Prevalence and predictors of the early psychological impact of the COVID-19 pandemic
compared with SARS and MERS:

A systematic literature review and meta-analysis

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Abstract

Objective: This meta-analysis examines the psychological impact of COVID-19, SARS and MERS pandemics on health-care workers, patients and the general population, in line with PRISMA, MOOSE, MARS and CASP guidelines.

Methods: Searches were conducted on 28-29 March 2020 in Pubmed, Medline, PsycInfo, APA articles, Web-of-Knowledge and scholar.google.com. Hedges' g was calculated with random-effects models.

Results: The final selection included 75 publications from 15,984 papers. Twenty-six studies described the impact of COVID-19 in 104,361 participants, showing that 59% (95%CI: 37%-85%) of health-care workers experienced acute/post-traumatic stress, and 37% (95%CI: 30%-54%) experienced depression, general distress, insomnia and/or anxiety. Of all COVID-19 patients, 32% (95% CI: 22%-42%) experienced acute/post-traumatic stress disorder, anxiety, depression, insomnia and/or distress. In the general population, 25% (95%CI: 15%-35%) experienced any of these psychological symptoms. COVID-19 had a larger impact than SARS/MERS in 28,499 participants in 44 studies. During SARS/MERS pandemics, 33% (95%CI: 25%-41%) of health-care workers, 31% (95%CI: 18%-45%) of SARS/MERS-patients and 15% (95%CI: 7%-23%) of the general population experienced any of these psychological symptoms. The psychological impact was predicted ($R^2 < .20-.40$) by the individual's physical health, restrictions to leisure and social activities, and quarantine. Frontline health-care workers experienced a larger psychological impact than the general population, particularly if they worked with infected patients and reported unfavourable work circumstances.

Conclusions: This study can be used to predict the prevalence of mental health problems during and after the COVID-19 pandemic, and to predict which individuals are most at risk of developing mental health problems. Health care workers and vulnerable individuals should be psychologically screened and offered mental health-care. Quarantine should be as short as possible, to prevent mental health problems.

Public health significance statement

This meta-analysis indicates that between one-third of the general population and half of all health care workers experience a moderate to severe mental health impact of the COVID-19 pandemic. This impact is larger than during SARS and MERS pandemics. The psychological impact on health care workers is mainly predicted by their work circumstances, and the impact on the general population by their pre-existing physical and mental well-being and the psychological effects of quarantine.

Prevalence and predictors of the psychological impact of the COVID-19 pandemic compared with SARS and MERS: a meta-analysis

Introduction

The 2019-novel coronavirus (SARS-CoV-2) is the third large Coronavirus outbreak in less than 20 years. This pandemic follows the Severe Acute Respiratory Syndrome (SARS) in 2002-2003 and the Middle East Acute Respiratory Syndrome (MERS) in 2012. Although compared to other pandemics, SARS-CoV-19 has a lower mortality rate, it seems to affect more individuals, due to larger transmission risks (Lin, Wen, & Chen, 2020; World Health Organization, 2020a; Sohrabi et al., 2020). The virus has spread to more than 170 countries with 179,111 people diagnosed with COVID-19 and 11,525 deaths as of 17 March 2020 (World Health Organization, 2020a). Whereas the first cases were found in the Hubei region in China, 65% of global cases are currently outside China, with epicentres in Europe and United States. This has triggered the WHO to declare a pandemic on 11 March 2020 (Sohrabi et al., 2020).

Data indicate that the disease is mild in 80 percent of patients, severe in 13 percent and critical in 6 percent, with larger mortality in elderly individuals and those with underlying medical conditions (Emami, Javanmardi, Pirbonyeh, & Akbari, 2020; Lin et al., 2020; Sun, Lu, Xu, Sun, & Pan, 2020). Common symptoms include a dry cough and fever, although some progress to severe pneumonia, respiratory or multiple organ failure (Lin et al., 2020). To date, there is no vaccine available, and treatment includes symptom management, supportive care and isolation (Lin et al., 2020). As the virus spreads from human-to-human via respiratory droplets and other bodily secretions, recommended prevention includes frequent hand washing, social distancing, covering coughs and sneezes with a tissue, and

keeping unwashed hands away from the face. Consequently, to stop the exponential spread of the virus via human contact, more than one third of all countries world-wide have executed nation-wide lock-downs (Mahase, 2020; World Health Organization, 2020a).

The National Health Commission of China (Bao, Sun, Meng, Shi, & Lu, 2020) and the World Health Organisation (2020b) recommend to offer mental health-care to those emotionally impacted by COVID-19. These recommendations follow the general observation, that many individuals experience psychological distress in response to the communication of health risks and the confrontation with life-threatening diseases (Vos, 2016, 2011). However, the WHO recommendations lack specificity and are based on extrapolation of a small number of studies on SARS/MERS-pandemics (Bao et al., 2020). It is understandable that these recommendations do not cite studies on COVID-19 as there are relatively few peer-reviewed studies on COVID-19, and these studies only focus on the psychological impact shortly after the outbreak of the pandemic. However, there are also no meta-analyses available on the psychological impact of SARS/MERS pandemics, and thus it is difficult for anyone to make reliable and valid extrapolations from SARS/MERS pandemics to the current period. To be able to provide more reliable estimations of the impact, it is important to conduct a meta-analysis of the psychological impact of COVID-19, SARS and MERS. It may also be beneficial to examine differences in impact between COVID-19 and SARS/MERS; this could help to make a more reliable estimation of the size of the psychological impact of the current pandemic and of the possible mental health care resources that may need to be made available to address this.

The WHO recommends identifying the psychologically most vulnerable individuals. The current recommendations for COVID-19 are based on research on the stress and coping response to other health risks (Vos, 2011; Folkman, 2011; Folkman & Lazarus, 1984). However, it is unknown whether individuals have a similar stress-coping response to

pandemics and to COVID-19 in specific. Consequently, no evidence-based guidelines can be provided identifying which individuals are most at risk to experience severe psychological stress or mental health problems and recommending who may benefit most from mental health care during COVID-19.

Therefore, this meta-analysis will summarise the psychological impact of the SARS-CoV-19 pandemic, compare this with SARS/MERS, and identify factors which put individuals at psychological risk. The psychological impact is defined as any changes in the emotional life of individuals, psychological distress and psychopathology such as anxiety, depression, and post-traumatic stress disorder. This meta-analysis will be broken down into three studies. Study 1 examines the psychological impact of the SARS-CoV-2 pandemic on patients, health-care workers, and the general population. As there are relatively few peer-reviewed studies on COVID-19 and these studies only focus on the short-term/middle impact of pandemics, study 2 will examine the psychological impact of SARS and MERS. The impact of SARS/MERS will be compared with COVID-19, to examine to which extent the conclusions of SARS/MERS could be extrapolated to the current pandemic; a range of possible predictors will be used to explain any possible differences. In study 3, we will identify any risk factors predicting the psychological impact in studies 1 and 2. These findings will be used in the discussion-section for further theorising on the possible causes and prevention of the psychological impact of pandemics.

Method

The systematic literature review was conducted in consecutive rounds, in line with PRISMA and MOOSE-guidelines (Liberati et al., 2009; Stroup et al., 2000) (see figure 1).

The systematic literature reviews in studies 1 and 2 included search terms to find psychological publications: psycholog*, psychiatr*, mental-health, mental-well-being, mood, affecti*, neurotic, neurosis, emotion*, feeling*, psychopath* (Boolean operator between these psychological terms: 'OR'). In addition, with the help of Boolean operator 'AND', study 1 also included the terms: COVID-19, 2019-nCoV, 2019 novel coronavirus, SARS-CoV-2, or severe acute respiratory syndrome-2 (Boolean operator between these SARS-CoV-2 terms: 'OR'). With the help of Boolean operator 'AND', study 2 also included the terms for the most common coronaviruses: coronavirus, SARS, MERS, HKU1, NL63, OC43, 229E, Severe Acute Respiratory Syndrome, or Middle East Respiratory Syndrome (Boolean operator between these coronavirus terms: 'OR'). Searches were conducted on 28-29 March 2020 in Pubmed, Medline, PsycInfo, APA articles, Web-of-Knowledge and scholar.google.com.

All titles and abstracts were initially screened for eligibility. Duplicates were removed, and studies excluded after reading full-text manuscripts. Articles had to be observational/survey studies in English, describe any psychological impact of COVID-19, SARS or MERS, have a systematic study design (e.g. description of clear justification and explanation of instrument selection and of sample, clear systematic procedures, unbiased recruitment), and use a psychometric instrument, such as a questionnaire, with proven validity and reliability in a similar sample. Unpublished articles and abstracts-only publications were included if there was sufficient data for analysis. We searched reference lists of included studies, and all authors were contacted to ask for other publications.

We assessed the quality of each study by answering multiple questions (good/bad/unknown) from an adjusted CASP diagnostic checklist (CASP, 2014): was there a clear question?; was the sample an appropriate spectrum of individuals?; was there a comparison with a reference standard?; was the diagnosis validated with a different group?; is

the disease status clearly described?; were the methods for performing the test described in detail?; does the test have good validity and reliability?; what are the results? ; how sure are we about the results? what are possible consequences and costs of alternatives?; can the results be applied to patients/populations of interest?; were all outcomes important?; would the results modify decisions about management of individuals? We summarised each study with an overall good/bad/unknown score.

We inserted study data into *Comprehensive Meta-Analysis* software via similar procedures as previous meta-analysis (cf. Vos & Vitali, 2018). Where needed, proportions were calculated for moderate to severe levels of psychological distress or psychiatric disorder, according to published cut-off scores for the instruments to diagnose a moderate to severe disorder in the general population (see table 1). Where no proportions were available, means and standard deviations were used to calculate proportions, assuming normal distribution. Thus, these proportions show the number of individuals reporting moderate to severe psychological distress or psychiatric disorder. It was decided not to compare individuals with the average number of individuals with psychological distress or psychiatric disorder in the general population in times when there is no pandemic (e.g. Odds Ratios), as the aim of this study is to identify the prevalence of psychological distress or psychiatric disorder during pandemics, regardless of whether this could be attributed to the pandemic or not. Research also seems to suggest that it may be difficult to differentiate the causes of mental health problems during pandemics, as for example pre-existing mental health issues could make individuals more vulnerable to experience large psychological stress during pandemics but this may also make them more vulnerable to get infected with SARS/MERS/COVID-19 (Biondi & Zannino, 1997; Garfin, Thompson, & Holman, 2018; Segerstrom & Miller, 2004). However, as an indication, in the discussion-section we will

compare the prevalence of moderate to severe psychological distress or psychiatric disorder during COVID-19/SARS/MERS with non-pandemic times.

Different instruments could operationalise the same type of psychological impact: for example, anxiety could be measured with the GAD or HADS. If multiple instruments were used in one study to measure one type of psychological impact, means were calculated. Whether an instrument belonged to a group of specific types of impact (anxiety, depression, PTSD, insomnia, psychological distress) was decided on the basis of the content and of small non-significant heterogeneity, i.e. homogeneity ($p(Q) > 0.05$, $I^2 < .25$) (Gavaghan, Moore, & McQuay, 2000; Higgins & Thompson, 2002; Huedo-Medina, Sánchez-Meca, Marín-Martínez, & Botella, 2006). Mean effect sizes were calculated with proportions and 95% Confidence Intervals(CI). Random effects were calculated, as samples differed from each other; the tables provide details on the variance component estimates. Cohen's d was used to test differences between studies on COVID-19 and SARS/MERS, and between different populations (health-care workers, pandemic patients, general population); Cohen's d of 0.20 is considered small, 0.50 medium and 0.70 large. Separate meta-analysis was conducted to calculate the mean correlations of risk-factors with the psychological impact. Correlations of 0.15 are considered small, 0.40 medium, 0.60 large, and 0.80 very large.

A second researcher validated the selection of publications in the abstract-selection stage and the full-text-reading stage by screening a random selection of 10% of all studies, showing good inter-rater reliability ($Kappa = .90, .88$). Both researchers had large inter-rater agreement on the coding of risk-of-bias ($Kappa = .85$); differences were discussed until agreement was reached. Both researchers are psychologists, with specific expertise on health and existential threats. To further validate the findings, we conducted sensitivity analyses. We used contrasts to test the hypothesis that studies published in peer-reviewed journals had larger risk-of-bias and larger effect sizes than studies that had not been peer-reviewed. We

also tested the hypothesis that effect sizes are larger for studies which were conducted on the short-term impact of pandemics (within 3 months after the outbreak of the pandemic) than for studies on the medium-term impact (<3-9 months>) and studies on the long-term impact (>9 months). We used contrasts to test the hypothesis that sample and study characteristics do not influence the effects (country, age, gender, income, sample size, recruitment procedure).

Additional analyses were conducted, first only in studies with the 25% largest effects compared with studies with the 25% smallest effects, second only in studies with the 25% most precise effects compared with studies with the 25% most imprecise effects. The effects of these re-analyses were regarded similar to the original findings if the significance and magnitude of the effects were similar (significant/nonsignificant; small/moderate/large) and effect sizes did not differ by more than 10% (see explanation in Vos & Vitali, 2018). We tested whether there were any significant differences between studies with a large risk-of-bias and those with a low risk-of-bias, and also between studies in which proportions were reported and those where proportions had to be derived indirectly, and between studies with pre-validated instruments and those with new instruments. Spurious outliers were identified in each meta-analytic step; outliers were discarded via a trimming technique that excluded studies where the 95% CI was lower than the aggregated confidence interval of all studies (Borenstein & Higgins, 2013). Publication bias was tested in each meta-analytic step by visual inspection of funnel plots and calculation of Egger intercepts, using a trim-and-fill procedure, which provides an estimate of effect size after publication bias has been considered (Duval & Tweedie, 2000). There was no funding source for this study.

A-priori power analyses estimated that four or more studies are required to detect moderately large effect sizes as suggested in a previous review on the psychological impact of SARS (Gardner & Moaleff, 2015), with a power over 0.80 (Valentine et al., 2010;

Borenstein et al., 2009). The findings-section only presents robust findings: if fewer than four studies reported on an outcome, this outcome was not presented.

Findings

Overview

The search yielded 15,984 initial publications, of which 753 articles on COVID-19 and 14,253 articles on SARS/MERS (see figure 1). From this, we selected 75 publications in 132,860 participants. Study 1 included 26 publications on COVID-19 in 104,361 participants. Study 2 included 37 publications on SARS in 17,505 participants, and 7 publications on MERS in 10,994 participants.

From the 26 COVID-19 studies, six had been published in a peer-reviewed journal. These six studies did not differ in their risk-of-bias and in their mean effect sizes on all outcome-measures. From the 44 studies on SARS/MERS, 23 had studied the short-term impact within three months after the public announcement of the outbreak of the pandemic; these 23 studies did not significantly differ in effect sizes compared to studies examining the medium-term impact of SARS-MERS between 3 and 9 months since the outbreak. However, these 23 studies on the short-term and medium-term impact had significantly smaller effect sizes than the COVID-19 studies, and they also had larger effects than long-term studies on SARS-MERS (longer than 9 months after the start of the outbreak). Therefore it was decided to do separate analyses for COVID-19, short-term/medium-term SARS/MERS and long-term SARS/MERS.

In meta-analytic studies 1 and 2, the included studies and their instruments had a low risk of bias, with three studies (4%) having a large-risk-of-bias due to unclarity about the sample. However, in study 3, forty studies (53.3%) had a large risk of bias, due to the

inclusion of new questionnaires to operationalise risk-factors predicting the psychological impact. However, 32 of these 40 studies gave sufficient details about the reliability and validity of the new instruments; if these studies are interpreted as low risk-of-bias, eight studies (10.7%) remain high risk for other reasons. Regardless of how studies were categorised, risk-of-bias did not significantly correlate with any findings or create significant heterogeneity between studies; therefore, all studies were included in analyses. The other findings from sensitivity analyses showed that sample and study characteristics, including sample size and preciseness of effects, did not significantly influence the findings. As described below, there were few outliers. Publication bias was little, except for a slightly larger bias in studies on acute stress disorder in COVID-19 and short-term/medium-term SARS/MERS studies. However, there were less than 10% difference between the non-adjusted effect size and the effect sizes adjusted for publication bias, using the trim-and-fill procedure; therefore, it was decided to report only the non-adjusted effects.

[place figure 1 & table 1 about here]

Study 1. The psychological impact of COVID-19

Overall

The average psychological impact of COVID-19 on health-care workers was slightly larger than the average impact on pandemic patients (Cohen's $d=.19$, $p=.02$; $p(Q)=.01$; $I^2=47$) and larger than the average general population (Cohen's $d=.47$, $p<.01$; $p(Q)=.01$; $I^2=67$).

Health Care Workers

Eleven studies described the impact on HCW. From all health-care workers, 59% (95%CI: 37%-85%) experienced symptoms of acute stress disorder, 41% (95%CI: 30%-52%)

depression, 39% (95%CI: 19%-52%) general psychological distress, 35% (95%CI: 34%-64%) insomnia and 31% (95%CI: 20%-42%) anxiety.

Pandemic Patients

One study has been conducted on patients diagnosed with COVID-19, which showed that 40% (95%CI: 27%-52%) experienced anxiety.

General Population

Ten studies described the impact in the general population: 34% (95%CI: 20%-51%) of all people experienced symptoms of acute stress disorder, 31% (95%CI: 20%-41%) anxiety, 29% (95%CI: 11%-58%) depression, 18% (95%CI: 15%-22%) insomnia, and 17% (95%CI: 4%-54%) general psychological distress.

[place table 2 about here]

Study 2. The psychological impact of SARS/MERS

Overall

The average psychological impact of SARS/MERS on health-care workers did not differ from the impact on pandemic patients (Cohen's $d=.07$, $p=.31$; $p(Q)=.23$; $I^2=0$) but was larger than the general population (Cohen's $d=.53$, $p<.01$; $p(Q)<.01$; $I^2=.87$).

Health Care Workers

Nine studies described the impact. From all health-care workers, 39% (95%CI: 24%-56%) experienced acute/post-traumatic stress, 41% (95%CI: 12%-78%) depression, 32% (95%CI: 23%-42%) general psychological distress, and 17% (95%CI: 4%-47%) anxiety. The average short-term impact of SARS/MERS was significantly smaller than the average impact of COVID-19 (Cohen's $d=.65$, $p<.01$; $p(Q)<.01$; $I^2=.87$). Between one and five years after the

SARS/MERS pandemics, health-care workers experienced on average a significantly lower psychological impact (Cohen's $d=.56$, $p<.01$; $p(Q)<.01$; $I^2=.62$), although there were still remaining symptoms as 20% (95%CI: 13%-31%) reported acute/post-traumatic stress, 23% (95%CI: 20%-27%) depression, and 64% (95%CI: 25%-90%) general psychological distress.

Pandemic Patients

Thirteen studies have been conducted on the psychological impact on patients: 34% (95%CI: 6%-78%) experienced anxiety, 41% (95%CI: 21%-64%) general psychological stress, 21% (95%CI: 14%-31%) acute/post-traumatic stress, and 27% (95%CI: 12%-48%) depression. Compared with the only study on COVID-19 patients, SARS/MERS patients experienced slightly less anxiety (Cohen's $d=.27$, $p<.05$; $p(Q)<.05$; $I^2=.39$). Between one and five years after the SARS/MERS pandemics, SARS/MERS patients experienced on average a slightly lower psychological impact (Cohen's $d=.47$, $p<.05$; $p(Q)<.04$; $I^2=.47$), although there were still remaining symptoms: 20% (95%CI: 13%-30%) experienced anxiety, 39% (95%CI: 29%-49%) general psychological stress, 38% (95%CI: 10%-77%) acute/post-traumatic stress, and 36% (95%CI: 17%-36%) depression.

General Population

Ten studies described the impact on the general population: 18% (95%CI: 6%-41%) of all people experienced acute/post-traumatic stress, 8% (95%CI: 3%-20%) anxiety, 13% (95%CI: 2%-50%) depression, and 29% (18%-44%) general psychological stress. The average short-term impact of SARS/MERS was smaller than COVID-19 (Cohen's $d=.45$, $p<.01$; $p(Q)<.01$; $I^2=.12$). Only one study was conducted on the long-term impact of SARS/MERS which showed that 31% (95%CI: 1%-99%) of the general population experienced general psychological stress, which did not significantly differ from the short-term impact.

Study 3. Summary of risk factors predicting the psychological impact

Health Care Workers (average effects within studies)

Table 3 provides an overview of the mean effect sizes for risk factors predicting the psychological impact of COVID-19/SARS/MERS. No significant differences were found between COVID-19 and SARS/MERS (Cohen's $d < .10$, $p(Q) > .05$, $I^2 < .25$). The following are the most robust risk factors, i.e. they are based on 5 or more studies and have mean correlations larger than .20 (medium or large effect sizes): dissatisfaction with the organisation, training and support at work ($R = .30$, 95%CI: .20-.40); lack of social support from colleagues, friends and family ($R = .23$; 95%CI = .20-.25); direct contact with infected patients ($R = .22$; 95%CI = .16-.28), lack of personal protective equipment ($R = .20$; 95%CI = .10-.30) and lack of self-efficacy ($R = .19$; 95% = .10-.28).

Pandemic Patients (average effects within studies)

Only seven studies have been conducted on psychological risk factors in patients diagnosed with COVID-19/SARS/MERS, with no factors reported in more than two studies (see table 3). No significant differences were found between COVID-19 and SARS/MERS (Cohen's $d < .10$, $p(Q) > .05$, $I^2 < .25$).

General Population (average effects within studies)

Table 4 provides an overview of the mean effect sizes for risk factors predicting the psychological impact of COVID-19/SARS/MERS. No significant differences were found between COVID-19 and SARS/MERS (Cohen's $d < .10$, $p(Q) > .05$, $I^2 < .25$). The most robust risk factors were poor physical health ($R = .29$; 95%CI = .20-.37) and restrictions of leisure activities ($R = .25$; 95% = .15-.31).

Between-studies effects

The analyses of differences between studies showed a small trend for age: studies with older samples have a slightly larger overall psychological impact ($p(Q)=.06, I^2=31$). However, no significant effects were found for the proportion of women or of other sociodemographic variables. Medical frontline workers experienced a much larger overall psychological impact than any other professions (Cohen's $d=.53, p<.01; p(Q)<.01; I^2=69$). Overall, people in quarantine/self-isolation showed a much larger overall psychological impact than non-quarantined samples (Cohen's $d=.49, p<.01; p(Q)<.01; I^2=85$): they reported more symptoms of acute or post-traumatic stress disorder ($M=51\%, SD=12\%$, instead of $M=27\%, SD=16\%$; Cohen's $d=.57, p<.01; p(Q)=.01; I^2=78$), depression ($M=45\%, SD=15\%$, instead of $M=25\%, SD=19\%$; Cohen's $d=.45, p<.01; p(Q)=.01; I^2=65$) and insomnia ($M=43\%, SD=13\%$, instead of $M=15\%, SD=21\%$; Cohen's $d=.41, p<.01; p(Q)=.01; I^2=51$). Studies in which participants had poor physical health had a slightly larger psychological impact than studies with more healthy samples (Cohen's $d=.26, p<.01; p(Q)=.02; I^2=57$). Studies in which individuals experienced strong social support showed a smaller psychological impact than studies with little support (Cohen's $d=.37, p<.01; p(Q)<.01; I^2=68$).

[place tables 3-4 about here]

Discussion

Coronavirus pandemics have a moderate to large psychological impact on one in three individuals in the general population, one in three pandemic patients, and one in two health-care workers. On the long-term, SARS/MERS continues to have a moderate to large psychological impact on one in three individuals in the general population, patients and health-care workers, and it may be hypothesized that COVID-19 may have similar long-lasting effects. This psychological impact of pandemics is larger than the average proportion

of 3% to 10% of the general population who experience symptoms of post-traumatic stress, anxiety or depression in normal times (Frans, Rimmö, Åberg, & Fredrikson, 2005; Guo et al., 2016; Lee, Tsang, et al., 2009). Thus, during COVID-19/SARS/MERS pandemics, the prevalence of moderate to severe mental health issues seems to be five to fifteen times larger than normal, -although this is a rough comparison, as different measurement instruments may have been used in these studies.

The large psychological impact of COVID-19 on the general population could be explained by the fact that COVID-19 has larger transmission risks than SARS/MERS, has led to more national lock-downs, leading to a larger impact on unemployment and the world economy (Atkeson, 2020). These health risks, lock-down and economic impact are likely to affect the daily life of more people than SARS/MERS (Lin et al., 2020). This explanation is supported by the finding, that restrictions to daily life activities, such as quarantine/self-isolation, and limitations to professional, social and leisure activities, are correlated with a larger psychological impact. Thus, it seems that the larger the changes are in daily life, the larger the psychological impact is.

The largest psychological impact was found in health-care workers, particularly frontline nurses working with infected patients. More than one in two suffers from mental health problems, and -extrapolating from SARS/MERS pandemics-, these problems may also continue for several years after COVID-19. Health care workers particularly suffer from acute or post-traumatic stress. The risk factors showed that the most important predictors of the psychological impact include dissatisfaction with the organisation, training and support at work, insufficient protective personal equipment, not feeling self-efficacious, and worrying about infecting others, particularly their loved ones. Furthermore, health-care staff report stigma and a lack of social support, as they feel that friends and family avoid them.

Only one study has been conducted in COVID-19 patients, but eight have focused on SARS/MERS patients. As risk factor analyses showed, the psychological impact of the disease depends on the perceived health status and severity of the disease. The worse one's physical health is, the more stressed, anxious and depressed people become. Most COVID-19 patients will experience mild influenza-like symptoms, which are associated with a small psychological impact, such as worse concentration and reaction times (Smith, 2013). However, in the most extreme cases, COVID-19 patients may suffer from Acute Respiratory Distress Syndrome, sepsis, and/or need ventilation. One in two of these extreme cases report severe post-traumatic stress, insomnia and unemployment, even years after hospital treatment (Chlan & Savik, 2011; Chlan, 2003; Davydow, Desai, Needham, & Bienvenu, 2008; Davydow, Hough, Langa, & Iwashyna, 2013; Smith, Ingham, & Jenkins, 2019). Similar negative long-term psychological effects may be expected for patients treated for severe COVID-19 disease.

As many studies on illness and risk perception have shown before, the larger the factual health risks are the more worried people are (Vos, 2011). This could be explained with the stress-coping model (Folkman, 2011; Folkman & Lazarus, 1984), which hypothesises that when individuals perceive the situation as threatening and when they feel that they have insufficient resources to cope with this threat, they experience health-related psychological distress. Our meta-analysis showed that the more individuals interpret COVID-19 as a severe health threat to themselves and their loved ones, the larger their psychological impact is. For example, SARS-CoV-2 mainly puts older individuals and those with a chronic physical disease at large risk, and no vaccines or antibodies have been produced yet to prevent or treat COVID-19. Due to this large health risk and lack of resources to prevent or treat it, these individuals worry more and suffer from more psychological distress, anxiety and depression.

Furthermore, those with a pre-existing psychiatric diagnosis seem more prone to experience severe stress or psychiatric disorders, possibly because of limited pre-existing psychological coping resources. The coping-style that individuals use to deal with the threat could also reduce stress. For instance, strictly following medical guidelines -e.g., hand-washing and self-isolation- is correlated with better mental health. Individuals also worry more, when they believe that the pandemic will last long, that there is no good treatment available, that the government is not in control, and that the pandemic threatens their jobs and financial security. These negative perceptions and worries are exacerbated by media and social media (Garfin, Silver, & Holman, 2020; Lunn et al., 2020; Pennycook, McPhetres, Zhang, & Rand, 2020).

This meta-analysis showed that quarantine -either nation-wide lock-down and/or self-isolation- is associated with symptoms of post-traumatic stress, depression and insomnia. Interview studies on the impact of quarantine reveal similar conclusions (Brooks et al., 2020). The meta-analysis indicates why quarantine could have a large psychological impact. First, individuals in quarantine are less physically active; research suggests that physical inactivity can worsen mental well-being (Bauman, 2004; Hoare, Milton, Foster, & Allender, 2016; Penedo & Dahn, 2005). Second, individuals report that they engage less in leisure activities and feel bored (Marafa & Tung, 2004), which may prevent them from releasing psychological and physical stress (Aldana, Sutton, Jacobson, & Quirk, 1996; Weng & Chiang, 2014). Third, people report less social contact, -particularly individuals without a partner or those feeling stigmatised (Best, Manktelow, & Taylor, 2014; Jeong et al., 2016). Research shows a strong relationship between having lack of social contact and poor mental health (Hawkey & Cacioppo, 2010; Heinrich & Gullone, 2006; Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Mushtaq, Shoib, Shah, & Mushtaq, 2014). Fourth, individuals could worry over their financial future, job loss or housing situation (Atkeson, 2020; Jeong et

al., 2016; Stephany et al., 2020; Yilmazkuday, 2020). Fifth, large families seem to experience more psychological distress, possibly due to the emotional impact of quarantine on children and family interactions (Brooks et al., 2020; Grechyna, 2020; Hong et al., 2014; Liu, Bao, Huang, Shi, & Lu, 2020). Sixth, inadequate supplies may deteriorate people's dietary and health behaviour, which could subsequently impact their emotional state (Jeong et al., 2016). Seventh, it may be argued that the psychological impact of quarantine could lead to a reduced immune system functioning and a larger infection risk (Biondi & Zannino, 1997; Garfin, Thompson, & Holman, 2018; Segerstrom & Miller, 2004). In sum, these risk factors seem to have in common that people struggle with living a meaningful and satisfying daily life within the constraints of quarantine (Pereira, Silva, & Dias, 2020; Tabri, Hollingshead, & Wohl, 2020; Vos, 2020).

Limitations

The studies on COVID-19 are limited to the extent that most of them (75%) have not been published in peer-reviewed journals yet, they focus only on the short-term impact of the pandemic, which does for example not account for the long-term impact of COVID-19 on unemployment and financial insecurity. However, we found that studies which were not peer-reviewed did not differ in their risk-of-bias and their effect sizes compared to peer-reviewed studies. However, the short-term impact of the COVID-19 pandemic was larger than SARS/MERS; consequently, one may hypothesize an extrapolation of this finding and argue that the medium-term and long-term impact of COVID-19 will be larger than SARS/MERS. Furthermore, the first indications suggest that COVID-19 may also have a larger impact on employment and the world economy than SARS/MERS (Atkeson, 2020); one may hypothesise that this could imply an even larger and longer-lasting psychological impact of COVID-19, as economic depression and unemployment are known to increase levels of

psychological distress and psychopathology (Vos, Roberts & Davies, 2019). Future studies need to confirm this.

This study is limited by the relatively small number of studies for each of the outcomes in each sub-group, and the small effect sizes of risk factors predicting the psychological impact. More longitudinal controlled studies are needed. Studies from China dominate the review, and although we did not find significant differences between countries, more international studies are required. Studies should not only include self-rating scales which are sensitive to detect small changes in one's emotional state but which may inflate the reported effect sizes. Researchers could include clinical interviews and diagnostic instruments to differentiate short-term emotional states from chronic psychiatric disorders. The use of psychiatric tools could help to distinguish between functional and dysfunctional anxiety (Harper, Satchell, Fido, & Latzman, 2020).

Implications

This meta-analysis shows that SARS/MERS pandemics have had a large and long-lasting impact on the mental health of approximately one-third of the population. Similarly, several studies have suggested that SARS/MERS may also lead to an increase of suicide rates with approximately one-third, particularly amongst elderly and physically sick individuals (Chan, Chiu, Lam, Leung, & Conwell, 2006; Chiu et al., 2004; Yip, Cheung, Chau, & Law, 2010).

Despite the before-mentioned limitations of studies on COVID-19, the current studies indicate that COVID-19 has a similar or even larger psychological impact than SARS/MERS and that this may also lead to long-lasting impact. Therefore, it could be recommended to make sufficient mental health-care resources available, particularly to those most at risk of psychological distress or psychiatric disorders (Bao et al., 2020). The first results from mental

health-care during the COVID-19 pandemic are promising (Duan & Zhu, 2020; Ho, Chee, & Ho, 2020; Jiang et al., 2020; Li et al., 2020; Liu et al., 2020; Park & Park, 2020; Yilmazkuday, 2020; Zheng, Yao, & Narayanan, 2020). Mental health-care providers may want to tailor their services to the unique needs of individuals affected by COVID-19; research suggests that individuals struggling with physical health problems and health risks may require a different psychotherapeutic approach than individuals primarily reporting mental health problems (Vos, 2016, 2017; Vos, Craig, & Cooper, 2015).

The overview of risk factors may be used to screen and identify individuals in need of psychological support, for example in hospitals and GP services, similar to routine psychological screening in oncology and palliative care (Meijer et al., 2013; Thekkumpurath, Venkateswaran, Kumar, & Bennett, 2008; Thewes, Meiser, Tucker, & Schnieden, 2003). The most psychologically vulnerable populations include frontline health-care workers, quarantined and elderly individuals, and those with poor physical health, a psychiatric history, and physically inactive, socially isolated or unemployed individuals. To reduce the psychological impact, health-care officials may want to keep national lock-down and self-isolation as short as possible. In addition to public campaigns about preventing infection, officials may want to run campaigns addressing issues around isolation, stigma, and the psychological impact of the pandemic and how to cope with this (Cairns, de Andrade, & MacDonald, 2013; K. Lee, 2009; Teasdale & Yardley, 2011; Vaughan & Tinker, 2009).

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Tables & figures

Figure 1

PRISMA Flowchart of the selection process

Table 1

Sociodemographic characteristics, psychometric instruments and proportions reported in the studies included in the meta-analysis

Authors, year	Type of pandemic	Country	Sample	Sample size	Depression	Anxiety	Acute or post-traumatic stress	Insomnia	General psychological distress	Overall risk of bias
COVID-19										
Arenliu et al, 2020	COVID-19	Kosovo	GP	158	-	-	-	-	K10 49.5	Low
Cai et al, 2020	COVID-19	China	HCW	534	-	New 38.6	-	-	-	Large
C19PRC, 2020	COVID-19	United Kingdom	GP	2000	PHQ 22.0	GAD 21.5	ITQ 16.9	-	-	Low
Dai et al, 2020	COVID-19	China	HCW	4357	-	-	-	-	GHQ 39.1	Low
Gao et al, 2020*	COVID-19	China	GP	4872	WHO 48.3	GAD 22.6	-	-	-	Low
Huang et al, 2020*	COVID-19	China	HCW	804	New 31.0	New 41.9	-	-	-	Large
Huang et al, 2020b	COVID-19	China	HCW	230	-	-	SAS 27.4	-	-	Low
Jiang et al, 2020*	COVID-19	China	HCW	1257	PHQ 50.4	GAD 44.6	IES 71.5	ISI 34.0	-	Low
Li et al, 2020	COVID-19	China	GP	4607	-	-	-	-	GHQ 10.1	Large
Li et al, 2020b	COVID-19	China	HCW	526	-	-	New N/A	-	-	Large
Li et al, 2020c	COVID-19	China	GP	214	-	-	New N/A	-	-	Large
Liu et al, 2020*	COVID-19	China	GP	14592	PHQ 53.5	GAD 44.6	-	-	SRQ 33.5	Low
Liu et al, 2020b	COVID-19	China	GP	285	-	-	PCL 7.0	PSQI 20.7	-	Large
Mertens et al, 2020	COVID-19	Netherlands	GP	439	-	HAI/PS WQ N/A	-	-	-	Low
Qian et al, 2020	COVID-19	China	GP	1011	-	GAD 26.6	-	-	-	Low
Qiu et al, 2020*	COVID-19	China	GP	52730	-	-	PTSI 35.0	-	-	Large
Siyu et al, 2020	COVID-19	China	HCW	5393	CESD 28.0	ZAS 5.9	-	ISI 34.3	-	Low
Sun et al, 2020	COVID-19	China	GP	2091	-	-	-	-	PCL 4.6	Low
Wang et al, 2020*	COVID-19	China	GP	1210	DASS 16.5	DASS 28.8	IES 53.8	-	-	Low
Xing et al, 2020	COVID-19	China	HCW	548	SCL 50.9	SCL 54.9	-	-	SCL 49.1	Low
Yang et al, 2020	COVID-19	China	HCW	30	HAM 6.7	HAM 1.6	-	-	-	Large
Yang et al, 2020	COVID-19	China	PP	26	HAM 26.9	HAM 50.0	-	-	-	Large
Ying et al, 2020	COVID-19	China	HCW	822	PHQ 29.3	GAD 33.7	-	-	-	Low

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Zhang et al, 2020*	COVID-19	China	HCW	1563	PHQ 57.0	GAD 44.7	IES 73.4	ISI 36.1	-	Low
Zhang et al, 2020b	COVID-19	China	GP	-	-	-	-	PSQI 17.0	PCL 4.0	Low
Zhu et al, 2020	COVID-19	China	HCW	5062	PHQ 49.5	GAD 47.3	IES 51.2	-	-	Low
SARS										
Bai et al, 2004*	SARS	China	HCW	338	-	New 5.0	-	-	-	Large
Chan et al, 2004*	SARS	Singapore	HCW	661	-	-	IES 27.0	-	GHQ 27.0	Low
Cheng et al, 2006*	SARS	China	PP	180	BDI 35.0	BDI 35.0	-	-	-	Low
Chua et al, 2004*	SARS	China	GP	79	-	-	-	-	PSS 40.9	Low
DiGiovanni et al, 2004*	SARS	Canada	GP	43	-	-	-	-	New 37.2	Large
Grace et al, 2005*	SARS	Canada	HCW	193	-	-	-	-	New 45.6	Large
Hawryluck et al, 2004*	SARS	Canada	GP	129	BDI 31.0	-	SAS 28.7	-	-	Low
Ko et al, 2006*	SARS	China	GP	1552	TDI 3.5	-	-	-	-	Large
Kwek et al, 2006*	SARS	China	PP	63	HAD 33.3	HAD 27.0	IES 69.8	-	-	Low
Lam et al, 2009*	SARS	China	PP	233	-	-	-	-	SCID 39.9	Low
Lancee et al, 2008*	SARS	Canada	HCW	587	-	-	IES 20.0	-	K10 53.0	Low
Lau et al, 2007*	SARS	China	PP	102	-	-	-	-	New .26	Large
Lee et al, 2005; Peng et al, 2005*	SARS	China	GP	1278	BRS 3.2	BRS 3.2	BRS 3.0	BRS 4.2	BRS 11.5	Large
Lee et al, 2007*	SARS	China	GP	49	DASS 44.9	DASS 20.4	-	-	PSS 85.7	Large
Lee et al, 2007*	SARS	China	HCW	30	DASS 73.3	DASS 46.7	-	-	PSS 81.8	Large
Liu et al, 2012*	SARS	China	HCW	549	CESD 22.8	-	IES 29.3	-	-	Low
MacAlonan et al, 2004*	SARS	Hong Kong	HCW	106	DASS 15.9	DASS 15.6	IES 17.9	-	PSS 15.3	Low
Main et al, 2011*	SARS	China	GP	381	-	-	-	-	SCL/New N/A	Large
Mak et al, 2009*	SARS	China	PP	90	HAD 18.9	HAD 15.6	IES 21.1	-	SCID 58.9	Low
Marjanovic et al, 2007*; Fiksenbaum et al, 2006*	SARS	Canada	HCW	333	New N/A	-	-	-	New N/A	Low
Maunder, 2004*; Maunder et al, 2004*, 2010*	SARS	Canada	HCW	1557	-	-	IES 36.0	-	-	Low
Maunder et al, 2006*	SARS	China	HCW	769	-	-	IES 13.8	-	K10 44.9	Low

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Mihashi et al, 2009*	SARS	China	PP	187	-	-	-	-	GHQ 26.2	Low
Moldofsky et al, 2011*	SARS	Canada	HCW	22	BDI 40.9	-	PCL-PTSD 40.9	-	-	low
Nickell et al, 2004*	SARS	Canada	HCW	510	-	-	-	-	GHQ 29.0	Low
Poon et al, 2004*	SARS	China	HCW	1926	-	STAI 26.0	-	-	BS 33.0	Low
Reynolds et al, 2008*	SARS	Canada	GP	1912	-	-	IES 11.0	-	-	Low
Sheng et al, 2005*	SARS	China	PP	102	-	-	-	-	GHQ 65.2	Low
Sim et al, 2004*	SARS	China	HCW	277	-	-	SAS 10.1	-	-	Large
Styra et al, 2008*	SARS	China	HCW	248	-	-	SAS 45.6	-	-	Large
Verma et al, 2004*	SARS	Singapore	HCW	721	-	-	-	-	GHQ 14.1	Low
Wing et al, 2009*	SARS	China	PP	90	HAD 15.6	HAD 15.6	-	-	SCID 58.9	Large
Wing et al, 2012*	SARS	China	PP	181	-	-	IES 77.3	-	-	Low
Wong et al, 2004*	SARS	China	PP	180	BDI 35.0	BAI 35.0	-	-	-	Low
Wong et al, 2006*	SARS	China	HCW	1260	-	-	-	-	New N/A	Large
Wu et al, 2005*	SARS	China	PP	131	HAD 17.6	HAD 13.0	IES 5.3	-	-	Low
Zheng et al, 2005*	SARS	China	GP	456	New 43.5	New 55.3	-	-	-	Large
MERS										
Abolfotouh et al, 2017*	MERS	Saudi Arabia	HCW	1031	-	-	-	-	New N/A	Large
Batawi et al, 2019*	MERS	Saudi Arabia	PP	78	-	-	-	-	SF 55.6	Low
Choi et al, 2018*	MERS	Korea	HCW	169	-	-	-	-	New	Large
Jeong et al, 2016*	MERS	Canada	GP	1656	-	HAD 9.8	-	-	-	Low
Kim et al, 2017*	MERS	China	PP	29	PHQ 37.9	-	IES 58.6	-	-	Low
Lee et al, 2018*	MERS	China	HCW	1800	-	-	IES 64.1	-	-	Low
Yoon et al, 2016*	MERS	Korea	GP	6231	New 19.3	-	-	-	-	Large

*Published in a peer-reviewed journal. Cells present proportions in percentages. Populations: HCW=Health Care Workers; PP=Pandemic Patients; GP=General Populations; N/A=data not available; acronyms for included instruments, including their Cut-Off Points for moderate to severe psychological impact, where available: BAI=Beck Anxiety Inventory (COP≥16); BDI=Beck Depression Inventory(COP≥20); BRS= Brief Resilience Scale(COP<18); BS=Burnout Scale(COP≥18); CID=Clinical Interview to identify symptoms of DSM diagnoses; CESD= Centre for Epidemiological Studies Symptoms Scale(COP≥16); DASS=Depression Anxiety Symptom Scale(COP≥14); GAD-7=Generalised Anxiety Disorder scale(COP≥8); GHQ-12=General Health Questionnaire (COP≥36); HADS=Hospital Anxiety and Depression Scale(COP≥8); HAM=Hamilton scale(COP≥14); IES=Impact of Event Scale(COP≥24); ISI=Insomnia Severity Index(COP≥10); ITQ=International Trauma Questionnaire (COP=see Cloitre et al, 2018); K10=Kessler Psychological distress Scale(COP≥16); New=new previously non-validated instrument developed for this study(COP≥); PHQ-

9=Patient Health Questionnaire(COP $\geq$); PCL-5=PTSD Checklist for DSM-5(COP $\geq$ 31); PSQI=Pittsburgh Sleep Quality Index(COP $\geq$ 5); PSS=PTSD Symptom Scale(COP=combination of scores for different items: see Foa, 2013); PTSI=Peri Traumatic Stress Index(COP $\geq$ 23); SAS=Self rating Anxiety Scale(COP $\geq$ 45); SCID=Systematic Clinical Interview of DSM); SCL=symptom checklist(COP $\geq$ 63); SF-36=Short Form(COP $\geq$ 60); SRQ=Self Reporting Questionnaire(COP $\geq$ 5 for men, 7 for women); STAI=State Trait Anxiety Inventory(COP $\geq$ 44); TDI=Taiwan Depression Questionnaire(COP $\geq$ 19); WHO-5=World Health Organisation Well-Being index(COP $\leq$ 28); ZAS=Zung Anxiety Scale(COP $\geq$ 45).

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Table 2

Psychological impact of COVID-19 and SARS/MERS in proportions

	COVID-19 Short term impact			SARS/MERS Short term impact (<9 months after outbreak)			SARS/MERS Long term impact (>9 months after outbreak)		
	N of studies	Proportion (95% CI)	References	N of studies	Proportion (95% CI)	References	N of studies	Proportion (95% CI)	References
Health care workers									
-PTSD symptoms	3	.59 (.37-.85) ^a	(Zhang et al., 2020; Zhang et al., 2020; Zhu et al., 2020)	4	.39 (.24-.56) ^{aj}	(Chan & Huak, 2004; McAlonan et al., 2007; Moldofsky & Patcai, 2011; Styra et al., 2008)	3	.20 (.13-.31) ^j	(Lancee, Maunder, & Goldbloom, 2008; Liu et al., 2012; Maunder et al., 2006)
-Depression	6	.41 (.30-.52) ^b	(Huang et al., 2020; Siyu et al., 2020; Xing et al.; Ying et al., 2020; Zhang et al., 2020; Zhu et al., 2020)	3	.41 (.12-.78) ^{bk}	(Lee et al., 2007; McAlonan et al., 2007; Moldofsky & Patcai, 2011)	1	.23 (.20-.27) ^k	(Liu et al., 2012)
-General psychological distress	3	.39 (.19-.64) ^c	(Dai, Hu, Xiong, Qiu, & Yuan, 2020; Huang et al., 2020; Xing et al.)	6	.32 (.23-.42) ^{cl}	(Chan & Huak, 2004; Dai et al., 2020; Grace, Hershenfield, Robertson, & Stewart, 2005; Lee et al., 2007; McAlonan et al., 2007; Sim,	2	.64 (.25-.90) ^l	(Lee et al., 2007; Maunder et al., 2006)

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						Chong, Chan, & Soon, 2004)			
-Insomnia	3	.35 (.34-.36)	(Siyu et al., 2020; Zhang et al., 2020; Zhu et al., 2020)	0	0		0		
-Anxiety	10	.31 (.20-.42) ^d	(Huang et al., 2020; Huang & rong Liu, 2020; Lai et al., 2020; Siyu et al., 2020; Z. Wu & McGoogan, 2020; Xing et al.; Ying et al., 2020; Zhang et al., 2020; Zhu et al., 2020)	4	.17 (.04-.47) ^d	(Bai et al., 2004; Lee et al., 2007; McAlonan et al., 2007)	0		
COVID-19/SARS/MERS patients									
-Anxiety	1	.40 (.27-.53) ^e	(Yang et al., 2020)	2	.34 (.06-.78) ^{em}		3	.20 (.13-.30) ^m	(Kwek et al., 2006; Lam et al., 2009; Mak, Chu, Pan, Yiu, & Chan, 2009)
-General psychological stress	0			4	.41 (.21-.64)	(Batawi et al., 2019; Chua et al., 2004; Mak, Law, Woo, Cheung, & Lee, 2009; Mihashi et al., 2009)	5	.39 (.29-.49)	(Chen, Chen, Liu, Romeis, & Lee, 2004; Lam et al., 2009; Lau, Yang, Tsui, & Kim, 2003; Mihashi et al., 2009)
-Acute/post-traumatic stress	0			1	.21 (.14-.31) ⁿ	(Mak et al., 2009)	4	.38 (.10-.77) ⁿ	(Kwek et al., 2006; Lam et al., 2009; Mak et al., 2009; Wu, Chan, & Ma, 2005)

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-Depression	0			2	.27 (.12-.48)	(Kim, Yoo, Lee, Lee, & Shin, 2018; Mak et al., 2009)	4	.26 (.17-.36)	(Cheng et al., 2006; Kwek et al., 2006; Lam et al., 2009; Wu et al., 2005)
General population									
-PTSD	4	.34 (.20-.51) ^f	(Consortium, 2020; DiGiovanni, Conley, Chiu, & Zaborski, 2004; Qiu et al., 2020; Wang et al., 2020)	2	.18 (.06-.41) ^f	(Hawryluck et al., 2004; Reynolds et al., 2008)	0		
-Anxiety	4	.31 (.20-.41) ^g	(Consortium, 2020; Liu et al., 2020; Qian et al., 2020; Tam, Pang, Lam, & Chiu, 2004)	3	.08 (.03-.20) ^g	(Cheng et al., 2006; Jeong et al., 2016; Lee et al., 2007)	0		
-Depression	2	.29(.11-.58) ^h	(Consortium, 2020; Liu et al., 2020; Tam et al., 2004)	4	.13 (.02-.50) ^h		0		
-Insomnia	2	.18 (.15-.22)	(Liu et al., 2020; Zhang et al., 2020)	0			0		
-General psychological distress	3	.17 (.04-.54) ⁱ	(Arënliu & Bërxulli; Liu et al., 2020; Tam et al., 2004)	5	.29 (.18-.44) ⁱ	(Chua et al., 2004; DiGiovanni et al., 2004; Jeong et al., 2016; Peng et al., 2010; Wong et al., 2004)	1	.31 (.03-.99)	(Lee et al., 2007)

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Proportions vary from 0 to 1. Significant differences and heterogeneity between proportions: ^a(Cohen's $d=.65$, $p<.01$; $p(Q)<.01$; $I^2=.89$); ^b(Cohen's $d=.26$, $p<.05$; $p(Q)<.05$; $I^2=.37$); ^c(Cohen's $d=.37$, $p<.01$; $p(Q)<.01$; $I^2=.46$); ^d(Cohen's $d=.58$, $p<.01$; $p(Q)<.01$; $I^2=.79$); ^e(Cohen's $d=.27$, $p<.05$; $p(Q)<.05$; $I^2=.39$); ^f(Cohen's $d=.61$, $p<.01$; $p(Q)<.01$; $I^2=.47$); ^g(Cohen's $d=.87$, $p<.01$; $p(Q)<.01$; $I^2=.97$); ^h(Cohen's $d=.46$, $p<.01$; $p(Q)<.01$; $I^2=.64$); ⁱ(Cohen's $d=.22$, $p<.05$; $p(Q)<.05$; $I^2=.37$); ^j(Cohen's $d=.68$, $p<.01$; $p(Q)<.01$; $I^2=.55$); ^k(Cohen's $d=.67$, $p<.01$; $p(Q)<.01$; $I^2=.68$); ^l(Cohen's $d=.59$, $p<.01$; $p(Q)<.01$; $I^2=.43$); ^m(Cohen's $d=.44$, $p<.01$; $p(Q)<.01$; $I^2=.37$); ⁿ(Cohen's $d=.29$, $p<.05$; $p(Q)<.05$; $I^2=.38$); ^o(Cohen's $d=.53$, $p<.01$; $p(Q)<.01$; $I^2=.87$). If no subscript letter is added, the difference is not significant.

Table 3

Health Care Workers & COVID-19/SARS/MERS patients: risk factors predicting the psychological impact

Risk factor	N of studies	R (95% CI)	References
Health Care Workers			
Being a parent	4	.42 (-.34 - .85)	(Lancee et al., 2008; Li et al., 2020; Maunder, 2004; Maunder et al., 2006; Zhu et al., 2020)
Dissatisfaction with the organisation, training and support at work	8	.30 (.20-.40)	(Fiksenbaum, Marjanovic, Greenglass, & Coffey, 2007; Lai et al., 2020; Marjanovic, Greenglass, & Coffey, 2007; Maunder et al., 2006; Park & Park, 2020; Wong et al., 2004; Ying et al., 2020; Zhu et al., 2020)
Stigma	4	.25 (.15-.35)	(Park & Park, 2020; Verma et al., 2004; Xing et al.; Zhu et al., 2020)
Worried about infecting others	3	.25 (.05-.42)	(Lai et al., 2020; Styra et al., 2008; Zhu et al., 2020)
Lack of social support from colleagues, friends and family ^a	6	.23 (.20-.20)	(Lai et al., 2020; Sim et al., 2004; Siyu et al., 2020; Wong et al., 2004; Xing et al.)
Personal psychiatric history	2	.23 (.10-.46)	(Maunder et al., 2004; Maunder, Peladeau, Savage, & Lancee, 2010)
Direct contact with infected patients	12	.22 (.16-.28)	(Abolfotouh et al., 2017; Fiksenbaum et al., 2007; Grace et al., 2005; Lai et al., 2020; Lancee et al., 2008; Liu et al., 2012; Marjanovic et al., 2007; Maunder et al., 2004; McAlonan

			et al., 2007; Siyu et al., 2020; Verma et al., 2004; Xing et al.; Ying et al., 2020; Zhu et al., 2020)
Quarantine	4	.22 (.03-.40)	(Bai et al., 2004; Dai et al., 2020; Marjanovic et al., 2007; Wu et al., 2009)
Lack of Protective Personal Equipment	5	.20 (.10-.30)	(Choi & Kim, 2018; Lai et al., 2020; Maunder et al., 2006; Ying et al., 2020; Zhu et al., 2020)
Lack of self-efficacy	5	.20 (.10-.29)	(Huang & rong Liu, 2020; Nickell et al., 2004; Styra et al., 2008; Wong et al., 2004; Zhang et al., 2020)
Working overtime	4	.19 (.15-.24)	(Lai et al., 2020; Nickell et al., 2004; Yoon, Kim, Ko, & Lee, 2016; Zhu et al., 2020)
Female	9	.16 (.10-.21)	(Dai et al., 2020; Huang & rong Liu, 2020; Lai et al., 2020; Lee, Kang, Cho, Kim, & Park, 2018; Z. Li et al., 2020; R. G. Maunder et al., 2006; Siyu et al., 2020; Ying et al., 2020; Zhu et al., 2020)
Being a nurse	9	.15 (.10-.20)	(Chan & Huak, 2004; Huang et al., 2020; Huang & rong Liu, 2020; Lee et al., 2018; Maunder et al., 2004; Nickell et al., 2004; Siyu et al., 2020; Tam et al., 2004; Zhu et al., 2020)
Older	7	.10 (.06-.14)	(Abolfotouh et al., 2017; Lee et al., 2018; Siyu et al., 2020; Verma et al., 2004; Xing et al.; Ying et al., 2020; Zhang et al., 2020)

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Frontline workers (Intensive Care Unit, isolation units, specialised hospitals or departments)	5	.13 (.10-.16)	(Dai et al., 2020; Huang et al., 2020; Lai et al., 2020; Siyu et al., 2020; Styra et al., 2008)
Working in heavily affected geographical regions	4	.11 (.03-.19)	(Dai et al., 2020; Lai et al., 2020; S. Lee, Guo, et al., 2009; Xing et al.)
COVID-19/SARS/MERS patients			
No use of stress reduction techniques	1	.65 (.54-.74)	(Mak et al., 2009)
Lack of self-efficacy	1	.46 (.30-.59)	(Cheng et al., 2006)
Lack of social support from medical staff, family and friends	1	.37 (.31-.47)	(Mak et al., 2009)
Female	1	.24 (.01-.44)	(Cheng et al., 2006)
Job loss & financial insecurity	1	.21 (.12-.30)	(Lam et al., 2009)
Being a health-care worker	2	.20 (.11-.29)	(Lam et al., 2009; Sheng, Cheng, Lau, Li, & Chan, 2005)
Age	2	.15 (.02-.28)	(Mihashi et al., 2009; Sheng et al., 2005)

^a Reported in the studies as social support correlating with less psychological distress. References in this table can be found in the reference list in the online only material.

Table 4

General Population: risk factors predicting the psychological impact

Risk factor	N of studies	R (95% CI)	References
Poor sleep quality	1	.40 (.37-.43)	(Sun et al., 2020)
Poor physical health	6	.29 (.20-.37)	(Li, Yang, Dou, & Cheung, 2020; X. Liu et al., 2012; Main, Zhou, Ma, Luecken, & Liu, 2011; Mihashi et al., 2009; Qian et al., 2020)
Restricted leisure activities	5	.25 (.15-.31)	(Lai et al., 2020; Mihashi et al., 2009; Nickell et al., 2004; Styra et al., 2008)
Physically inactive	3	.21 (.11-.30)	(Gao et al., 2020; Wong et al., 2004; Wong et al., 2005; Zhu et al., 2020)
Living in a heavily affected geographical location	4	.20 (.04-.36)	(Qiu et al., 2020; Sun et al., 2020; Zhang et al., 2020; Zheng, Jimba, & Wakai, 2005)
Worried about health risks of loved ones	5	.19 (.06-.32)	(Dai et al., 2020; Mertens, Gerritsen, Saleminck, & Engelhard, 2020; Styra et al., 2008; Wang et al., 2020; Xing et al.)
Quarantine (duration)	3	.26 (.10-.42)	(Hawryluck et al., 2004; Jeong et al., 2016; Mihashi et al., 2009; Reynolds et al., 2008)
Being a health-care worker	3	.19 (.11-.26)	(Liu et al., 2020; Sun et al., 2020; G. Zheng et al., 2005)
Perceived severity of the disease	3	.18 (.10-.26)	(J.-B. Li et al., 2020; Peng et al., 2010; Qian et al., 2020)
Older age	8	.16 (.09-.24)	(Gao et al., 2020; Ko, Yen, Yen, & Yang, 2006; Lau, Yang, Wong, & Tsui, 2006; Liu et al., 2020; Liu et al., 2012; Peng et al., 2010; Qiu et al., 2020; Zheng et al., 2005)
History of psychiatric disease	2	.16 (0-.31)	(Li et al., 2020; Wu et al., 2005)
Perceived risk to the disease	3	.15 (.09-.21)	(Liu et al., 2012; Qian et al., 2020; Wong et al., 2004)
Lack of social connections	1	.15 (.05- .25)	(Main et al., 2011)
Low education level	2	.14 (.03-.25)	(Gao et al., 2020; Peng et al., 2010)
Information-searching behaviour (press, news, social media)	5	.13 (.08-.17)	(Lai et al., 2020; Mertens et al., 2020; Qian et al., 2020; Styra et al., 2008; Wang et al., 2020)
Self-efficacy	6	.13(.10-.16)	(Li et al., 2020; Mihashi et al., 2009; Peng et al., 2010; Qian et

			al., 2020; Reynolds et al., 2008; Wang et al., 2020)
Unemployment and financial insecurity	4	.12 (.06-.18)	(Hawryluck et al., 2004; Ko et al., 2006; X. Liu et al., 2012; Mihashi et al., 2009)
Female	8	.11 (.08-.14)	(Gao et al., 2020; Lee et al., 2007; X. Liu et al., 2012; Mihashi et al., 2009; Peng et al., 2010; Qiu et al., 2020; Sun et al., 2020)
Lack of trust in medical treatment and public health control	2	.11 (.07-.16)	(Peng et al., 2010; Qian et al., 2020)
Being single	3	.11 (-.06, .26)	(Gao et al., 2020; Hawryluck et al., 2004; X. Liu et al., 2012)
Having a chronic physical disease	1	.09 (.06-.11)	(W. Li et al., 2020; Peng et al., 2010)