Journal of Affective Disorders 287 (2021) 145–157

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

The prevalence of psychiatric comorbidities during the SARS and COVID-19 epidemics: a systematic review and meta-analysis of observational studies

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ARTICLE INFO

Keywords:
Psychiatric comorbidities
COVID-19
SARS
depression
anxiety
stress

ABSTRACT

The coronavirus disease 2019 (COVID-19) and Severe Acute Respiratory Syndrome (SARS) are associated with various psychiatric comorbidities. This is a systematic review and meta-analysis comparing the prevalence of psychiatric comorbidities in all subpopulations during the SARS and COVID-19 epidemics. A systematic literature search was conducted in major international (PubMed, EMBASE, Web of Science, PsycINFO) and Chinese (China National Knowledge Internet [CNKI] and Wanfang) databases to identify studies reporting prevalence of psychiatric comorbidities in all subpopulations during the SARS and COVID-19 epidemics. Data analyses were conducted using the Comprehensive Meta-Analysis Version 2.0 (CMA V2.0). Eighty-two studies involving 96,100 participants were included. The overall prevalence of depressive symptoms (depression hereinafter), anxiety symptoms (anxiety hereinafter), stress, distress, insomnia symptoms, post-traumatic stress symptoms (PTSS) and poor mental health during the COVID-19 epidemic were 23.9% (95% CI: 18.4%-30.3%), 23.4% (95% CI: 19.9%-27.3%), 14.2% (95% CI: 8.4%-22.9%), 16.0% (95% CI: 8.4%-28.5%), 26.5% (95% CI: 19.1%-35.5%), 24.9% (95% CI: 11.0%-46.8%), and 19.9% (95% CI: 11.7%-31.9%), respectively. Prevalence of poor mental health was higher in general populations than in health professionals (29.0% vs. 11.6%; Q=10.99, p=0.001). The prevalence of depression, anxiety, PTSS and poor mental health were similar between SARS and COVID-19 epidemics (all p values>0.05). Psychiatric comorbidities were common in different subpopulations during both the SARS and COVID-19 epidemics. Considering the negative impact of psychiatric comorbidities on health and wellbeing, timely screening and appropriate interventions for psychiatric comorbidities should be conducted for subpopulations affected by such serious epidemics.

1. Introduction

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first reported in Wuhan, Hubei province, China in December 2019 (World Health Organization, 2020, World Health Organization, 2020). Subsequently, the WHO declared COVID-19 as a Public Health Emergency of International Concern (PHEIC) on 30 January 2020 (World Health Organization, 2020, World Health Organization, 2020). As of the end of February 2021, approximately 113 million cases had been confirmed and over 2.5

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https://doi.org/10.1016/j.jad.2021.03.016
Received 31 January 2021; Received in revised form 1 March 2021; Accepted 5 March 2021
Available online 11 March 2021
0165-0327/

million deaths were reported worldwide (Johns Hopkins University, 2021). Severe acute respiratory syndrome (SARS) is an infectious disease caused by another coronavirus, severe acute respiratory syndrome coronavirus (SARS-CoV-1) (World Health Organization, 2004). SARS was first reported in southern China in November 2002, and later found in Hong Kong (World Health Organization, 2004) and many other Asian countries and territories. By 31 December 2003, a total of 8,096 SARS cases were confirmed worldwide (World Health Organization, 2003).

Clinical features of SARS and COVID-19 are similar in some aspects, but also different in others. For example, most patients with SARS suffered from a fever above 38.0°C, chills, headache, lethargy, and muscle pain. After 2 to 7 days, they may develop a dry, nonproductive cough with low blood oxygen levels. Most SARS patients developed shortness of breath and pneumonia subsequently, either primary viral pneumonia or secondary bacterial pneumonia (Centers for Diseases Control and Prevention, 2017). In contrast, COVID-19 patients usually experienced flu-like symptoms, including fever and/or dry cough. Severe cases may present difficult breathing, chest pain, sudden confusion, and bluish face or lips (Grant et al., 2020, Centers for Diseases Control and Prevention, 2020). Some COVID-19 patients eventually developed pneumonia, acute respiratory distress syndrome, sepsis, and kidney failure (World Health Organization, 2020). Further, SARS-CoV-1 and SARS-CoV-2 are different in both transmission characteristics and virulence. Compared to SARS-CoV-1, SARS-CoV-2 is more infectious with the reproduction number (R_0) of around 3.3 (Liu et al., 2020, Xie et al., 2020), while the R_0 of SARS-CoV-1 is around 2.7 (Riley et al., 2003, Lipsitch et al., 2003). The SARS-CoV-1 is more virulent than SARS-CoV-2. As of the end of 2003, SARS caused 774 deaths, resulting in a mortality rate of 9.2% (World Health Organization, 2003). In contrast, as of 18 October 2020, the mortality rate of COVID-19 was 2.8% (Johns Hopkins, 2020).

In any major catastrophes including bio-disasters, psychiatric comorbidities and related problems, such as depression, anxiety, sleep disturbances, fear, and stigmatization, are common and may act as barriers to accessing appropriate medical and mental health care. In order to prevent or minimise the negative outcomes caused by psychiatric comorbidities, understanding their patterns and associated factors is important. Previous studies on prevalence of psychiatric comorbidities found that confusion symptoms (27.9%), depression (32.6%), memory impairment (34.1%) insomnia (41.9%) and steroid-induced mania and psychosis (0.7%) were common in patients with SARS or Middle East respiratory syndrome (MERS) (Rogers et al., 2020). In addition, psychiatric comorbidities also persisted after the SARS epidemic, such as post-traumatic stress disorder (PTSD) (Hawryluck et al., 2004) and major depressive disorder (MDD) (Ma, 2009) in SARS survivors. Other subpopulations including family members and close contacts of SARS patients, health professionals, and the public also suffered from psychiatric problems during the epidemic (Cong et al., 2003), which could be associated with a range of negative consequences, such as decreased quality of life, increased treatment burden, and increased suicidality (Chinese Ministry of Health 2003). Similarly, psychiatric comorbidities, such as depression, anxiety, and sleep disturbance were common in COVID-19 patients (Deng et al., 2020), health professionals, and other subpopulations (Salazar de et al., 2020, Li et al., 2020).

To date, very few studies have compared the psychiatric comorbidities of SARS and COVID-19 epidemics. Understanding their differences would be important to identify high-risk subpopulations, allocate health resources and provide appropriate treatments. A number of meta-analyses focused on psychiatric comorbidities of coronavirus diseases (Rogers et al., 2020, Kisely et al., 2020), but only one compared the epidemiological data of psychiatric comorbidities between multiple coronavirus diseases among health professionals (Salazar de et al., 2020). Several meta-analyses on prevalence of psychiatric comorbidities during the COVID-19 pandemic have been conducted, but most only focused on specific subpopulations, such as infected or suspected patients (Deng et al., 2020), health professionals (Pappa et al., 2020), or the public (Salari et al., 2020).

In order to better understand the psychiatric comorbidities of SARS and COVID-19, it is necessary to compare the prevalence of psychiatric comorbidities in all subpopulations during the SARS and COVID-19 epidemics. Therefore, we conducted this systematic review and meta-analysis of observational studies to compare the overall prevalence of psychiatric comorbidities (e.g., depressive symptoms [depression hereinafter], anxiety symptoms [anxiety hereinafter], stress, distress, insomnia symptoms [insomnia hereinafter], post-traumatic stress symptoms [PTSS], post-traumatic stress disorder [PTSD], and poor mental health) during the SARS and COVID-19 epidemics across all subpopulations studied. We also explored the moderating effects of sociodemographic characteristics (e.g., sex, education level and marital status) on the results. We hypothesized that the overall prevalence of psychiatric comorbidities during the COVID-19 epidemic would be similar to that during the SARS epidemic; 2) the overall prevalence of psychiatric comorbidities in healthcare professionals would be higher than that in the general population during the COVID-19 epidemic.

2. Methods

2.1. Literature search and selection

This systematic review and meta-analysis were conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher et al., 2009), with the PROSPERO registration number of CRD42020211604. Literature search was systematically and independently conducted by three researchers (WWR, YJ, WL) in PubMed, EMBASE, Web of Science, PsycINFO, China National Knowledge Internet (CNKI) and WanFang databases from their inception to May 25, 2020, using the following search terms: "novel coronavir*", "alphacoronavirus", "betacoronavirus", "COVID", "COVID-19", "severe acute respiratory syndrome" and "SARS". For the psychiatric outcome category, the following search terms were used: "psychiatr*", "mental", "psycholog*", "depress*", "anxiety", "posttraumatic stress disorder", "PTSD", "insomnia", "sleep", "epidemiology" and "prevalence". The references of retrieved articles were also searched by hand for additional studies.

The same three researchers independently screened titles and abstracts, and then two of the researchers (YJZ and YJ) read the full texts of relevant articles for eligibility. Inclusion criteria were: 1) studies that examined psychiatric comorbidities during the SARS or COVID-19 epidemics in any subpopulations; 2) studies with available data on the prevalence of psychiatric comorbidities or relevant data that could generate the prevalence of psychiatric comorbidities during the SARS or COVID-19 epidemics in any subpopulations, as measured by standardized scales or diagnostic instruments; 3) case-control studies, cross-sectional or cohort studies. Case studies, reviews, systematic reviews, meta-analyses or commentaries were excluded. If more than one article were published using the same dataset, only the one with the most complete information or highest quality assessment score was included. Disagreement was resolved by consensus.

2.2. Data extraction

Relevant data were independently extracted by two researchers (YJZ and YJ) using a pre-designed data extraction sheet, including sex, education level, marital status, the first author, publication year, study design, study location, study period, study population, sample size, sampling method, prevalence of specific psychiatric co-morbidities. Disagreement was resolved by consensus, or a discussion with a senior researcher (YTX).

2.3. Quality assessment

The quality of included studies was evaluated using the Loney's 8-

item scale (Loney et al., 1998) which has been widely used previously (Boyle, 1998, Yang et al., 2016). This scale assesses the quality of observational studies in eight domains: target population, probability sampling, response rate, non-responders, sample representative of the target population, standardized data collection method, validated criteria for outcomes, and confidence intervals (CI) of the prevalence of target outcomes. The total quality score ranges from 0 to 8, with '7-8' as "high quality", '4-6' as "moderate quality" and '0-3' as "low quality". Two researchers (YJZ and YJ) independently evaluated the study quality, and disagreement was resolved by consensus or a discussion with the senior researcher (YTX).

2.4. Data analysis

Data analyses were performed using Comprehensive Meta-Analysis Version 2.0 (CMA V2.0, Biostat Inc., Englewood, New Jersey, USA). I^2 test was used to evaluate heterogeneity between studies, with $I^2 > 50\%$ indicating significant heterogeneity. The random-effects model was used in data syntheses due to different demographic characteristics between studies. In SARS related studies, December 31, 2003 was used as the cutoff date to classify acute SARS phase and SARS recovery phase. At least three articles were needed for data synthesis in each phrase. If the number of articles in either SARS phase was less than three, the relevant data in the two phrases were pooled.

Subgroup and meta-regression analyses were conducted to explore moderating effects of categorical (e.g. study population, sex, education level and marital status) and continuous variables (e.g., female percentage and quality assessment score) respectively, on the prevalence of psychiatric comorbidities in COVID-19 patients. Publication bias was examined by funnel plots, Egger's test and Duval and Tweedie trim-and-fill method. Two-tailed tests were conducted with the significance level of 0.05.

3. Results

3.1. Study characteristics

A total of 1,793 studies were identified in the literature search, and 82 met the eligibility criteria; of them, 74 studies with available data were included in the meta-analysis. Details of literature search, screening and selection are shown in Figure 1. Study characteristics are presented in Table 1. The included studies were conducted across 10

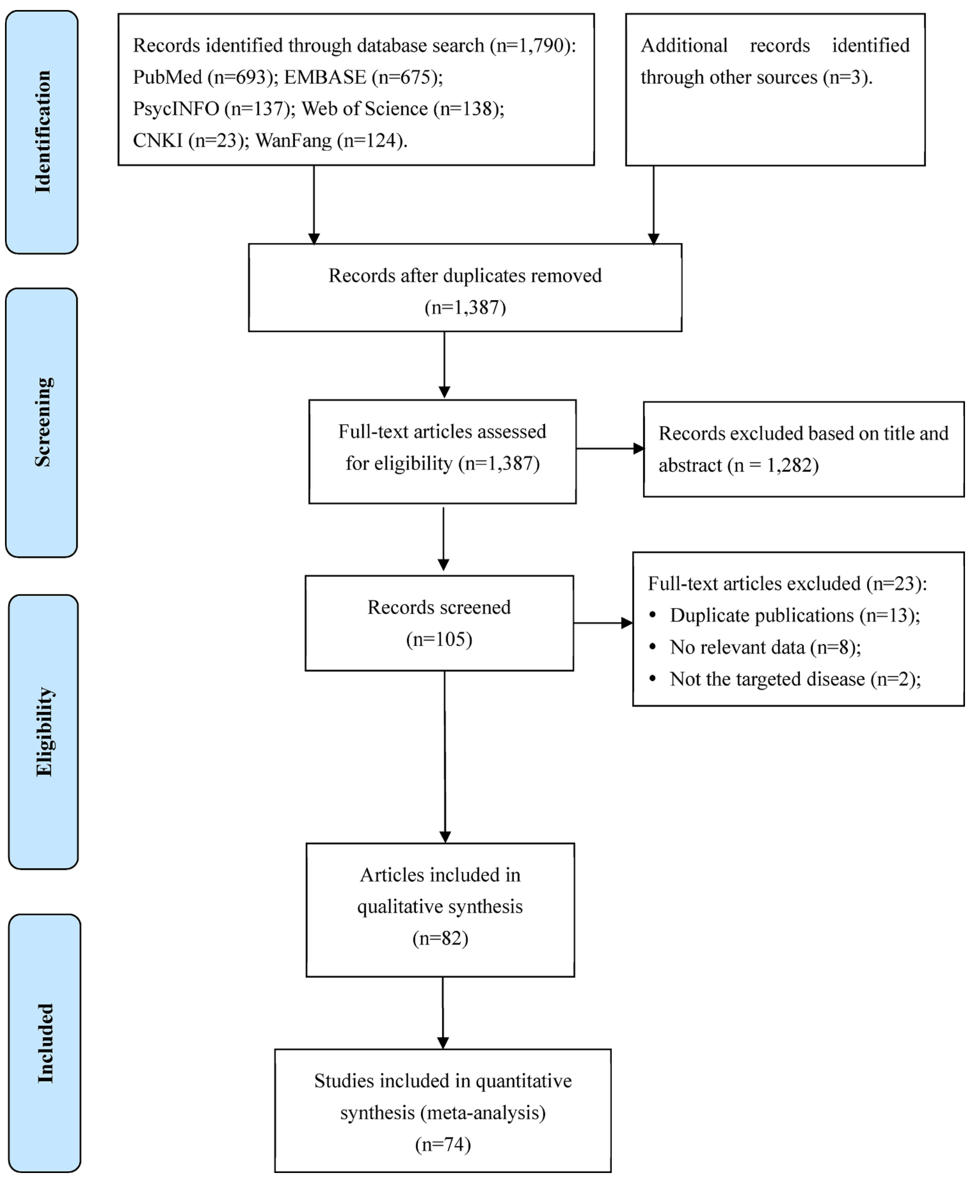

Figure 1. Flow diagram

Table 1
Characteristics of studies included in this systematic review and meta-analysis.

Study	Language	Disease	Study design	Survey period	Country/ territory	Population	Sampling method	Sample size	Female percentage (%)	Age Mean	SD	Min	Max	Response rate (%)	Quality score	Reference
Ahmed, M. Z. et al. 2020	English	COVID-19	cross-sectional	2020/NR	Mainland China	general population	NR	1074	46.83	33.54	11.13	14	68	NR	4	(Ahmed et al., 2020)
Bo, H. X. et al. 2020	English	COVID-19	cross-sectional	2020.3	Mainland China	infected people	NR	714	50.90	50.2	12.9	-	-	97.80	6	(Bo et al., 2020)
Cai, W. et al. 2020	English	COVID-19	cross-sectional	2020/NR	Mainland China	health professionals	NR	1521	75.54	-	-	18	-	NR	4	(Cai et al., 2020)
Cao, W et al. 2020	English	COVID-19	cross-sectional	2020/NR	Mainland China	university students	C	7143	69.65	-	-	-	-	100.00	7	(Cao et al., 2020)
Chan, A. O. M. et al. 2004	English	acute SARS	cross-sectional	2 months after first case in Singapore	Singapore	health professionals	NR	661	NR	-	-	-	-	67.00	4	(Chan and Huak, 2004)
Chang, J. et al. 2020	Chinese	COVID-19	cross-sectional	2020.1-2020.2	Mainland China	university students	convenient	3881	63.05	20	-	18	-	91.38	5	(Chang et al., 2020)
Chen, C. S. et al. 2005	English	acute SARS	cross-sectional	2003.5	Taiwan	health professionals	NR	128	100.00	26.5	3.1	-	-	69.57	4	(Chen et al., 2005)
Chen, Y. et al. 2020	English	COVID-19	cross-sectional	2020/NR	Mainland China	health professionals	NR	105	90.5	32.6	6.5	-	-	84.70	5	(Chen et al., 2020)
Cheng, S. K. et al. 2004	English	acute SARS	cross-sectional	2003.6	Hong Kong	total sample	NR	284	62.32	-	-	-	-	60.17	5	(Cheng et al., 2004)
Chew, N. W. S. et al. 2020	English	COVID-19	cross-sectional	2020.2-2020.4	Singapore, India	health professionals	NR	906	64.35	29 (median)	-	-	-	90.60	5	(Chew et al., 2020)
Chong, M. Y. et al. 2004	English	acute SARS	cross-sectional	2003.5-2003.6	Taiwan	health professionals	NR	1257	81.07	31.8	6.4	21	59	50.28	5	(Chong et al., 2004)
Consolo, U. et al. 2020	English	COVID-19	cross-sectional	2020.4	Italy	health professionals	C	356	39.61	-	-	-	-	40.73	5	(Consolo et al., 2020)
Fang, Y. et al. 2004	Chinese	acute SARS	cross-sectional	2003.7-2003.10	Mainland China	infected people	NR	286	52.80	33.43	11.85	15	64	100.00	6	(Fang et al., 2004)
Gao, J. et al. 2020	English	COVID-19	cross-sectional	2020.1-2020.2	Mainland China	general population	NR	4827	67.68	32.3	10.0	10	85	82.50	6	(Gao et al., 2020)
Hawryluck, L. et al. 2004	English	acute SARS	cross-sectional	2003.2-2003.6	Canada	general population	convenient	129	NR	-	-	18	66+	0.86	4	(Hawryluck et al., 2004)
Hong, X. et al. 2009	English	acute SARS	cohort	2003.6-2007.9	Mainland China	infected people	NR	68	66.18	38.5	12.3	-	-	97.14	6	(Hong et al., 2009)
Huang, J. Z. et al. 2020	Chinese	COVID-19	cross-sectional	2020.2	Mainland China	health professionals	NR	230	81.30	32.6	6.2	22	59	93.50	5	(Huang et al., 2020)
Huang, Y. et al. 2020	English	COVID-19	cross-sectional	2020.2	Mainland China	total sample	NR	7236	54.62	35.3	5.6	-	-	85.30	6	(Huang and Zhao, 2020)
Ko, C. H. et al. 2006	English	SARS	cross-sectional	when the epidemic had just been controlled	Taiwan	general population	R	1472	51.97	-	-	15	51+	94.85	6	(Ko et al., 2006)
Kwek, S. K. et al. 2006	English	SARS	cross-sectional	3 month post-discharge	Singapore	infected people	NR	63	79.37	34.83	10.49	-	-	43.45	5	(Kwek et al., 2006)
Lai, J. et al. 2020	English	COVID-19	cross-sectional	2020.1-2020.2	Mainland China	health professionals	CMRS	1257	76.69	-	-	18	40+	68.69	5	(Lai et al., 2020)
Lam, M. H. B. et al.2009	English	recovery SARS	cross-sectional	2005.12-2007.7	Hong Kong	infected people	NR	181	68.51	43.3	13.7	-	-	49.05	5	(Lam et al., 2009)
Lancee, W. J. et al. 2008	English	recovery SARS	cohort	2004.10-2005.9	Canada	health professionals	NR	139	87.05	45.0	9.6	-	-	23.68	6	(Lancee et al., 2008)
Lau, J. T. F. et al. 2006	English	acute SARS	cross-sectional	2003.5-2003.6	Hong Kong	general population	R	818	50.24	-	-	18	50+	64.70	6	(Lau et al., 2006)
Lee, A. M. et al. 2007	English	recovery SARS	cohort	2004.4-2004.5	Hong Kong	infected people	NR	96	63.54	-	-	18	61+	80.00	5	(Lee et al., 2007)
Lei, L. et al. 2020	English	COVID-19	cross-sectional	2020.2	Mainland China	general population	convenient	1593	61.27	32.3	9.8	-	-	80.17	5	(Lei et al., 2020)

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Table 1 (*continued*)

Study	Language	Disease	Study design	Survey period	Country/territory	Population	Sampling method	Sample size	Female percentage (%)	Age Mean	SD	Min	Max	Response rate (%)	Quality score	Reference
Li, X. et al. 2020	English	COVID-19	cross-sectional	2020.2	Mainland China	health professionals	NR	948	76.79	-	-	20	60+	NR	4	(Li et al., 2020)
Li, Y. et al. 2020	English	COVID-19	prospective cohort	2020.2	Mainland China	university students	NR	1442	61.79	-	-	-	-	71.20	4	(Li et al., 2020)
Liang, L. L. et al. 2020	English	COVID-19	cross-sectional	2020.1	Mainland China	general population	convenient	584	61.82	-	-	14	35	95.70	5	(Liang et al., 2020)
Liu, C. Y. et al. 2020	English	COVID-19	cross-sectional	2020.2	Mainland China	health professionals	NR	512	84.57	-	-	18	60+	85.33	5	(Liu et al., 2020)
Liu, N. et al. 2020	English	COVID-19	cross-sectional	2020.1-2020.2	Mainland China	general population	NR	285	54.39	-	-	-	-	95.00	5	(Liu et al., 2020)
Liu, X. et al. 2012	English	recovery SARS	cross-sectional	2006	Mainland China	health professionals	SR	549	76.50	-	-	-	-	83.00	6	(Liu et al., 2012)
Liu, Z. R. et al. 2004	Chinese	acute SARS	cross-sectional	2003.5	Mainland China	university students	CS	6280	38.74	20.3	2.0	-	-	92.35	6	(Liu et al., 2004)
Lü, S. H. et al. 2010	Chinese	acute SARS	retrospective	2003.3-2003.6	Mainland China	general population	MS	2379	45.61	39.12	13.67	18	69	93.96	6	(Lü et al., 2010)
Lu, W. et al. 2020	English	COVID-19	cross-sectional	2020.2	Mainland China	health professionals	NR	2299	77.64	-	-	-	-	94.88	5	(Lu et al., 2020)
Lu, Y. C. et al. 2006	English	acute SARS	cross-sectional	2003.7-2004.3	Taiwan	health professionals	NR	127	58.27	-	-	-	-	94.07	5	(Lu et al., 2006)
Lung, F. W. et al. 2009	English	recovery SARS	longitudinal	2004.7-2005.3	Taiwan	health professionals	NR	123	NR	-	-	-	-	96.85	5	(Lung et al., 2009)
Mak, I. W. C. et al. 2009	English	recovery SARS	cohort	2005.9-2006.3	Hong Kong	infected people	NR	90	62.22	41.1	12.1	-	-	96.77	6	(Mak et al., 2009)
Maunder, R. G. et al. 2006	English	recovery SARS	cohort	2004.10-2005.9	Canada	health professionals	NR	769	86.87	-	-	-	-	38.76	4	(Maunder et al., 2006)
Mazza, C. et al. 2020	English	COVID-19	cross-sectional	2020.3	Italy	general population	NR	2766	71.66	32.94	13.2	18	90	98.36	5	(Mazza et al., 2020)
Mihashi, M. et al. 2009	English	recovery SARS	cross-sectional	2004.2-2004.3	Mainland China	general population	NR	187	36.90	26.3	8.0	-	-	62.33	3	(Mihashi et al., 2009)
Ni, M. Y. et al. 2020	English	COVID-19	cross-sectional	2020/NR	Mainland China	total sample	NR	1791	61.75	-	-	-	-	NR	5	(Ni et al., 2020)
Nickell, L. A. et al. 2004	English	acute SARS	cross-sectional	2003.4	Canada	health professionals	NR	510	80.59	-	-	-	-	11.91	4	(Nickell et al., 2004)
Ozamiz-Etxebarria, N. et al. 2020	English	COVID-19	cross-sectional	2020.3	Spain	general population	NR	976	81.15	-	-	18	78	40.67	4	(Ozamiz-Etxebarria et al., 2020)
Peng, E. Y. C. et al. 2010	English	acute SARS	cross-sectional	2003.11	Taiwan	general population	SR	1278	49.69	41.6	16.6	18	89	68.31	5	(Peng et al., 2010)
Reynolds, D. L. et al. 2008	English	acute SARS	cross-sectional	2003.3-2003.6	Canada	total sample	NR	1057	61.12	-	-	-	-	55.28	6	(Reynolds et al., 2008)
Shacham, M. et al. 2020	English	COVID-19	cross-sectional	2020.3-2020.4	Israel	health professionals	NR	338	58.58	46.39	11.18	24	74	NR	4	(Shacham et al., 2020)
Sim, K. et al. 2004	English	acute SARS	cross-sectional	2003.7	Singapore	health professionals	NR	277	85.20	38.0	12.7	-	-	92.03	5	(Sim et al., 2004)
Sim, K. et al. 2010	English	acute SARS	cross-sectional	2003.7	Singapore	general population	consecutive	415	40.72	36.6	13.9	-	-	78.01	4	(Sim et al., 2010)
Su, T. P. et al. 2007	English	acute SARS	prospective	2003.4-2003.6	Taiwan	health professionals	NR	102	100.00	25.4	3.7	-	-	95.33	5	(Su et al., 2007)
Tan, W. et al. 2020	English	COVID-19	cross-sectional	2020.2	Mainland China	general population	NR	673	25.56	30.8	7.4	-	-	50.87	4	(Tan et al., 2020)
Tang, W. et al. 2020	English	COVID-19	cross-sectional	2020.2	Mainland China	university students	convenient	2485	61.37	19.81	1.55	16	27	68.84	4	(Tang et al., 2020)
	English			2003.11	Singapore	health professionals	NR	96	68.75	-	-	-	-	77.42	4	(Tham et al., 2004)

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Table 1 (*continued*)

Study	Language	Disease	Study design	Survey period	Country/ territory	Population	Sampling method	Sample size	Female percentage (%)	Age Mean	SD	Min	Max	Response rate (%)	Quality score	Reference
Tham, K. Y. et al. 2004		acute SARS	cross-sectional													
Tian, B. C. et al. 2007	Chinese	recovery SARS	cross-sectional	2006.3-2006.4	Mainland China	general population	convenient	2424	45.46	39.12	13.67	-	-	101.00	5	(Tian et al., 2007)
Tian, F. et al. 2020	English	COVID-19	cross-sectional	2020.1-2020.2	Mainland China	general population	convenient	1060	48.21	35.01	12.8	13	76	93.64	5	(Tian et al., 2020)
Wang, C. et al. 2020	English	COVID-19	cross-sectional	2020.1-2020.2	Mainland China	general population	convenient	1210	67.27	-	-	12	59	92.79	5	(Wang et al., 2020)
Wang, S. et al. 2020	English	COVID-19	cross-sectional	2020.1-2020.2	Mainland China	health professionals	NR	123	90.24	33.75	8.41	20	50+	50.00	4	(Wang et al., 2020)
Wu, K. et al. 2020	English	COVID-19	cross-sectional	2020/NR	Mainland China	health professionals	NR	60	26.67	33.5	12.4	25	59	NR	4	(Wu and Wei, 2020)
Yin, Q. et al. 2020	English	COVID-19	cross-sectional	2020.2	Mainland China	health professionals	convenient	371	61.46	35.30	9.48	20	40+	98.41	5	(Yin et al., 2020)
Zhang, C. et al. 2020	English	COVID-19	cross-sectional	2020.1-2020.2	Mainland China	health professionals	convenient	1563	82.73	-	-	18	60+	80.32	6	(Zhang et al., 2020)
Zhang, K. R. et al. 2005	Chinese	acute SARS	cross-sectional	2003.9-2003.10	Mainland China	total sample	NR	296	67.57	34	12	8	81	NR	4	(Zhang et al., 2005)
Zhang, W. R. et al. 2020	English	COVID-19	cross-sectional	2020.2-2020.3	Mainland China	health professionals	NR	2182	64.21	-	-	16	60+	NR	4	(Zhang et al., 2020)
Zhang, Y. et al. 2020	English	COVID-19	cross-sectional	2020.1-2020.2	Mainland China	general population	convenient	263	59.70	37.7	14.0	18	50+	65.75	5	(Zhang and Ma, 2020)
Zhu, J. et al. 2020	English	COVID-19	cross-sectional	2020.2	Mainland China	health professionals	NR	165	83.03	34.16	8.06	-	-	100.00	6	(Zhu et al., 2020)
Zhu, S. et al. 2020	English	COVID-19	cross-sectional	2020.2-2020.3	Mainland China	total sample	NR	2279	59.72	-	-	-	-	NR	4	(Zhu et al., 2020)
Shi, T. Y. et al. 2005	Chinese	acute SARS	cross-sectional	2003.12-2004.1	Mainland China	total sample	C	162	79.63	-	-	-	-	93.1	6	(Shi et al., 2005)
Zhang, X. J. et al. 2003	Chinese	acute SARS	cross-sectional	2003.4-2003.5	Mainland China	general population	C	1031	35.89	33.17	-	16	86	91.73	6	(Zhang et al., 2003)
He, L. P. et al. 2004	Chinese	acute SARS	cross-sectional	2003.5	Mainland China	general population	CR	1016	NR	27.30	9.62	-	-	94.69	6	(He et al., 2004)
Zhao, Q. et al. 2020	Chinese	COVID-19	cross-sectional	2020.2	Mainland China	infected people	NR	106	56.60	35.90	11.92	21	65	100.00	6	(Zhao et al., 2020)
Gao, H. S. et al. 2006	Chinese	acute SARS	longitudinal	2003.9-2004.6	Mainland China	infected people	NR	67	68.66	25.32	8.54	15	67	88.16	5	(Gao et al., 2006)
Gao, H. S. et al. 2006	Chinese	SARS	longitudinal	2003.6-2004.6	Mainland China	infected people	NR	67	68.66	-	-	-	-	NR	4	(Gao et al., 2006)
Wei, L. P. et al. 2005	Chinese	SARS	longitudinal	within 2 weeks and after 3 months of post-charge	Mainland China	infected people	NR	22	86.36	-	-	-	-	NR	4	(Wei et al., 2005)
Cheng, S. K. et al. 2004	English	acute SARS	cross-sectional	2003.5-2003.7	Hong Kong	infected people	NR	180	66.67	36.9	11.1	18	70	42.35	5	(Cheng et al., 2004)
Wu, K. K. et al. 2005	English	SARS	longitudinal	at 1 month and 3 months after discharge from hospital	Hong Kong	infected people	NR	131	56.49	41.82	14.01	18	84	27.52	4	(Wu et al., 2005)
Lee, D. T. S. et al. 2006	English	acute SARS	case-control	2003.4-2003.6	Hong Kong	pregnant women	consecutive	235	100.00	29.6	5.4	-	-	57.6	4	(Lee et al., 2006)
Wu, Y. et al. 2020	English	COVID-19	cross-sectional	2020.1-2020.2	Mainland China	pregnant women	NR	1285	100.00	-	-	27	32	NR	4	(Wu et al., 2020)
Xie, X. et al. 2020	English	COVID-19	cross-sectional	2020.2-2020.3	Mainland China	children	NR	1784	43.27	-	-	-	-	76.57	4	(Xie et al., 2020)
	English	COVID-19		2020.3		adolescents	NR	8079	53.55	16	-	12	18	99.25	5	(Zhou et al., 2020)

(continued on next page)

Table 1 (*continued*)

Study	Language	Disease	Study design	Survey period	Country/ territory	Population	Sampling method	Sample size	Female percentage (%)	Age Mean	SD	Min	Max	Response rate (%)	Quality score	Reference
Zhou, S. J. et al. 2020			cross-sectional		Mainland China											
Yuan, R. et al. 2020	English	COVID-19	cross-sectional	2020/NR	Mainland China	the parents of children hospitalized or not hospitalized	NR	100	57.00	-	-	-	-	NR	4	(Yuan et al., 2020)
Nguyen, H. C. et al. 2020	English	COVID-19	cross-sectional	2020.2-2020.3	Vietnam	outpatients	NR	3947	55.66	44.4	17.0	18	60+	97.96	6	(Nguyen et al., 2020)
Han, Z. H. et al. 2020	Chinese	COVID-19	longitudinal	2020.1-2020.3	Mainland China	suspected infected people	NR	72	41.67	-	-	11	73	100	5	(Han et al., 2020)
Wan, I. Y. P. et al. 2004	English	acute SARS	cross-sectional	2003.4	Hong Kong	patients on a waiting list for thoracic surgery	NR	57	31.58	59.77	14.5	17	83	31.67	4	(Wan et al., 2004)

Abbreviations: COVID-19: Coronavirus disease 2019; SARS: Severe acute respiratory syndrome; M: multistage; SD: standard deviation; S: stratified; C: cluster; R: random; NR: not reported.

countries or areas including Asia, Europe, North America and South America.

3.2. *Prevalence of psychiatric comorbidities during the COVID-19 epidemic*

Of the 36 studies on COVID-19, 21 studies reported prevalence of depression during the COVID-19 epidemic and the pooled prevalence of depression was 23.9% (95% CI: 18.4% - 30.3%; I^2=99.43%, p<0.001; Supplementary Figure 1). Twenty-four studies reported prevalence of anxiety during the COVID-19 epidemic and the pooled prevalence of anxiety was 23.4% (95% CI: 19.9% - 27.3%; I^2=98.78%, p<0.001; Supplementary Figure 2). Five studies reported the prevalence of stress during the COVID-19 epidemic and the pooled prevalence was 14.2% (95% CI: 8.4% - 22.9%; I^2=98.65%, p<0.001; Supplementary Figure 3). Three studies reported prevalence of distress the COVID-19 epidemic and the pooled prevalence of distress was 16.0% (95% CI: 8.4% - 28.5%; I^2=97.77%, p<0.001; Supplementary Figure 4). Eight studies reported the prevalence of insomnia during the COVID-19 epidemic and the pooled prevalence of insomnia was 26.5% (95% CI: 19.1% - 35.5%; I^2=98.79%, p<0.001; Supplementary Figure 5). Thirteen studies reported prevalence of PTSS during the COVID-19 epidemic and the pooled prevalence of PTSS was 24.9% (95% CI: 11.0% - 46.8%; I^2=99.68%, p<0.001; Supplementary Figure 6). Five studies reported the prevalence of poor mental health during the COVID-19 epidemic and the pooled prevalence of poor mental health was 19.9% (95% CI: 11.7% - 31.9%; I^2=98.92%, p<0.001; Supplementary Figure 7). Details of pooled prevalence of psychiatric comorbidities are presented in Table 2.

3.3. *Comparisons of prevalence of psychiatric comorbidities between COVID-19 and SARS epidemics*

Of the 38 studies on SARS, 6 studies reported prevalence of depression during the acute SARS phase, while 3 studies reported that during the SARS recovery phase, with the pooled prevalence of 27.5% (95% CI: 17.3% - 40.6%; I^2=94.95%, p<0.001) and 26.0% (95% CI: 15.6% - 40.0%; I^2=87.59%, p<0.001), respectively. No significant difference in prevalence of depression between SARS and COVID-19 epidemics was found (Q=0.34, p=0.85). Nine studies reported prevalence of anxiety during the SARS epidemic and the pooled prevalence of anxiety was 17.7% (95% CI: 8.2% - 34.1%; I^2=97.37%, p<0.001), with no significant difference compared to that during the COVID-19 epidemic (Q=0.59, p=0.44). Fifteen studies reported the prevalence of PTSS during the SARS epidemic and the pooled prevalence of PTSS was 16.8% (95% CI: 12.9% - 21.5%; I^2=93.94%, p<0.001), with no significant difference compared to that during the COVID-19 epidemic (Q=0.89, p=0.35).

Nine studies reported prevalence of poor mental health in acute SARS phase while 3 studies reported that in SARS recovery phase, with the pooled prevalence of 26.6% (95% CI: 11.7% - 49.8%; I^2=99.61%, p<0.001) and 32.8% (95% CI: 12.4% - 62.8%; I^2=96.44%, p<0.001), respectively. The pooled prevalence of poor mental health in SARS was similar with that during the COVID-19 epidemic (Q=1.06, p=0.59). Three studies reported prevalence of PTSD in acute SARS phase while 3 studies reported that in SARS recovery phase, with the pooled prevalence of 29.4% (95% CI: 9.3% - 63.0%; I^2=96.62%, p<0.001) and 15.3% (95% CI: 6.7% - 31.3%; I^2=89.83%, p<0.001), respectively. No study on prevalence of PTSD during the COVID-19 epidemic was published by the date of literature search; therefore, comparison between SARS and COVID-19 could not be made. Detailed comparisons of psychiatric comorbidities between COVID-19 and SARS epidemics are shown in Table 3.

3.4. *Subgroup analyses in prevalence of psychiatric comorbidities during the COVID-19 epidemic*

The pooled prevalence of poor mental health in the general population and health professionals during the COVID-19 epidemic was 29.0% (95% CI: 18.1% - 43.1%) and 11.6% (95% CI: 9.2% - 14.6%), respectively. Subgroup analyses revealed that compared with health professionals, general populations were more likely to have poorer general mental health (Q=10.99, p=0.001). No significant difference was found between health professionals (28.0%, 95% CI: 9.5% - 59.0%) and general populations (19.2%, 95% CI: 4.6% - 54.2%) in prevalence of PTSS (Q=0.21, p=0.63). The prevalence estimates of depression and anxiety during the COVID-19 were similar between the general population and health professionals (Q=0.01, p=0.91 for depression; Q=0.23, p=0.64 for anxiety). Details of the comparisons are presented in Table 4. No significant differences were found in prevalence of depression, anxiety, insomnia and PTSS during the COVID-19 epidemic between different sex, between different education levels and between different marital status (all p values > 0.05; Table 5).

3.5. Meta-regression analyses

Meta-regression analyses revealed that the prevalence estimates of depression (r=2.31), stress (r=4.54) and insomnia (r=3.97) were positively and significantly associated with proportion of female participants. Studies with higher quality scores reported higher prevalence of depression (r=0.64), anxiety (r=0.40) and PTSS (r=2.08). Details of meta-regression analyses are shown in Supplementary Table 2.

3.6. Prevalence of psychiatric comorbidities in special subpopulations

A case-control study in Hong Kong reported that the prevalence of depression in pregnant women during the SARS epidemic was 12.3% (Lee et al., 2006), while another cross-sectional study in mainland China reported that the prevalence of depression in pregnant women during the COVID-19 epidemic was 29.6% (Wu et al., 2020). Two cross-sectional studies conducted in mainland China reported that the prevalence of depression in children and adolescents during the COVID-19 epidemic ranged from 22.6% to 43.7%, and the prevalence of anxiety in children and adolescents during the COVID-19 epidemic ranged from 18.9% to 37.4% (Xie et al., 2020, Zhou et al., 2020). A cross-sectional study conducted in mainland China reported that during the COVID-19 epidemic, parents of children hospitalized for any reason had significantly more severe depression and anxiety than parents of non-hospitalized children (48.0% vs. 8.0% in depression; 42.0% vs. 8.0% in anxiety) (Yuan et al., 2020).

A longitudinal study in mainland China reported that inpatients with COVID-19 or suspected COVID-19 had high levels of anxiety (86.1% before psychological intervention vs. 58.3% after psychological intervention; p<0.05) (Han et al., 2020), while a cross-sectional study in Vietnam reported that outpatients with suspected COVID-19 symptoms had significantly higher prevalence of depression than those without (64.3% vs. 35.7%; p<0.001) (Nguyen et al., 2020). A cross-sectional study in Hong Kong reported that during the SARS epidemic mental health problems were common in patients on a waiting list for thoracic surgeries, of whom 26.3% had depression, and 42.1% had anxiety (Wan et al., 2004).

3.7. Quality assessment and publication bias

Of the 82 included studies, the mean quality assessment score was 4.9, ranging from 3 to 7. Eighty studies are rated as “moderate quality”, while one study was rated as “low quality” and one study was rated as “high quality” (Supplementary Table 1). Egger’s test found marginal publication bias in studies on PTSS during the COVID-19 epidemic (t=2.26, p=0.04; shown in Table 2). Funnel plots are shown in Supplementary Figures 8-15. A sensitivity analysis using the trim-and-fill method was performed with one imputed study, producing an approximately symmetrical funnel plot (Supplementary Figure 14). Using the trim-and-fill method, the adjusted pooled prevalence of PTSS was 53.1% (95% CI: 30.2% - 74.7%).

4. Discussion

To the best of our knowledge, this was the first systematic review that compared the prevalence of psychiatric comorbidities between the SARS and COVID-19 epidemics in all sub-populations. We found that psychiatric comorbidities were common in different subpopulations in both epidemics, and the prevalence estimates of psychiatric comorbidities were similar between both epidemics.

The overall prevalence of depression in all subpopulations studied during the COVID-19 epidemic was 23.9% (95% CI: 18.4%-30.3%) in this systematic review, which is similar to the findings of an earlier meta-analysis (18.9%; 95% CI: 13.0% - 26.6%) of depression during the COVID-19 epidemic (Li et al., 2020). We found the overall prevalence of anxiety in all subpopulations studied during the COVID-19 epidemic was 23.4% (95% CI: 19.9% - 27.3%), which is significantly lower than the corresponding figure in an earlier meta-analysis (44.5%; 95% CI: 29.8% - 60.1%) (Li et al., 2020). The reasons might be that the previous meta-analysis included studies published on or before 6 March 2020 (early stage of the COVID-19 epidemic), and conducted specifically on frontline health professionals, confirmed cases and quarantined populations. Another meta-analysis on COVID-19 patients also found higher prevalence of depression (45%; 95% CI 37% - 54%) and anxiety (47%; 95% CI 37% - 57%) (Deng et al., 2020), probably due to uncertainty about the novel virus, lack of specific treatments and fear of transmission to vulnerable populations (Xiang et al., 2020). The pooled prevalence of insomnia in this systematic review was 26.5% (95% CI: 19.1% - 35.5%), which is comparable with the findings of two earlier meta-analyses (49.8%, 95% CI: 18.6% - 81.1% (Li et al., 2020); and 34%, 95% CI: 19% - 50% (Deng et al., 2020)). The overall prevalence of stress and PTSS in this systematic review was 14.2% (95% CI: 8.4% - 22.9%) and 24.9% (95% CI: 11.0% - 46.8%), respectively, both of which are comparable with the corresponding figure in the previous meta-analysis (21.6%; 95% CI: 3.4%-68.1%) conducted in early stage of the COVID-19 epidemic (Li et al., 2020).

We found that the prevalence of depression and anxiety in all subpopulations studied between the SARS and COVID-19 epidemics were similar (Q=0.34, p=0.85 for depression; Q=0.59, p=0.44 for anxiety), which is also consistent with the findings in health professionals (Q=1.153, p=0.283 for depression; Q=0.557, p=0.456 for anxiety)

Table 2
Prevalence of psychiatric comorbidities during the COVID-19 epidemic in all subpopulations

Psychiatric outcomes	Number of studies	Events	Sample size	Prevalence (%)	95% *CI* (%)	I^2 (%)	*p*	Publication bias (Egger's test)
Depression	21	10025	39542	23.9	18.4 - 30.3	99.43	< 0.001	t = 1.28, p = 0.22
Anxiety	24	11690	45253	23.4	19.9 - 27.3	98.78	< 0.001	t = 1.28, p = 0.21
Stress	5	1440	6531	14.2	8.4 - 22.9	98.65	< 0.001	t = 3.37, p = 0.04
Distress	3	555	2840	16.0	8.4 - 28.5	97.77	< 0.001	t = 1.40, p = 0.39
Insomnia	8	3481	14042	26.5	19.1 - 35.5	98.79	< 0.001	t = 0.61, p = 0.57
PTSS	13	4268	11983	24.9	11.0 - 46.8	99.68	< 0.001	t = 2.26, p = 0.04
Poor mental health	5	1216	6406	19.9	11.7 - 31.9	98.92	< 0.001	t = 0.14, p = 0.90

Notes: I^2 statistic was used to assess the heterogeneity of the studies.
The minimum number of studies required to synthesize data is 3.

Table 3
Comparison of prevalence of psychiatric comorbidities during the COVID-19 and SARS epidemics

Psychiatric outcomes	Condition	Number of studies	Events	Sample size	Prevalence (%)	95% *CI* (%)	I^2 (%)	*p* (within subgroup)	*Q* (*p* across subgroups)
Depression	COVID-19	21	10025	39542	23.9	18.4 - 30.3	99.43	< 0.001	$Q = 0.34$, $p = 0.85$
	Acute SARS	6	348	1780	27.5	17.3 - 40.6	94.95	< 0.001	
	SARS Recovery	3	175	712	26.0	15.6 - 40.0	87.59	< 0.001	
Anxiety	COVID-19	24	11690	45253	23.4	19.9 - 27.3	98.78	< 0.001	$Q = 0.59$, $p = 0.44$
	SARS	9	275	2892	17.7	8.2 - 34.1	97.37	< 0.001	
PTSS	COVID-19	13	4268	11983	24.9	11.0 - 46.8	99.68	< 0.001	$Q = 0.89$, $p = 0.35$
	SARS	15	938	5653	16.8	12.9 - 21.5	93.94	< 0.001	
Poor mental health	COVID-19	5	1216	6406	19.9	11.7 - 31.9	98.92	< 0.001	$Q = 1.06$, $p = 0.59$
	Acute SARS	9	2034	9907	26.6	11.7 - 49.8	99.61	< 0.001	
	SARS Recovery	3	129	406	32.8	12.4 - 62.8	96.44	< 0.001	
PTSD	Acute SARS	3	89	421	29.4	9.3 - 63.0	96.62	< 0.001	$Q = 0.95$, $p = 0.33$
	SARS Recovery	3	71	410	15.3	6.7 - 31.3	89.83	< 0.001	

Note: Acute SARS refers to study period before January 1, 2004; Recovery SARS refers to study period after January 1, 2004.
Studies involving anxiety during SARS were not divided into "acute SARS/recovery SARS" because only 2 studies were conducted during recovery phase of SARS and they did not reach the minimum number of studies to synthesize data. Studies involving stress, distress, insomnia were not compared between COVID-19 and SARS due to the similar reason.

Table 4
Prevalence of psychiatric comorbidities during the COVID-19 epidemic in all subpopulations

Psychiatric outcomes	Population	Number of studies	Events	Sample size	Prevalence (%)	95% *CI* (%)	I^2 (%)	*p* (within subgroup)	*Q* (*p* across subgroups)
Depression	General population	10	6016	20644	23.2	16.6 - 31.4	99.38	< 0.001	$Q = 0.01$, $p = 0.91$
	Health professionals	11	2809	11922	23.9	15.0 - 35.9	99.32	< 0.001	
Anxiety	General population	10	5118	20599	21.2	16.6 - 26.7	98.74	< 0.001	$Q = 0.23$, $p = 0.64$
	Health professionals	14	3584	13020	23.2	17.1 - 30.8	98.77	< 0.001	
PTSS	General population	5	1164	3015	19.2	4.6 - 54.2	99.57	< 0.001	$Q = 0.21$, $p = 0.63$
	Health professionals	5	2190	4327	28.0	9.5 - 59.0	99.59	< 0.001	
Poor mental health	General population	3	742	2575	29.0	18.1 - 43.1	97.93	< 0.001	$Q = 10.99$, $p = 0.001$
	Health professionals	3	402	3327	11.6	9.2 - 14.6	83.06	< 0.001	

Note: Only the first visit of longitudinal studies was included in order to avoid data duplication.
Studies involving stress, distress, insomnia were not compared between different populations because their numbers of studies in at least one population did not reach the minimum number of studies to synthesize data.

(Salazar de et al., 2020). We found that the prevalence of PTSS in all subpopulations studied between the SARS and COVID-19 epidemics were similar (Q=0.89, p=0.35). However, in an earlier meta-analysis the prevalence of PTSD features in health professionals during the SARS, MERS and COVID-19 epidemics were different (16.7% in SARS, 40.7% in MERS, and 7.7% in COVID-19 epidemics; Q=22.74, p<0.001) (Salazar de et al., 2020). This may be because only one COVID-19 study with very low prevalence of PTSD features was included (Salazar de et al., 2020).

Subgroup analyses revealed that compared with health professionals, the general population was more likely to have poor general mental health status during the COVID-19 epidemic. This could be due to several reasons. Widespread misinformation on social mass media may have resulted in panic, fear and other mental health problems at the early phase of COVID-19 epidemic (Apuke and Omar, 2020, Pennycook et al., 2020, Brennen et al., 2020). Compared to health professionals, the general population may have less relevant medical knowledge to appraise the appropriate level of risks (O'Connor and Murphy, 2020), and may be more likely to suffer from mental health problems. In addition, substantial mental health services and psychological assistances were specifically developed for health professionals during the COVID-19 epidemic, which reduced the risk of adverse mental health effects (Liu et al., 2020, Li et al., 2020).

The prevalence of depression and anxiety between the general population and health professionals during the COVID-19 epidemic are comparable, consistent with previous findings (Li et al., 2020) in which

Table 5
Prevalence of psychiatric comorbidities during the COVID-19 epidemic by sex, education level and marital status.

Psychiatric outcomes	Categories	Number of studies	Events	Sample size	Prevalence (%)	95% *CI* (%)	I^2 (%)	*p* (within subgroup)	*Q* (*p* across subgroups)
Depression	Male	5	1770	5892	32.4	20.1 - 47.6	99.00	< 0.001	$Q = 0.02, p = 0.90$
	Female	5	3234	9478	33.7	20.1 - 50.7	99.53	< 0.001	
Anxiety	Male	8	2748	9663	25.7	21.0 - 31.1	96.25	< 0.001	$Q = 0.64, p = 0.42$
	Female	8	4928	17907	28.7	23.8 - 34.1	98.07	< 0.001	
Insomnia	Male	5	848	4089	25.2	19.7 - 31.6	87.08	< 0.001	$Q = 1.07, p = 0.30$
	Female	5	1818	7048	31.7	21.6 - 43.9	98.72	< 0.001	
	Senior high school or below	3	62	147	43.3	28.5 - 59.5	52.96	0.12	$Q = 1.15, p = 0.28$
	University or above	3	860	2486	34.6	31.4 - 38.1	56.12	0.10	
	Married	3	606	1775	34.6	31.0 - 38.3	47.55	0.15	$Q = 0.17, p = 0.68$
	Unmarried	3	316	859	35.8	31.140.9	43.56	0.17	
PTSS	Male	4	235	993	19.1	4.2 - 56.3	98.65	< 0.001	$Q = 0.08, p = 0.78$
	Female	4	907	2199	25.4	5.1 - 68.3	99.56	< 0.001	

Note: Only studies reported all categories of sex and education level were included.
The minimum number of studies required to synthesize data is 3.

the prevalence of depression was 12.6% (95% CI: 7.2%-21.2%) in the general population and 13.4% (95% CI: 5.3% - 29.7%) in health professionals during the COVID-19 epidemic, while the corresponding figures of anxiety was 40.6% (95% CI: 15.1% - 72.4%) and 41.1% (95% CI: 28.4% - 55.1%), respectively (Li et al., 2020). In contrast to the previous study, no significant difference in the prevalence of PTSS between the general population and health professionals was found in this meta-analysis. In the previous study, the prevalence of stress-related symptoms in health professionals (73.4%, 95% CI: 71.1% - 75.5%) was higher than in the general population (2.3%, 95% CI: 0.6% - 8.7%) (Li et al., 2020). However, the previous study only had one survey each on stress-related symptoms in the general population and in health professionals respectively (Li et al., 2020), which could lead to unreliable results.

Subgroup analyses revealed that no gender difference was found in the prevalence of depression, anxiety, insomnia and PTSS in all subpopulations studied during the COVID-19 epidemic in this meta-analysis, which is consistent with earlier meta-analyses conducted in COVID-19 patients (Deng et al., 2020) and health professionals (Pappa et al., 2020). However, meta-regression analysis found that female gender was positively associated with higher risk of depression, stress and insomnia. An earlier meta-analysis found that female health professionals were more likely to suffer from distress in coronavirus disease epidemics (Salazar de et al., 2020). This may be attributed to hormonal and cultural differences in females, for instance, socially sanctioned expression of emotions is encouraged in females more than males (Burt and Stein, 2002, Albert, 2015, Zhang and Wing, 2006, Barsky et al., 2001, Jayaratne et al., 1983). Marital status and education level did not moderate the prevalence of insomnia in this meta-analysis. As no other meta-analysis examined this potential association, direct comparisons could not be made. We also found that higher quality studies were associated with higher prevalence of depression, anxiety and PTSS. Due to random sampling, large sample size, strict study design and better trained interviewers that were adopted in high quality studies, mental health problems were more likely to be identified compared to lower quality studies (Rao et al., 2020, Xu et al., 2018, Wang et al., 2018).

The strengths of this systematic review included first, psychiatric comorbidities of all subpopulations studied during the COVID-19 and SARS epidemics were included, while previous meta-analyses focused either on COVID-19 or SARS alone (Deng et al., 2020, Li et al., 2020, Salari et al., 2020), and only on certain subpopulations (Rogers et al., 2020, Deng et al., 2020, Salazar de et al., 2020, Kisely et al., 2020). Second, the number of included studies and the total sample size were large, which enabled us to perform sophisticated analyses, such as subgroup and meta-regression analyses and test publication bias. However, several methodological limitations should be noted when interpreting the results. First, only studies published in English and Chinese languages were included. Second, even after subgroup analyses were performed, significant between-study heterogeneity was found. Such heterogeneity is unavoidable in the meta-analyses of epidemiological studies (Rotenstein et al., 2016, Wang et al., 2017). Third, some factors related to psychiatric comorbidities, such as pre-existing psychiatric disorders, social support, and severity and treatments of SARS and COVID-19, were not examined due to insufficient data.

In conclusion, psychiatric comorbidities were common in different subpopulations during both the SARS and COVID-19 epidemics. Although clinical features of both diseases are different, their prevalence of psychiatric comorbidities were almost similar. Considering the negative impact of psychiatric comorbidities on health and wellbeing during serious epidemics, timely screening and appropriate interventions for psychiatric comorbidities should be conducted for vulnerable subpopulations. Further public mental health education and psychological assistance hotlines should also be provided for the affected populations.

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Declaration of Competing Interest

There is no conflict of interest related to the topic of this manuscript.

Acknowledgments

None.

Role of funding

The study was supported by the National Science and Technology Major Project for investigational new drug (2018ZX09201-014), the Beijing Municipal Science & Technology Commission (No. Z181100001518005), and the University of Macau (MYRG2019-00066-FHS).

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2021.03.016.

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