OR "hospital medical staffs" OR "medical staff" OR "staffs medical" OR "staff medical" OR "medical staffs")

AND

(Psychosocial OR psychological OR anxiety OR stress OR stressors OR stressful OR Stresses OR Anxieties OR "psychologic adaptation" OR "adaptation psychological" OR "behavior coping" OR "behaviors coping" OR "skill coping" OR "behavior adaptive" OR "adaptive behavior" OR "coping behavior" OR "skills coping" OR "coping behaviors" OR "adaptation psychologic" OR "coping skill" OR "coping skills" OR "adaptive behaviors" OR "behaviors adaptive" OR "psychological adaptation" OR "health mental" OR "mental hygiene" OR "hygiene mental" OR "emotional health" OR "mental health" OR "mental well-being" OR "caregiver burnout" OR "burn-out syndrome" OR "psychological burn-out" OR "burnout" OR "burnout" OR "student burnout" OR "burnout psychological" OR "burnout school" OR "school burnout" OR "psychological burn-out" OR "caregiver exhaustion" OR "burnout syndrome" OR "burn-out syndrome" OR "psychological burnout" OR "burn-out" OR "burn-out" OR "stressor psychological" OR "stressed" OR "stressors psychological" OR "psychological stressors" OR "life stresses" OR "stress" OR "psychological stresses" OR "psychological stressor" OR "stresses job" OR "workplace stresses" OR "job-related stresses" OR "work place stresses" OR "work-related stresses" OR "job stresses" OR "occupational stresses" OR "stresses professional" OR "professional stresses" OR "posttraumatic neurosis" OR "posttraumatic psychosis" OR "complex ptsd" OR "neuroses post traumatic" OR "moral injury" OR "stress disorders posttraumatic" OR "moral injuries" OR "post-traumatic neuroses" OR "posttraumatic neuroses" OR "posttraumatic syndrome" OR "post-traumatic stress disorder" OR "post-traumatic neuroses" OR "ptsd" OR "chronic ptsd" OR "adjustment disorder diagnosis" OR "disorders adjustment" OR "culture shock" OR "adjustment disease" OR "depressions reactive" OR "grief reaction" OR "adjustment disorder diagnosis" OR "disorders adjustment" OR "reactive disorder" OR "adjustment disorder" OR "adjustment reaction" OR "adaptation reaction" OR "reactive depression" OR "depressions reactive" OR "performance anxieties")

AND

("SARS virus OR "coronavirus infections" OR "corona virus infection" "sars-cov1" OR "sars-cov-1" OR "sars-cov" OR "coronavirus sars" "sars-1" OR "severe acute respiratory syndrome sars cov" OR "severe acute respiratory syndrome sars" OR "sars-associated coronavirus" OR "severe acute respiratory syndrome sars cov" OR "sars-cov infection" OR "sars" OR "respiratory syndrome severe acute" OR "sars coronavirus infection" OR "coronavirus" OR "severe acute respiratory syndrome sars" OR "sars-cov infection" OR "respiratory syndrome severe acute" OR "sars severe acute respiratory syndrome" OR "severe acute respiratory syndrome" OR "sars severe acute respiratory syndrome" OR "sars-associated coronavirus" OR "severe acute respiratory syndrome sars diagnosis" OR "severe acute respiratory syndrome sars diagnosis" OR "sars-related coronavirus" OR "severe acute respiratory syndrome-related coronavirus" OR "severe acute respiratory syndrome virus" OR "sars" OR "severe acute respiratory syndrome-related coronavirus" OR "severe

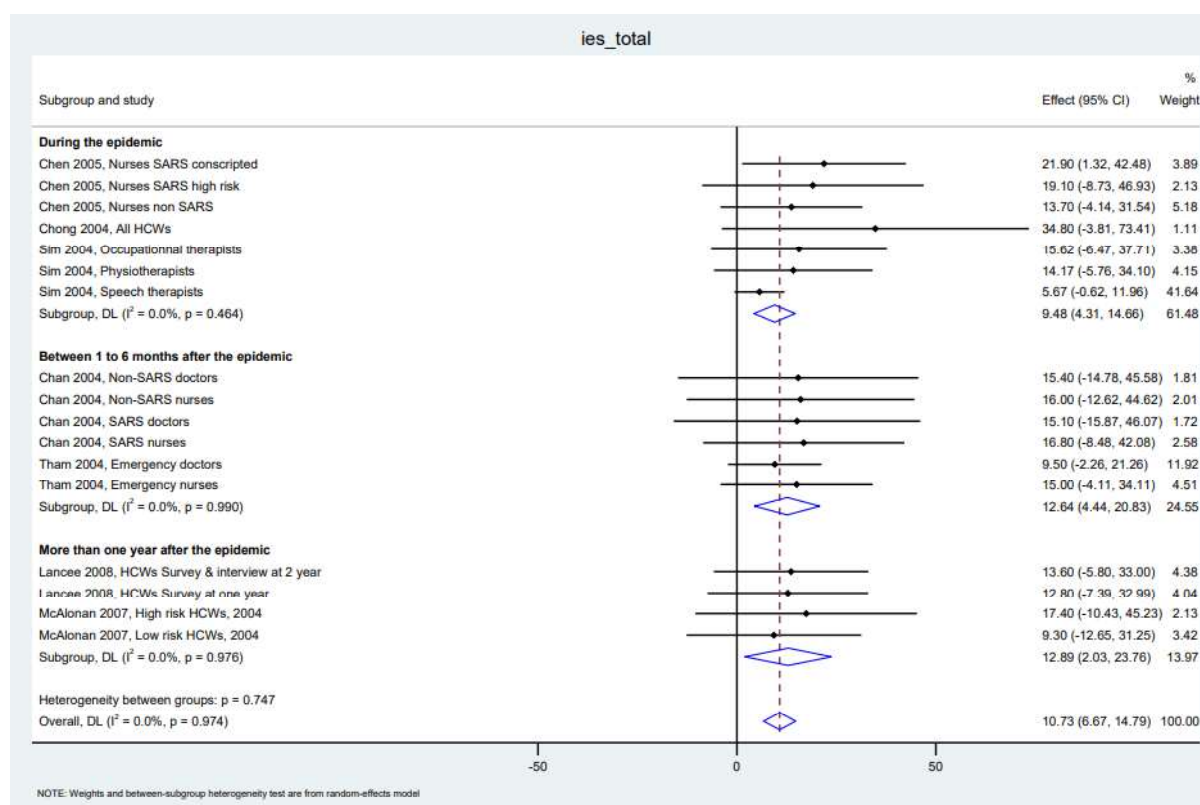
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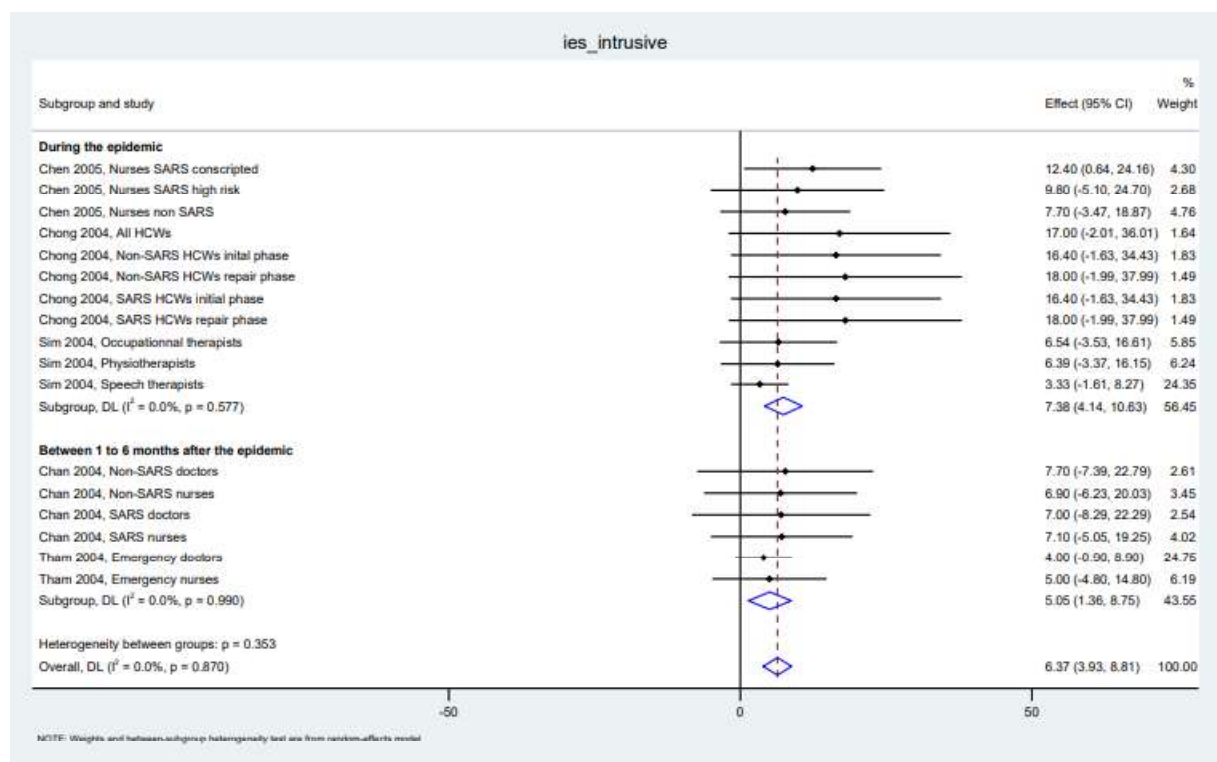
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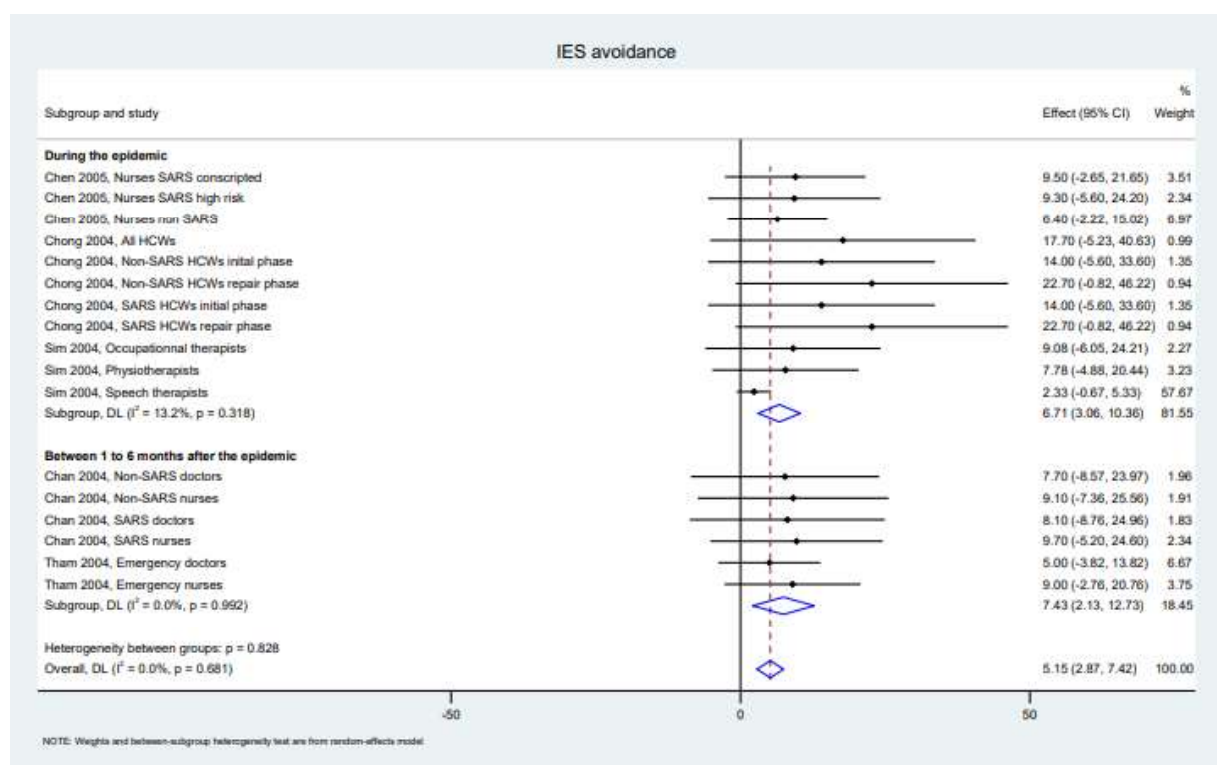
	STROBE						NOS	
	Abstract Introduction	Method	Results	Discussion Other information	Total	Score (%)	Total	Score (%)
Chan 2004	4	7	4	3	18	56.3	8	100
Chen 2005	3	6	5	4	18	56.3	8	100
Chong 2004	4	7	6	4	21	65.6	3	37.5
Lancee 2008	4	6	4	5	19	59.4	4	50
Lin 2007	3	7	4	4	18	56.3	7	87.5
Maunder 2006	3	9	6	4	22	64.7	8	100
McAlonan 2007	4	6	5	5	20	62.5	8	100
Sim 204	4	6	4	4	18	56.3	5	62.5
Su 2005	4	7	5	5	21	65.6	8	100
Tham 2004	4	8	6	5	23	67.6	4	50
Verma 2004	4	7	5	4	20	62.5	2	25
Wu 2008	4	8	6	5	23	71.9	5	62.5
Wu 2009	4	8	6	5	23	71.9	8	100

Appendix 3. Meta-analysis on IES score (total, intrusive and avoidance) following the SARS-CoV-1 epidemic of 2003.





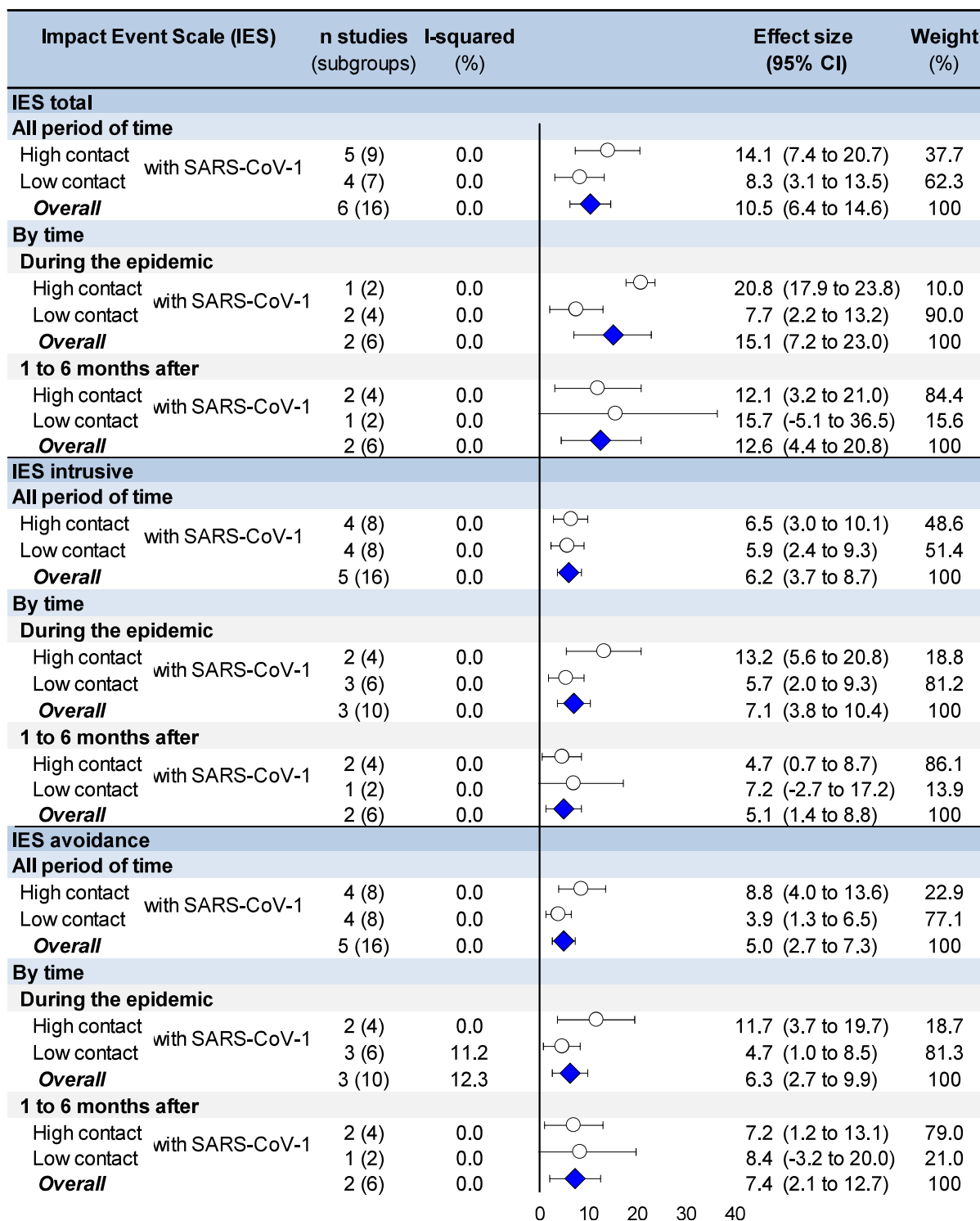
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Appendix 4. Summary of meta-analysis on IES score (total, intrusive and avoidance) following the SARS-CoV-1 epidemic of 2003, by contact with SARS-CoV-1 (high or low contact) and by time (follow-up).



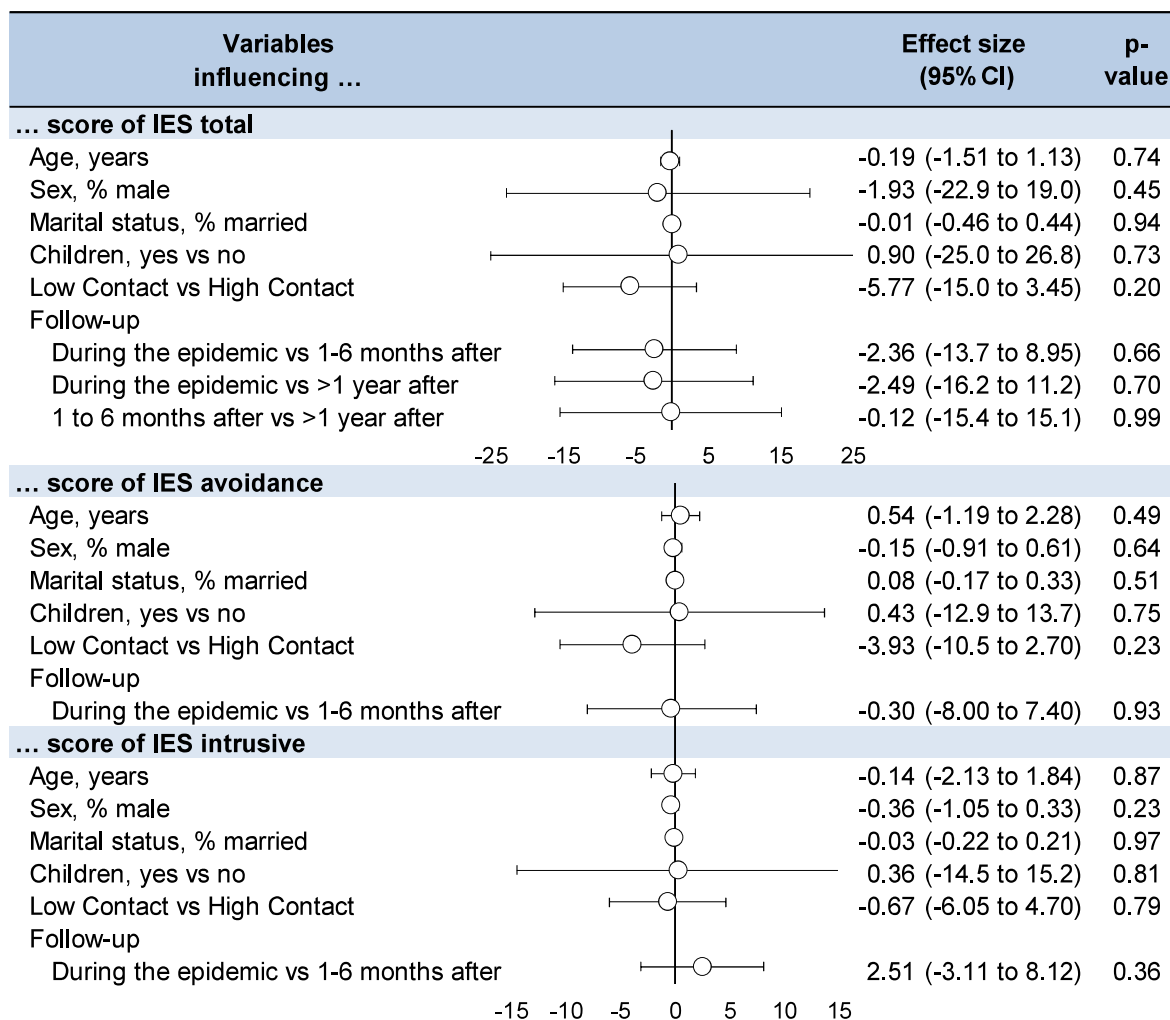
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Appendix 5. Factors influencing (meta-regressions) IES score (total, intrusive and avoidance) following the SARS-Co-V1 epidemic of 2003.



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References

- [1] Al Jowf GI, Ahmed ZT, An N, Reijnders RA, Ambrosino E, Rutten BPF, et al. A Public Health Perspective of Post-Traumatic Stress Disorder. *Int J Environ Res Public Health* 2022;19:6474. <https://doi.org/10.3390/ijerph19116474>. 478
- [2] Bisson JL, Cosgrove S, Lewis C, Roberts NP. Post-traumatic stress disorder. *BMJ* 2015;351:h6161. <https://doi.org/10.1136/bmj.h6161>. 480
- [3] Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CB. Posttraumatic stress disorder in the National Comorbidity Survey. *Arch Gen Psychiatry* 1995;52:1048–60. <https://doi.org/10.1001/archpsyc.1995.03950240066012>. 481
- [4] Ouyang H, Geng S, Zhou Y, Wang J, Zhan J, Shang Z, et al. The increase of PTSD in front-line health care workers during the COVID-19 pandemic and the mediating role of risk perception: a one-year follow-up study. *Transl Psychiatry* 2022;12:180. <https://doi.org/10.1038/s41398-022-01953-7>. 482
- [5] Crabbe J, Bowley D, Boffard K, Alexander D, Klein S. Are health professionals getting caught in the crossfire? The personal implications of caring for trauma victims. *Emerg Med J* 2004;21:568–72. <https://doi.org/10.1136/emj.2003.008540>. 483
- [6] Dutheil F, Mondillon L, Navel V. PTSD as the second tsunami of the SARS-Cov-2 pandemic. *Psychological Medicine* 2021;51:1773–4. <https://doi.org/10.1017/S0033291720001336>. 484
- [7] Shi J, Chen Y, Li X, An Y. Predicting Posttraumatic Stress and Depression Symptoms Among Frontline Firefighters in China. *J Nerv Ment Dis* 2021;209:23–7. <https://doi.org/10.1097/NMD.0000000000001250>. 485
- [8] Ćosić K, Popović S, Šarlija M, Kesedžić I, Jovanovic T. Artificial intelligence in prediction of mental health disorders induced by the COVID-19 pandemic among health care workers. *Croat Med J* 2020;61:279–88. 486
- [9] Antonaccio CM, Pham P, Vinck P, Collet K, Brennan RT, Betancourt TS. Fear, distress, and perceived risk shape stigma toward Ebola survivors: a prospective longitudinal study. *BMC Public Health* 2021;21:2066. <https://doi.org/10.1186/s12889-021-12146-0>. 487
- [10] Chan-Yeung M, Xu R. SARS: epidemiology. *Respirology* 2003;8:S9–14. <https://doi.org/10.1046/j.1440-1843.2003.00518.x>. 488
- [11] Wu P, Fang Y, Guan Z, Fan B, Kong J, Yao Z, et al. The psychological impact of the SARS epidemic on hospital employees in China: exposure, risk perception, and altruistic acceptance of risk. *Can J Psychiatry* 2009;54:302–11. <https://doi.org/10.1177/070674370905400504>. 489
- [12] Lin C-Y, Peng Y-C, Wu Y-H, Chang J, Chan C-H, Yang D-Y. The psychological effect of severe acute respiratory syndrome on emergency department staff. *Emerg Med J* 2007;24:12–7. <https://doi.org/10.1136/emj.2006.035089>. 490
- [13] Maunder RG, Lancee WJ, Balderson KE, Bennett JP, Borgundvaag B, Evans S, et al. Long-term Psychological and Occupational Effects of Providing Hospital Healthcare during SARS Outbreak - Volume 12, Number 12—December 2006 - *Emerging Infectious Diseases journal - CDC* n.d. <https://doi.org/10.3201/eid1212.060584>. 491
- [14] Horowitz M, Wilner N, Alvarez W. Impact of Event Scale: a measure of subjective stress. *Psychosom Med* 1979;41:209–18. <https://doi.org/10.1097/00006842-197905000-00004>. 492
- [15] Sundin EC, Horowitz MJ. Impact of Event Scale: psychometric properties. *Br J Psychiatry* 2002;180:205–9. <https://doi.org/10.1192/bjp.180.3.205>. 493
- [16] Creamer M, Bell R, Failla S. Psychometric properties of the Impact of Event Scale - Revised. *Behav Res Ther* 2003;41:1489–96. <https://doi.org/10.1016/j.brat.2003.07.010>. 494
- [17] Davidson JRT, Tharwani HM, Connor KM. Davidson Trauma Scale (DTS): normative scores in the general population and effect sizes in placebo-controlled SSRI trials. *Depress Anxiety* 2002;15:75–8. <https://doi.org/10.1002/da.10021>. 495
- [18] Chen CH, Lin SK, Tang HS, Shen WW, Lu ML. The Chinese version of the Davidson Trauma Scale: a practice test for validation. *Psychiatry Clin Neurosci* 2001;55:493–9. <https://doi.org/10.1046/j.1440-1819.2001.00895.x>. 496
- [19] O'Donnell ML, Elliott P, Lau W, Creamer M. PTSD symptom trajectories: From early to chronic response. *Behaviour Research and Therapy* 2007;45:601–6. <https://doi.org/10.1016/j.brat.2006.03.015>. 497
- [20] Kaysen D, Rosen G, Bowman M, Resick PA. Duration of Exposure and the Dose-Response Model of PTSD. *J Interpers Violence* 2010;25:63–74. <https://doi.org/10.1177/0886260508329131>. 498
- [21] Goenjian AK, Walling D, Steinberg AM, Karayan I, Najarian LM, Pynoos R. A prospective study of posttraumatic stress and depressive reactions among treated and untreated adolescents 5 years after a catastrophic disaster. *Am J Psychiatry* 2005;162:2302–8. <https://doi.org/10.1176/appi.ajp.162.12.2302>. 499
- [22] Motreff Y, Baubet T, Pirard P, Rabet G, Petitclerc M, Stene LE, et al. Factors associated with PTSD and partial PTSD among first responders following the Paris terror attacks in November 2015. *Journal of Psychiatric Research* 2020;121:143–50. <https://doi.org/10.1016/j.jpsychires.2019.11.018>. 500
- [23] Wells G, Shea B, O'Connell D, Robertson J, Peterson J, Losos M, et al. The Newcastle-Ottawa Scale (NOS) for Assessing the Quality of Nonrandomized Studies in Meta- Analysis n.d.:12. 501
- [24] Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. *Eur J Epidemiol* 2010;25:603–5. <https://doi.org/10.1007/s10654-010-9491-z>. 502
- [25] Vandenbroucke JP, Elm E von, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): Explanation and Elaboration. *Ann Intern Med* 2007;147:W-163. <https://doi.org/10.7326/0003-4819-147-8-200710160-00010-w1>. 503
- [26] da Costa BR, Cevallos M, Altman DG, Rutjes AWS, Egger M. Uses and misuses of the STROBE statement: bibliographic study. *BMJ Open* 2011;1:e000048. <https://doi.org/10.1136/bmjopen-2010-000048>. 504

- [27] DerSimonian R, Laird N. Meta-analysis in clinical trials. *Controlled Clinical Trials* 1986;7:177–88. [https://doi.org/10.1016/0197-2456\(86\)90046-2](https://doi.org/10.1016/0197-2456(86)90046-2). 536
- [28] Chan AOM, Huak CY. Psychological impact of the 2003 severe acute respiratory syndrome outbreak on health care workers in a medium size regional general hospital in Singapore. *Occup Med* 2004;54:190–6. <https://doi.org/10.1093/occmed/kqh027>. 538
- [29] Chen C-S, Wu H-Y, Yang P, Yen C-F. Psychological distress of nurses in Taiwan who worked during the outbreak of SARS. *Psychiatr Serv* 2005;56:76–9. <https://doi.org/10.1176/appi.ps.56.1.76>. 539
- [30] Chong M-Y, Wang W-C, Hsieh W-C, Lee C-Y, Chiu N-M, Yeh W-C, et al. Psychological impact of severe acute respiratory syndrome on health workers in a tertiary hospital. *Br J Psychiatry* 2004;185:127–33. <https://doi.org/10.1192/bjp.185.2.127>. 540
- [31] Tham KY, Tan YH, Loh OH, Tan WL, Ong MK, Tang HK. Psychiatric morbidity among emergency department doctors and nurses after the SARS outbreak. *Ann Acad Med Singap* 2004;33:578–79. 541
- [32] Lancee WJ, Maunder RG, Goldbloom DS. Prevalence of psychiatric disorders among Toronto hospital workers one to two years after the SARS outbreak. *Psychiatr Serv* 2008;59:91–5. <https://doi.org/10.1176/ps.2008.59.1.91>. 542
- [33] Lu Y-C, Shu B-C, Chang Y-Y, Lung F-W. The mental health of hospital workers dealing with severe acute respiratory syndrome. *Psychother Psychosom* 2006;75:370–5. <https://doi.org/10.1159/000095443>. 543
- [34] McAlonan GM, Lee AM, Cheung V, Cheung C, Tsang KWT, Sham PC, et al. Immediate and sustained psychological impact of an emerging infectious disease outbreak on health care workers. *Can J Psychiatry* 2007;52:241–7. <https://doi.org/10.1177/070674370705200406>. 544
- [35] Sim SS, Huak CY. Psychological impact of the SARS outbreak on a Singaporean rehabilitation department. *International Journal of Therapy and Rehabilitation* 2004;11:417–23. <https://doi.org/10.12968/ijtr.2004.11.9.19589>. 545
- [36] Su T-P, Lien T-C, Yang C-Y, Su YL, Wang J-H, Tsai S-L, et al. Prevalence of psychiatric morbidity and psychological adaptation of the nurses in a structured SARS caring unit during outbreak: A prospective and periodic assessment study in Taiwan. *Journal of Psychiatric Research* 2007;41:119–30. <https://doi.org/10.1016/j.jpsychires.2005.12.006>. 553
- [37] Verma S, Mythily S, Chan YH, Deslypere JP, Teo EK, Chong SA. Post-SARS psychological morbidity and stigma among general practitioners and traditional Chinese medicine practitioners in Singapore. *Ann Acad Med Singap* 2004;33:743–8. 554
- [38] Wu P, Liu X, Fang Y, Fan B, Fuller CJ, Guan Z, et al. Alcohol abuse/dependence symptoms among hospital employees exposed to a SARS outbreak. *Alcohol Alcohol* 2008;43:706–12. <https://doi.org/10.1093/alcalc/agn073>. 555
- [39] Duthel F, Aubert C, Pereira B, Dambrun M, Moustafa F, Mermillod M, et al. Suicide among physicians and health-care workers: A systematic review and meta-analysis. *PLoS One* 2019;14:e0226361. <https://doi.org/10.1371/journal.pone.0226361>. 556
- [40] Yates SW. Physician Stress and Burnout. *The American Journal of Medicine* 2020;133:160–4. <https://doi.org/10.1016/j.am-jmed.2019.08.034>. 557
- [41] Menon NK, Shanafelt TD, Sinsky CA, Linzer M, Carlasare L, Brady KJS, et al. Association of Physician Burnout With Suicidal Ideation and Medical Errors. *JAMA Netw Open* 2020;3:e2028780. <https://doi.org/10.1001/jamanetworkopen.2020.28780>. 558
- [42] Renner A, Kaiser J, Kersting A. [Traumatization in the Medical Profession: Initiating Events, Roles and Process Factors]. *Psychother Psychosom Med Psychol* 2022. <https://doi.org/10.1055/a-1749-6325>. 559
- [43] Edmondson D, von Känel R. Posttraumatic Stress Disorder and Cardiovascular Disease. *Lancet Psychiatry* 2017;4:320–9. [https://doi.org/10.1016/S2215-0366\(16\)30377-7](https://doi.org/10.1016/S2215-0366(16)30377-7). 560
- [44] Miller MW, Lin AP, Wolf EJ, Miller DR. Oxidative Stress, Inflammation, and Neuroprogression in Chronic PTSD. *Harv Rev Psychiatry* 2018;26:57–69. <https://doi.org/10.1097/HRP.0000000000000167>. 561
- [45] Perkins JD, Wilkins SS, Kamran S, Shuaib A. Post-traumatic stress disorder and its association with stroke and stroke risk factors: A literature review. *Neurobiol Stress* 2021;14:100332. <https://doi.org/10.1016/j.ynstr.2021.100332>. 562
- [46] Rosman L, Sico JJ, Lampert R, Gaffey AE, Ramsey CM, Dziura J, et al. Posttraumatic Stress Disorder and Risk for Stroke in Young and Middle-Aged Adults. *Stroke* 2019;50:2996–3003. <https://doi.org/10.1161/STROKEAHA.119.026854>. 563
- [47] Schug C, Geiser F, Hiebel N, Beschner P, Jerg-Bretzke L, Albus C, et al. Sick Leave and Intention to Quit the Job among Nursing Staff in German Hospitals during the COVID-19 Pandemic. *Int J Environ Res Public Health* 2022;19:1947. <https://doi.org/10.3390/ijerph19041947>. 564
- [48] Giannopoulou I, Tsobanoglou GO. COVID-19 pandemic: challenges and opportunities for the Greek health care system. *Ir J Psychol Med* 2020;37:226–30. <https://doi.org/10.1017/ipm.2020.35>. 565
- [49] Bashier H, Ikram A, Khan MA, Baig M, Al Gunaid M, Al Nsour M, et al. The Anticipated Future of Public Health Services Post COVID-19: Viewpoint. *JMIR Public Health Surveill* 2021;7:e26267. <https://doi.org/10.2196/26267>. 566
- [50] Galli F, Pozzi G, Ruggiero F, Mameli F, Cavicchioli M, Barbieri S, et al. A Systematic Review and Provisional Metanalysis on Psychopathologic Burden on Health Care Workers of Coronavirus Outbreaks. *Front Psychiatry* 2020;11:568664. <https://doi.org/10.3389/fpsy.2020.568664>. 567
- [51] Hong X, Currier GW, Zhao X, Jiang Y, Zhou W, Wei J. Posttraumatic stress disorder in convalescent severe acute respiratory syndrome patients: a 4-year follow-up study. *Gen Hosp Psychiatry* 2009;31:546–54. <https://doi.org/10.1016/j.genhosppsych.2009.06.008>. 568
- [52] Shlosberg A, Strous RD. Long-term follow-up (32 Years) of PTSD in Israeli Yom Kippur War veterans. *J Nerv Ment Dis* 2005;193:693–6. <https://doi.org/10.1097/01.nmd.0000180744.97263.d3>. 569

- [53] Tam CWC, Pang EPF, Lam LCW, Chiu HFK. Severe acute respiratory syndrome (SARS) in Hong Kong in 2003: stress and psychological impact among frontline healthcare workers. *Psychol Med* 2004;34:1197–204. <https://doi.org/10.1017/s0033291704002247>. 593
594
595
- [54] Grace SL, Hershenfield K, Robertson E, Stewart DE. The Occupational and Psychosocial Impact of SARS on Academic Physicians in Three Affected Hospitals. *Psychosomatics* 2005;46:385–91. <https://doi.org/10.1176/appi.psy.46.5.385>. 596
597
- [55] Notman MT, Nadelson CC. Medicine: a career conflict for women. *Am J Psychiatry* 1973;130:1123–7. <https://doi.org/10.1176/ajp.130.10.1123>. 598
599
- [56] Mao J, Wang C, Teng C, Wang M, Zhou S, Zhao K, et al. Prevalence and Associated Factors of PTSD Symptoms After the COVID-19 Epidemic Outbreak in an Online Survey in China: The Age and Gender Differences Matter. *Neuropsychiatr Dis Treat* 2022;18:761–71. <https://doi.org/10.2147/NDT.S351042>. 600
601
602
- [57] Jakšić N, Brajković L, Ivezić E, Topić R, Jakovljević M. The role of personality traits in posttraumatic stress disorder (PTSD). *Psychiatr Danub* 2012;24:256–66. 603
604
- [58] Dutheil F, Danini B, Bagheri R, Fantini ML, Pereira B, Moustafa F, et al. Effects of a Short Daytime Nap on the Cognitive Performance: A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health* 2021;18:10212. <https://doi.org/10.3390/ijerph181910212>. 605
606
607
- [59] Benichou T, Pereira B, Mermillod M, Tauveron I, Pfabigan D, Maqdasy S, et al. Heart rate variability in type 2 diabetes mellitus: A systematic review and meta-analysis. *PLoS One* 2018;13:e0195166. <https://doi.org/10.1371/journal.pone.0195166>. 608
609
- [60] Al Falasi B, Al Mazrouei M, Al Ali M, Al Dhamani M, Al Ali A, Al Kindi M, et al. Prevalence and Determinants of Immediate and Long-Term PTSD Consequences of Coronavirus-Related (CoV-1 and CoV-2) Pandemics among Healthcare Professionals: A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health* 2021;18:2182. <https://doi.org/10.3390/ijerph18042182>. 610
611
612
- [61] Dutheil F, Parreira LM, Eismann J, Lesage F-X, Balayssac D, Lambert C, et al. Burnout in French General Practitioners: A Nationwide Prospective Study. *Int J Environ Res Public Health* 2021;18:12044. <https://doi.org/10.3390/ijerph182212044>. 613
614
- [62] Lopez V, Chamoux A, Tempier M, Thiel H, Ughetto S, Trousselard M, et al. The long-term effects of occupational exposure to vinyl chloride monomer on microcirculation: a cross-sectional study 15 years after retirement. *BMJ Open* 2013;3:e002785. <https://doi.org/10.1136/bmjopen-2013-002785>. 615
616
617
- [63] Hopwood CJ, Morey LC, Edelen MO, Shea MT, Grilo CM, Sanislow CA, et al. A comparison of interview and self-report methods for the assessment of borderline personality disorder criteria. *Psychol Assess* 2008;20:81–5. <https://doi.org/10.1037/1040-3590.20.1.81>. 618
619
620
- [64] Young Ho Lee. An overview of meta-analysis for clinicians. *Korean J Intern Med* 2018;33:277–83. 621
622
623
624