

The work environment for healthcare workers during the Covid-19 pandemic

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Preface

The appropriation directions presented to the Swedish Agency for Work Environment Expertise in 2022 tasked the Agency with analysing the short and long-term consequences of the Covid-19 pandemic on work environments in Sweden. In order to complete this major government assignment, the agency conducted five projects, each focusing on a professional group or groups particularly affected by the pandemic. These projects were also used to highlight general changes to the work environment, such as remote working and working in hybrid organisations.

The results of these studies provide insight into how society can address similar crises and social disruptions in the future. The report, ‘The Covid-19 pandemic on work environments in Sweden A2021/02355, A2021/02331 (partial)’ presents a summary of the results from all of the projects included in the assignment.

This report summarises the impact of the Covid-19 pandemic on healthcare workers over time and the effects of interventions for improving their work environment and health. The expert group tasked with creating the systematic literature review comprised: Docent Anna Nyberg, Health Equity and Working Life (HEAL), Uppsala University, Docent Ingrid Demmelmaier, Uppsala University, Kristiina Rajaleid PhD, Stress Research Institute, Stockholm University, Magnus Helgesson PhD, Karolinska Institutet, Åsa Anderzén PhD, Uppsala University, Docent Ingrid Anderzén, Uppsala University and Research Assistant Beatrice Carpentier, Uppsala University.

The authors selected their own theoretical and methodological starting points and are responsible for the results and conclusions presented in this systematic literature review.

Professor Emerita Kristina Westerberg, Umeå University and Professor Kjell Toren, University of Gothenburg were commissioned by the Agency to review the quality of this systematic literature review. Library staff at Mid Sweden University contributed the literature and information searches. Librarians Anders Danielsson and Marlene Franzén, Mid Sweden University contributed to reference management. Docent Mikael Nilsson was the process leader at the Swedish Agency for Work Environment Expertise and oversaw the creation of this systematic literature review. Monica Kaltenbrunner PhD joined as process leader towards the end of the project.

My heartfelt thanks go to the external researchers and quality reviewers and staff at the Agency who contributed to the creation of this systematic literature review.

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Summary

The origin of this compilation of knowledge is that the Swedish Agency for Work Environment Expertise was allocated additional financial resources in the appropriation directions for 2022 for the identification and analysis of the short-term and long-term consequences of the corona pandemic for the work environment in Sweden.

Aim and research questions

The overall aim of this systematic review is to map and summarise research about how the Covid-19 pandemic has affected the work environment and health in healthcare workers and to map and summarise research about effects of interventions aimed at improving the work environment and health. The time span is the start of the pandemic in November 2019 until spring 2022.

The specific research questions were:

1. What changes in the work environment were observed over time in the healthcare sector during the Covid-19 pandemic?
2. What associations over time between the work environment and employee health were identified in the healthcare sector during the Covid-19 pandemic?
3. What effect did interventions have to improve the work environment or employee health in the health care sector during the Covid-19 pandemic?

For each of the three research questions, are there any differences between subgroups of employees, for example based on profession and sex?

Inclusion and exclusion criteria

The systematic literature review includes studies of all occupational categories within healthcare. Studies of care homes, such as elderly care, were excluded. All kinds of work environment (physical, ergonomic and psychosocial) and all types of health outcomes were included. No restriction regarding health was used in the search strategy. Only empirical peer-reviewed studies published in English, Swedish and other Nordic languages were selected, and only observational studies with repeated measurements or intervention studies. Studies based on qualitative or cross-sectional quantitative data were excluded because research based on such study designs was thoroughly examined in a previous review performed on commission by the Swedish Agency for Work Environment Expertise (1).

Methods

The development of the research review followed the method used by the Swedish Agency for Work Environment Expertise as well as Prisma guidelines for systematic literature reviews. The search strategy was based on restrictions in Population (healthcare personnel), Exposure (Covid-19) and Outcome (work environment). The databases PsycINFO (EBSCO), PubMed (NCBI) and Web of Science were searched at the beginning of May 2022 and articles published from November 2019 to 3rd May 2022 were included. The search yielded 4601 titles. The articles were imported to the software programme Covidence. Titles and abstracts were screened for inclusion and exclusion criteria independently by two researchers. In the next step the full texts of the selected articles were reviewed by two researchers and, if excluded, the reason was registered. Of the 4601 titles, 64 articles met the inclusion criteria and were included in quality assessment. The quality was assessed using an extended version of the Mixed Methods Appraisal Tool (MMAT). Observational studies were assessed using one set of criteria and randomised controlled trials using another set. Of the studies that were assessed, 23 were excluded due to low quality. The results of the systematic research review are based on 41 studies published during 2020-2022. An external reviewer suggested the term 'occupational risk' complement the original search terms. This additional search term generated 74 titles, of which 20 full texts were reviewed. All 20 were excluded due to either wrong study design (n=14), wrong exposure (n=3), wrong population (n=2) or wrong outcome (n=1).

Results

1. What changes in the work environment were observed over time in the healthcare sector during the Covid-19 pandemic?
 - Several studies showed consistently that the workload increased during the Covid-19 pandemic.
 - The results were inconsistent regarding the availability of emotional support to employees by managers and external consultants.
 - The results were also inconsistent regarding how access to personal protective equipment varied over time.
2. What associations over time between the work environment and employee health were identified in the healthcare sector during the Covid-19 pandemic?
 - Increased risk for mental ill-health over time was associated with:
 - Working in direct contact with Covid-19 patients
 - Heavy workload
 - Moral distress at work

3. What effect did interventions have to improve the work environment or employee health in the health care sector during the Covid-19 pandemic?

- Interventions at the individual level (for example, meditation and breathing/ relaxation exercises) had immediate, positive effects on mental health, but the studies are few in number and are based on study designs that do not allow for conclusions regarding neither causal relationships nor long-term effects.
- Interventions at the organisational level (for example, changes in work routines, staffing and professional supervision) resulted in immediate, moderately strong positive changes in mental health in employees. No conclusions about causal associations can be made, however, due to limitations in study designs.

For each of the three research questions, are there any differences between subgroups of employees, for example based on profession and sex?

- A few studies compared subgroups based on profession, sex and age, but the results were inconsistent and it is not possible to draw any strong conclusions.

Methodological limitations in the original studies

- Self-reported data have been used for most exposure and outcome measures.
- The exposure measurements were often based on non-validated questions.
- Some studies of associations between the work environment and health did not adjust for the health level at baseline, limiting support for causal associations.
- Intervention studies lacked long-term follow-ups.

Research gaps and future research

- Longitudinal studies from Sweden and other Nordic countries are few in number and studies that compare the work environment and health in the healthcare sector between Nordic countries during Covid-19 are lacking. Such studies could contribute with increased knowledge about the consequences of different strategies to handle pandemics.
- Studies of organisational factors, such as allocation of resources, staffing, work schedules and so on are few in number regarding both development over time during the Covid-19 pandemic and the effects on employee health.
- More studies on how protective workplace resources, such as support from managers and colleagues, developed during the Covid-19 pandemic and the possibility of workplace resources to buffer negative health outcomes are needed.

- Intervention studies focused primarily on coping strategies among personnel with short-term effects on mental health. More studies of interventions at an organisational level and with longer follow-ups are needed.
- More studies with longer follow-up times are needed generally.
- To strengthen the quality of the research, more studies with representative samples, in which exposure measures were validated, and in which internal attrition and relevant confounders were taken into account are needed.

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- Appendix 3. Table 1–4 of the included studies

1 Background

1.1 Introduction

This systematic literature review was created following appropriation directions from the Swedish Government in 2022. The Swedish Agency for Work Environment Expertise was tasked with mapping and analysing the short and long-term effects the Covid-19 pandemic had on Sweden. It is intended to describe how the pandemic affected the work environments and health of healthcare workers. The scientific literature summarised in this compilation was published in academic journals between November 2019 and early May 2022. This systematic literature review can be seen as a follow-up to a compilation commissioned by the Swedish Agency for Work Environment Expertise published in 2022 (1), which described the knowledge status based on previous epidemics (SARS and MERS) and the earlier stage of the Covid-19 pandemic.

The literature search that formed the basis of the previous compilation included all industries, not just healthcare, and all forms of research study designs. The search returned a considerable number of studies involving links between various work environment factors and (predominantly) mental illness. These studies compared individuals or groups at a set time (cross-sectional studies), rather than following individuals over time (longitudinal studies). The search also returned several qualitative studies, and studies combining qualitative and quantitative methods. Many studies were of poor quality. As few studies were longitudinal, it was difficult to present any firm conclusions in the previous review. With this in mind, the Swedish Agency for Work Environment Expertise identified the need to update the systematic literature review at a later stage of the pandemic, as more higher quality studies would be available.

The results presented in the previous systematic literature review demonstrated that the scientific data for industries other than healthcare was far too limited to be able to reach any conclusions. The scientific literature on the pandemic's effects on the work environment and workers' health concluded that both qualitative and quantitative work demands increased. Healthcare workers were forced to rapidly transition to new procedures, work under uncertain conditions and deal with a situation with a lack of resources, particularly staffing and protective equipment. It became apparent that there was a need for transparent, present leadership involving clear communication and psychosocial support for staff. Direct contact with infected patients formed a work environment factor that correlated with mental illness among healthcare staff.

Furthermore, high demands, lack of protective equipment, skills and support also contributed to the changed work environment, as did staff facing stigma

from those around them as a result of their work with infected patients. The results of the compilation identified a number of knowledge gaps which needed to be filled, and so this updated version has been created to provide answers to some of them. As mentioned above, the results of the previous compilation were almost exclusively based on qualitative interview studies and quantitative cross-sectional studies. In order to describe the impact of the pandemic on healthcare workers over time, this study only includes intervention studies and longitudinal observation studies that collect data on the same individuals from more than one measurement period. Hence, the compilation only includes studies where the design has generated results that enable greater potential to be able to draw conclusions about causal relationships between elements such as work environment factors and health, or between intervention and changes to the work environment. Consequently, the basis for the present systematic literature review is somewhat narrower. Nevertheless, it comprises higher quality studies that enable greater opportunities to reach conclusions on causal relationships.

The systematic literature review follows the Swedish Agency for Work Environment Expertise and Prisma's selection, review and summary methods for scientific studies. The purpose and specific questions raised in the systematic literature review are presented below, followed by an account of the delimitations and key terms used in the literature search. The method section describes how the scientific basis for the compilation was created and the quality appraisal process and compilation of the results. A flow diagram also presents the reasons why studies were excluded. The results of each question are then presented with reference to tables of the studies included. Finally, the discussion section presents a summary and discussion on each of the work environment factors explored in at least two studies. It is followed by a discussion on the method, how the results can be implemented in a Swedish context, conclusions and the knowledge gaps and need for further research.

1.2 Purpose and research questions

The purpose of this compilation was to map and summarise research on how the Covid-19 pandemic affected the health and work environments of healthcare workers as well as research into the effects of interventions intended for improving staff health and the work environment. It covers the period from the start of the pandemic in November 2019 until the spring 2022.

Research questions

1. How did healthcare workers' work environments change during the Covid-19 pandemic?
2. What links between the work environment and workers' health can be identified within healthcare during the pandemic?
3. How successful were the interventions at improving healthcare workers' work environment or health during the Covid-19 pandemic?

We also asked:

Are there identifiable differences between groups of healthcare workers, such as between professions and genders?

1.3 Limitations

The systematic literature review includes research on the Covid-19 pandemic that was published between November 2019 and May 2022. The articles were selected based on the criteria below.

1.3.1 Inclusion criteria

Articles were included on the following criteria:

- All healthcare professions.
- All elements of the work environment (ergonomic, physical, organisational and social).
- All forms of disease, illness or problems linked to work environment factors.
- Published between November 2019 and May 2022 (from the start of the pandemic to the final search date).
- All countries.
- Observational studies with a minimum of two measurement periods, and intervention studies.
- Peer-reviewed articles published in English, Swedish or other Nordic language.

1.3.2 Exclusion criteria

Articles that did not meet any of the following criteria were excluded:

- Description of changes in health status of healthcare workers, without there being clear links between the health status and the work environment.
- Description of vaccination uptake or infection channels without clear links to risk factors in the work environment.
- Study participants were students undergoing professional training.
- Poor methodological quality following quality appraisal of the results and analysis method.

1.4 Key concepts

Work environment: Organisational, social, ergonomic and physical work environment.

Covid-19: (Coronavirus disease 2019) Pandemic disease caused by the SARS-Cov-2 coronavirus, which began spreading at the end of 2019.

Exposure: Being left vulnerable to a factor that negatively affects health, for example an infection or heavy workload over a long period.

Healthcare workers: Those who worked in professions involving the medical prevention, diagnosis and treatment of illnesses and injuries.

Interventions to improve the work environment: All action taken to improve the work environment, such as infection control measures or organisational work environment measures.

Interventions to improve health: All action related to an individual's health, such as preventive measures or treatment of stress-related conditions linked to the work environment.

Longitudinal study: Study following participants over time with regular measurements.

Observational study: Quantitative study in which researchers collect data but do not perform an intervention.

Personal protective equipment: Used here to refer to equipment that protects against infection. This includes face shields, face masks, gloves, and aprons.

Population: The group included in a scientific study, about whom conclusions are to be made, often by looking at a representative random sample.

Mental illness: Conditions such as stress-related illness and discomfort, depression, panic and anxiety to have arisen in conjunction with a difficult work situation.

Infection: Used here to refer to infection with SARS-Cov-2.

Stigma or stigmatisation: Used here to refer to discriminatory and fearful attitudes towards healthcare workers during the period they were exposed to SARS-Cov-2.

Study design: The fundamental structure of the study, designed to answer its purpose.

Cross-sectional study: Study that examines a random sample of a population at a set time or during a short period.

Repeated cross-sectional study: Study design with repeated measurements of different random population samples. The study does not follow the same participants over time.

Outcome: Results. Can also mean the methods used to measure the results.

2 Method

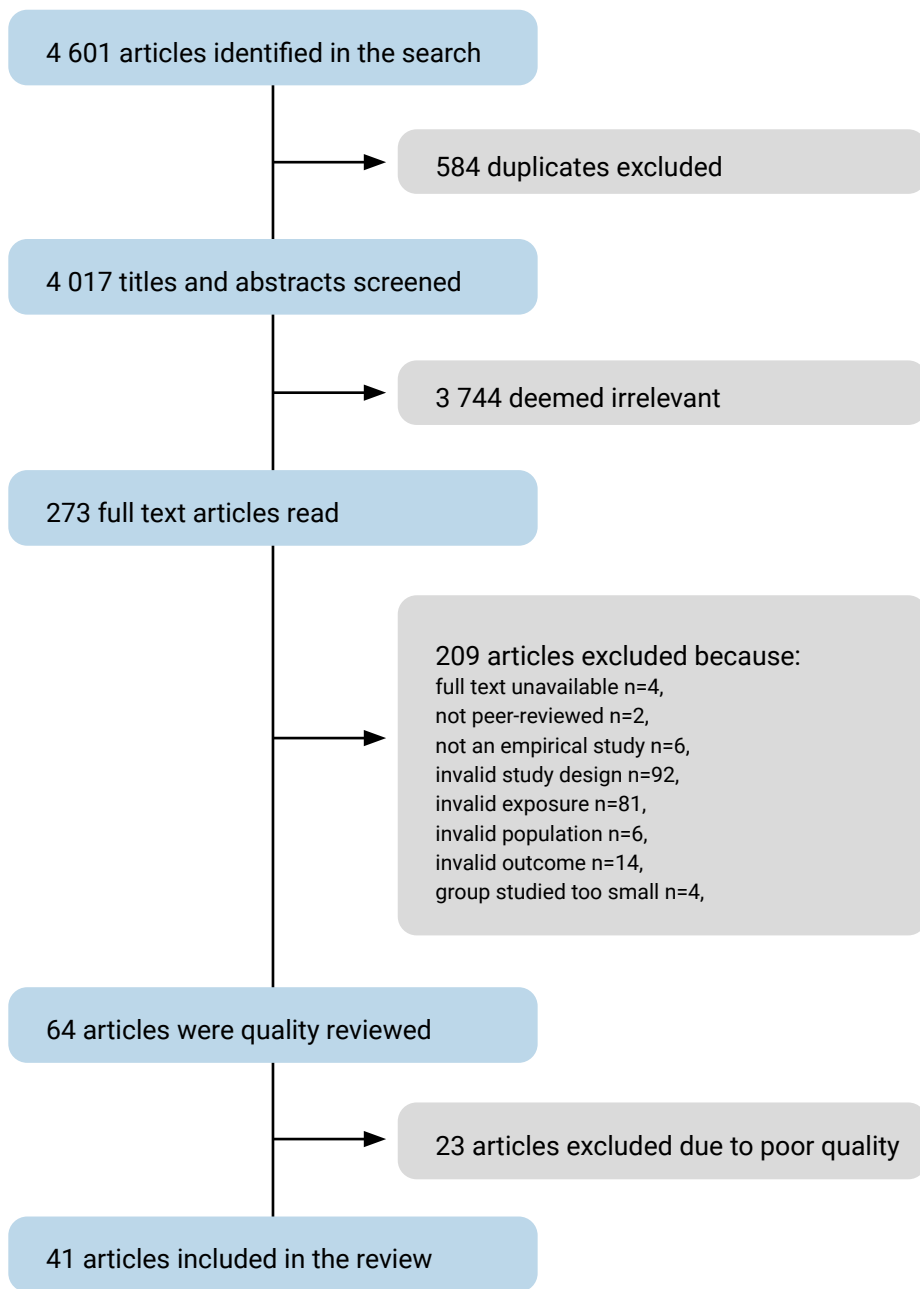
The methods used in the systematic literature review are presented below, under the headings: Strategy, Selection of studies, Quality appraisal, Summary and analysis. Appendix 1 contains a more comprehensive method description. The systematic literature review was created following the Prisma guidelines for systematic reviews (<http://www.prisma-statement.org/>).

2.1 Search strategy

The literature search was delimited based on: Population (healthcare staff), Exposure (Covid-19) and Outcome (work environment). No delimitations related to health were included, meaning the search included how both physical and mental health were affected. The systematic literature searches were conducted by two specialists at the Mid Sweden University Library, using the PsycINFO (EBSCO), PubMed (NCBI) and Web of Science databases. The searches were conducted at the start of May 2022 and include articles published from November 2019 until 3 May 2022. The search generated a total of 4 601 articles. See Appendix 1 for a more detailed description of the search strategy.

2.2 Selection of studies

All articles returned from the search were transferred to the Covidence web-based program, and 584 duplicates were excluded. An article's title and abstract were reviewed first to determine their relevance to the systematic literature review, using the inclusion and exclusion criteria. A total of 3 744 articles were deemed irrelevant. Each article was examined by two independent reviewers in a work group comprising seven people: six researchers and one research assistant. Should the two reviewers' assessments differ, the articles were passed on to the remainder of the work group to obtain a consensus. 273 articles remained, and were assessed in full. 209 articles were excluded based on the following criteria: full text unavailable, not peer-reviewed, not an empirical study, invalid study design, invalid exposure, invalid population, invalid outcome and group studied too small all as per the process above. A flow diagram of the number of articles in each stage is presented below, from the results of the literature search (4 601 articles) to the final 41 articles included in the systematic literature review.



2.3 Quality review

The Mixed Methods Appraisal Tool (MMAT) 2018 (2) was used to assess the quality of each study included in the compilation. See Appendix 1 for more information. MMAT has been designed to appraise the quality of empirical studies with various designs and methods. The tool includes a number of questions and criteria, which are then applied to each study and an overall quality score is awarded. The tool can be used to appraise the quality of quantitative descriptive studies, quantitative non-randomised studies, randomised controlled studies, qualitative studies and combined qualitative and quantitative studies.

This systematic literature review follows the review templates for quantitative non-randomised studies, and randomised controlled studies. The quality aspects assessed in each study design are included in Appendix 1. The process began with two researchers, independent of each other, evaluating the quality of each study. If the researchers' evaluations of the quality of the study differed, the study was then passed on to the remaining researchers in the group to reach a consensus on its quality. An overall appraisal of the study's quality was then conducted based on the initial evaluation. It addressed each question and criterion in the quality appraisal instrument and was then categorised as being of low, moderate, or high quality. The assessment criteria are presented in Appendix 1. Only moderate and high-quality studies were included in the results of the systematic literature review. Appendix 2 contains a list of the studies excluded due to them being of low quality.

2.4 Summary and analysis

The summary and analysis of this systematic literature review are based on the results of the studies whose overall quality was deemed as being of moderate or high quality. The studies are presented in the results section based on questions 1–3.

The results are summarised in the discussion to the best possible extent based on the type of exposure in working life, i.e. how a certain factor developed during the pandemic, its correlation with health and, if possible, the results of the interventions for changing the exposure to this factor in the work environment, and how this affected the workers' health. The interventions addressing workers' mental health are discussed in a separate section.

3 Results

3.1 How the healthcare work environment changed over time

The search identified eight relevant studies that addressed changes in the work environment over time (research question 1), (3–10). All of them were of moderate quality. Five of these studies were conducted in European countries (3, 6–8, 10), one in North America (5) and two in South America (4, 9). Each study addressed the organisational and work environments (3–10), and infection risk was included in three (5, 9, 10). Table 1 in Appendix 3 contains a summary of the studies.

3.1.1 Organisational and social work environment

The majority of the studies to look at changes in healthcare work environment during the pandemic addressed factors such as workload (demands), control (influence on the work) and support – either as a combined factor (4, 8) or separate measurements for demands (3, 6–9) and support (3, 7, 10). In addition, several studies looked at changes to other aspects of working life, such as the extent to which an employee's skills were used correctly (3, 7) and shift work (4).

3.1.1.1 Workload

The majority of studies explored workload as a work environment factor (3, 4, 6–9). The section below on workload also includes the effort-reward imbalance¹ and various measurements of (perceived)¹ workload.

One study of employees at a hospital in Recôncavo of Bahia, Brazil, investigated whether workload, in terms of 'tense work' (a combination of high demands and low levels of control), changed during the pandemic. The proportion of those who believed that tense work had doubled reached 14 per cent when first measured in autumn 2019. This increased to 29 per cent by the second measurement period in spring 2020 (4). The increased workload was determined to be greater among healthcare practitioners compared to administrative staff (4).

Two Swedish studies investigated the workloads of staff at the Sahlgrenska University Hospital. The studies were based on two measurements of different workplace factors and were conducted in October 2019 (before the pandemic) and September 2020 (during the pandemic) (3, 7). The first study (7) evaluated all employees and performed separate analyses for staff working on intensive

¹ A model introduced by Johannes Siegrist. It is based on the idea that there must be a mutual relationship between the perceived work efforts and rewards obtained. However, a person experiences stress when they feel there is an imbalance between effort and reward.

care units. The second study (3) looked at all employees within psychiatry. The results from the first study showed that workers on intensive care units experienced a heavier workload throughout the pandemic. The study also found that the situation deteriorated in the staff group; compared to life before the pandemic, significantly fewer employees believed they had a reasonable workload, were able to take breaks, were able to stop thinking about work during their free time, had energy after work or were able to recuperate in their free time (7). Women were more likely to report heavier workloads than men at both measurement points (7). In psychiatry, there was no change to the proportion of those who believed they had a reasonable workload during the pandemic compared to before. However, responses given in the second measurement period – during the pandemic – illustrated that fewer felt they were able to take breaks, stop thinking about work during their free time, or were able to recuperate in their free time, compared to the first measurement period (3).

A study of intensive care nurses at six emergency hospitals in The Netherlands explored changes to workloads both before and during the Covid-19 pandemic. The results showed that the nurse-to-patient ratio increased from 1.0 when first measured in March 2019 to 1.1 when measured again in March 2020. There was also an increase in workload when measured on an activity scale between 0 and 100. This scale included 23 regular duties for intensive care nurses. The number grew from 50.0 before the Covid-19 pandemic to 76.4 when measured during the pandemic (6).

A study was conducted of healthcare workers who worked with Covid-19 patients on an anaesthesia ward at a hospital in Rome, Italy. The results showed that 52 per cent of staff felt their workload had increased during the first wave of the pandemic (April 2020), rising to 86 per cent during the second wave (December 2020) (8).

3.1.1.2 Control at work

Two studies used the same data to investigate control at work. One study looked at all staff at the Sahlgrenska University Hospital in Sweden (7) and the other looked at staff within psychiatry. Both studies found that control – measured in terms of being able to plan work hours and knowing what was expected at work – deteriorated during the Covid-19 pandemic. Significantly fewer workers believed they were in control when measured in September 2020 during the Covid-19 pandemic, compared to October 2019.

This applied to both those working in the emergency department and all other staff (7), and was the same for those working in psychiatry (3).

3.1.1.3 Support

The same data collection from all staff at the Sahlgrenska University Hospital (7) and staff in psychiatry (3) also looked at access to support in the workplace. The studies found that, in September 2020, the time of measurement during the pandemic, many struggled to receive emotional support, such as

counselling and debriefing compared to when the previous measurements were taken in October 2019 (3). The proportion stating that their line manager supported them with prioritising their work duties did not change between the measurement periods (3).

A study of hospital staff working with Covid-19 patients at one of the six emergency hospitals in Argentina found that access to psychological support in the workplace increased from 30 per cent at the start of April 2020 to 36 per cent when followed up at the end of the same month (9).

A study of hospital staff at hospitals around Turkey found similar results. The proportion of those saying they could access psychological support in the workplace increased from 12 to 23 per cent in the period between two surveys conducted at an interval of approximately one month in spring 2020 (10).

3.1.1.4 Shift work

A study of workers at a hospital in Bahia, Brazil, investigated whether there were differences in the proportion who worked shifts (defined as work at a time other than during the day, irregular hours or rotating shifts) before and during the pandemic. The results found that the proportion of shift workers increased somewhat, from 31 per cent in the autumn of 2019 before the pandemic, to 39 per cent in the spring of 2020, during the pandemic (4).

3.1.1.5 Skills and learning

Two Swedish studies that used the same data explored whether the skills of all staff and staff within psychiatry at the Sahlgrenska University Hospital were being utilised in the best possible way (3, 7). Among all staff in addition to those in emergency medicine, it was clear that significantly fewer believed that their skills were being utilised correctly when measured during the Covid-19 pandemic (September 2020), compared to the measurement period before the pandemic (October 2019) (7). Among staff within psychiatry, the proportion who believed that their skills were being utilised correctly remained unchanged between the measurement periods (3).

3.1.1.6 Other organisational and social exposures

A study of healthcare workers working with Covid-19 patients on an anaesthesia unit at a hospital in Rome, Italy, found that there was no difference in repetitive and monotone work between the first measurement period conducted during the first wave of the Covid-19 pandemic (April 2020) and the second period conducted during the second wave of the pandemic (December 2020) (8).

A study of healthcare staff working with Covid-19 patients at any of the 32 hospitals in Argentina found that many believed the work environment had deteriorated during the first few weeks of the pandemic, growing from 67 per cent at the start of April 2020, to 79 per cent when the final measurement was taken at the end of April of the same year (9).

3.1.2 Risk of infection and personal protective equipment

A study of intensive care doctors at various hospitals in the USA found that access to personal protective equipment improved over time. In spring 2020, 53 per cent of doctors reported insufficient access to protective equipment. This figure had dropped to 22 per cent by the autumn of 2020 (5).

A study of healthcare staff working with Covid-19 patients in Argentina found that a low proportion stated they had adequate access to protective equipment when measured at the start of April 2020 (63 per cent). This figure was roughly the same when the final measurements were taken a few weeks later (9).

A study of workers at hospitals around Turkey explored a number of protection measures and the protective equipment available that were used to reduce the spread of Covid-19. These included separate waiting areas for patients with Covid-19, special rooms for procedures that generate aerosol particles, Covid-19 units, warning signs reminding people of the importance of wearing face masks, testing staff who had been in contact with Covid-19 patients, workplace protection training and providing soap, hand sanitiser, disposable gloves, surgical masks, face shields, safety glasses, aprons and protective gowns.

Between the first measurements taken in April 2020 and those taken approximately four weeks later, there was an increase in the proportion responding that their workplace used these protective measures and equipment. This was true for the majority of factors, with the exception of the separate waiting area for Covid-19 patients and the special room for procedures generating aerosol particles. Consequently, they succeeded in improving many procedures over a short period in order to limit the spread of Covid-19 at the hospital.

3.2 Correlation over time between the work environment and staff health

The search identified a total of 22 studies (4, 11–31) exploring the correlation between the work environment and health over time (research question 2). The quality of these studies was either moderate (4, 11, 13–21, 23–31) or high (12, 22). See Table 2. Nine of the studies were conducted in European countries (12, 13, 16, 18, 20, 21, 23, 26, 27), seven in America (14, 17, 19, 24, 25, 29, 30), four in Asia (11, 22, 28, 31) and two in South America (4, 15). Organisational and social work environments were explored in 16 of the studies (4, 11–14, 16, 18–20, 22, 25, 26, 28–31) and infection risk in six (15, 17, 21, 23, 24, 27).

3.2.1 Organisational and social work environments

The majority of the studies that addressed organisational and social work environments looked at one or more of the following work environment factors: ‘working with Covid-19 patients’, ‘workload’, ‘leadership and support’ and ‘moral stress’. Many of the studies raise a number of these exposures. The results are presented below, based on the relevant exposure.

3.2.1.1 Working with Covid-19 patients

The compilation identified five studies (12, 16, 20, 22, 30) that explored the link between working with Covid-19 patients and various symptoms of mental illness, such as depression, generalised anxiety disorder, burnout, post-traumatic stress disorder (PTSD), and substance use disorder. The follow-up periods varied from six weeks to one year.

Two studies looked at burnout, one conducted in the USA and one in The Netherlands. The American study (30) explored different healthcare professions. It found that those working with Covid-19 patients that died were at a greater risk of developing burnout than those who did not. The Dutch study (20) looked at intensive care staff. The results showed that the staff who diagnosed, treated and cared for Covid-19 patients were at a greater risk of developing symptoms of burnout compared to those who did not. Nurses were more likely to develop burnout than doctors, however the nurses were less likely to develop symptoms of burnout while the pandemic was ongoing.

Two studies investigated trauma or post-traumatic stress disorder, one from China and one from the USA. Of the nurses in China working with Covid-19, those who worked with patients diagnosed with the virus were more likely to develop post-traumatic stress disorder than patients only suspected of having Covid-19 (22). The American study previously mentioned (30) found that those who worked with Covid-19 patients who then died were at greater risk of developing trauma than those not working with Covid-19-related deaths.

A British study examined the link with symptoms of depression over time (16). It identified a correlation between symptoms of depression during the study period and the healthcare workers who worked with Covid-19 patients.

Furthermore, a Spanish study (12) was identified that included the following mental illness: depression, generalised anxiety disorder, post-traumatic stress disorder and substance use disorder. Of the healthcare staff without these conditions when baseline measurements were taken, the following exposures generated a correlation with mental illnesses when the follow-up measurements were taken: direct contact with Covid-19 patients, needing to take decisions to prioritise how Covid-19 patients were cared for, and caring for Covid-19 patients who later died as a result of the virus.

3.2.1.2 Workload

Four studies with follow up periods ranging from one month to one year explored the correlation between workload and various symptoms of mental illnesses (19, 20, 28, 31) among front line healthcare staff during the Covid-19 pandemic. Many of the studies addressed more than one symptom. One of the studies looked at depression and three at burnout, two included post-traumatic stress and one studied poorer mental wellbeing. A study exploring whether there was a link between workload and body mass index (BMI) was also identified.

The study on depression looked at front line emergency healthcare workers in Singapore (28). It found that those who were concerned about their workload were at a greater risk of developing depression over time.

The three studies looking at the links between symptoms of burnout or PTSD were conducted in the USA, Taiwan and The Netherlands. The Dutch study (20) examined overtime work among intensive care workers and found that working overtime was linked to an increased risk of developing symptoms of burnout over time. The Taiwanese study (31) looked at emergency care nurses and examined the correlation between stress in the workplace (primarily linked to heavy workloads), burnout and symptoms of post-traumatic stress. The result showed that stress in the workplace was linked to burnout, which in turn was linked to symptoms of post-traumatic stress. The American study (19) included emergency healthcare workers and looked at the link between increased responsibility at work during the past week and the risk of poorer wellbeing and burnout. It found that there was only a correlation with poorer wellbeing.

Finally, a Brazilian study of healthcare workers (4) explored ‘tense’ work – a combination of high demands and low control – over time in relation to an increase in staff BMI. It found that tense work was not linked to increased BMI.

3.2.1.3 Leadership and support

One Spanish study of healthcare workers (12) found that in workplaces that were poorly prepared for managing the Covid-19 pandemic, the staff who at the time of the baseline measurement were not experiencing any mental illness were at an increased risk of conditions such as depression, generalised anxiety disorder, post-traumatic stress disorder or substance use disorder following a four-month period. One American study of healthcare workers (14) found that supportive leadership, in which the participant believed that the hospital administration were well-equipped for taking and communicating decisions and taking on board staff feedback, was linked to lower levels of exhaustion five months later. A study of nurses in China found that inclusive leadership, in which the participant felt their leader was open, accessible when needed and present for providing support and advice, found that there was a negative correlation with mental illness, and a positive correlation with psychological security² over a three-month period. In-depth analyses of the correlation between the three variables found that psychological security was a mediator variable, meaning that inclusive leadership contributes to psychological security thus reducing the risk of mental illness.

One American study (25) with a three-month follow-up period demonstrated that positive organisational support was linked to a lower risk of burnout and anxiety. A study of emergency healthcare workers in Singapore (28) found that social support in the workplace was also linked to a lower risk of developing depression one year later.

2 Feeling safe and secure knowing you will not be humiliated due to your opinions, and not being punished for any mistakes made at work.

3.2.1.4 Moral stress

Two American and one Dutch study followed healthcare workers for a period of five to seven months during the Covid-19 pandemic. The studies explored the correlation between moral stress (which arises when healthcare workers are prevented from doing what they believe is right at work due to external factors) and mental illness. (14, 20, 29). One of the American studies (29) of healthcare staff found that moral stress over time was linked with increased mental health problems and symptoms of burnout. The link was greater among those who spent time with patients than those who did not. The Dutch study of intensive care staff (20) also found that participants who reported moral stress demonstrated higher levels of symptoms of burnout during the follow-up period. Additionally, the second American study of healthcare staff (14) found that self-moral injury – having acted against your own moral compass and consequently becoming distressed – was linked to an increased risk of developing exhaustion.

3.2.1.5 Other organisational and social exposures

One Brazilian study (4) found that there was a correlation between shift work and increased BMI twelve to eighteen months following the baseline measurement. This applied to all healthcare workers included in the study and also to abdominal fat in women healthcare workers.

3.2.2 Infection risk and personal protective equipment

A number of studies looking at the risk factors of contracting Covid-19 at work are presented below together with other factors linked to personal protective equipment and its link to mental illness.

3.2.2.1 Infection risk

Six studies (15, 17, 21, 23, 24, 27) explored the workplace risk factors of becoming infected with Covid-19. The follow up periods varied from six days to eight months. Some of the studies compared the risk of being infected at work against the risk of contracting Covid-19 outside of work. Three studies were conducted in Europe, two in the USA and one in South America.

One of the American studies of healthcare workers (17) found that contact with infected people at work did not generate a risk of contracting Covid-19, as long as the staff were not without suitable personal protective equipment. The highest risk of contracting the virus was during contact with a person with Covid-19 outside of work. However, the second American study (24) demonstrated the opposite; there were no significant differences between groups who faced high and low exposure risks (i.e. those exposed to Covid-19 without and with suitable personal protective equipment respectively) in terms of developing Covid-19.

The South American study (15) of healthcare workers found that the risk of being infected by people with Covid-19 could be seen in both the work environment and in society. Contact with suspected or confirmed Covid-19 cases either in or outside of the workplace during the past 15 days increased the

risk of contracting the virus over the period studied. The study did not find any other risk factors, such as incorrect use of protective equipment, direct contact with Covid-19 patients in the workplace or using public transport, were linked to confirmed Covid-19 infection.

A Dutch study (27) compared the proportion of infected healthcare workers between units and found that a greater proportion of infected staff worked on units caring for Covid-19 patients. Staff working on intensive care units for Covid-19 patients were at a lower risk of becoming infected compared to those working on emergency or other units. A study by a rescue service company in Denmark and Sweden (21) found that the level of client or patient contact during a working day was the greatest predictor of Covid-19 infection. In contrast, there were no statistically verifiable results in an Italian study (23) outlining a link between Covid-19 exposure at work and later infection with the virus.

3.2.2.2 Personal protective equipment

One Spanish and one Portuguese study (12, 26) examined the lack of and use of personal protective equipment in relation to mental illness. Healthcare workers in Spain (12) who, at the time of baseline measurements had no mental illness, were more likely to develop conditions such as depression, generalised anxiety disorder, post-traumatic stress disorder or substance use disorder four months later if there was insufficient protective equipment. The Portuguese study (26) of nurses working in front line Covid-19 care settings explored various factors related to the use of protective equipment and how they linked to changes in estimated stress, sleep disturbances, depression and anxiety two months later. The results showed that a fear of catching Covid-19 or infecting others were the only factors directly related to the pandemic. Over time, these linked to an increased risk of depression, anxiety and stress – not the use of protective equipment itself.

A Turkish study (18) of healthcare staff working with N95 face masks investigated how their use affected body temperature, pulse, blood pressure, oxygen saturation and PetCO₂³ during a workday. The outcomes were measured at the start of the shift (0 hours), before lunch (after 4 hours), after lunch (5 hours) and at the end of the shift (after 9 hours). These parameters were compared against healthcare workers who had taken breaks during their shifts and those who did not. The results found statistically significant differences in blood pressure measurements taken at the start and end of the day. Those who worked without taking a break had higher levels of PetCO₂ between the measurements taken at the start of the shift and after four hours. There were no significant changes to the other parameters during the working day.

3.2.3 Other work environment exposures

One Spanish study (12) with a follow-up period of four months examined work factors that did not come under any of the above headings. These factors

3 Measures carbon dioxide levels at the end of exhalation.

included being placed in quarantine or being isolated. Spending time in quarantine or having been isolated increased the risk of developing a mental illness such as depression, generalised anxiety disorder, post-traumatic stress disorder or substance use disorder among staff who otherwise did not have any mental health problems during the follow-up period.

3.3 Efforts to improve the work environment and health

The systematic literature review includes twelve studies (32–43) that evaluated interventions aimed at improving the work environment or health of Covid-19 healthcare staff (research question 3). These studies were assessed as being of moderate (32–39, 43) or high (40–42) quality. Of these twelve studies, eight were non-randomised⁴ (32–39) and four were randomised controlled studies (40–43). Five were conducted in Europe (39–43), four in North America (32–34, 37), and three in Asia (35, 36, 38). The non-randomised studies are summarised in Table 3, and the randomised controlled studies are summarised in Table 4⁵. The results below are presented based on the level for which the interventions were intended (organisational and individual level), and their content.

3.3.1 Interventions on an organisational level

3.3.1.1 Organisational and social work environment

Three studies (36, 38, 39) evaluated the interventions that were mainly aimed at the organisational and social work environments. These three studies are described below.

An Italian study (39) of nurses at one hospital evaluated an intervention where Covid-19 adaptations were introduced, in the form of staffing, workload, staff skills and physical work environment. Resources were redistributed so staffing increased and the patient to nurse ratio decreased. In addition, nurses had access to psychological support from an easily accessible helpdesk. They also received training in infection control procedures and how to use personal protective equipment. In terms of the physical work environment, the units were re-designed so they were suitable for caring for Covid-19 patients. Self-reported work-related stress reduced and quality of life improved after these changes were implemented.

A non-randomised study including a control group evaluated the effects of time management training, i.e. planning work and leisure hours based on personal values and circumstances as well as eight week's professional group supervision on mental health and stress among nurses at a hospital in China (36). Upon evaluation, the intervention group reported better mental health and less stress than the control group who did not have access to the intervention.

4 The participants are not randomly assigned to the intervention or control group. Alternatively, there is no control group.

5 The participants are randomly assigned to the intervention or control group.

Another Chinese study (38) without a control group evaluated systematic improvement work at one hospital on three occasions. On each occasion, the management identified work environment problems the nurses faced, as well as their needs. They then took action to improve the situation. The work environment problems identified were infection risk, heavy workloads and stress. Nurses requested better infection control and other types of encouragement and relief, larger bonuses, more time off and access to meals during work hours. A number of improvement measures were taken. The nurses reported somewhat lower work-related stress following the intervention. There was also a reduction in the stress linked to using personal protective equipment, and the risk of infection decreased.

3.3.1.2 Personal protective equipment and the spread of infection

A randomised controlled study (42) of ambulance workers and emergency doctors in Switzerland evaluated the effects of a digital training module with gaming elements for learning about how to select the correct personal protective equipment. The module included 19 sections and seven video sequences with focus on the choice of equipment in different situations. The intervention group took this module once. They were also given the national guidelines on protective equipment for Covid-19. The control group were only given the national guidelines. No differences between the groups were identified after the intervention. Both groups improved over time, meaning they were more likely to choose the correct protective equipment.

A North American study (32) investigated the link between using a face shield in addition to face masks and Covid-19 infection among all hospital workers in the state of Massachusetts. After two months, the introduction of face shields was evaluated and found changes in the development of positive Covid-19 tests. The number of positive tests decreased considerably, with the decrease among staff being greater than the decrease among the general population.

3.3.2 Interventions on an individual level

Seven studies evaluated interventions involving meditation, breathing techniques and relaxation to improve mental health or sleep quality among healthcare workers (33–35, 37, 40, 41, 43). These seven studies are described below.

A Spanish randomised controlled study (41) reviewed a mobile app used by doctors and nurses caring for Covid-19 patients either in hospitals or primary healthcare. The intervention group used the app for two weeks. The app's content was based on mindfulness and cognitive behavioural therapy, and focused on four areas: managing emotions, healthy lifestyle, work-related stress and social support. During this period, the control group used an app providing psychological self-care advice. The results suggested no differences between the groups after two weeks, based on a self-evaluation scale with a summary of depression, anxiety and stress. However, the sub-group analysis showed that staff who had previously received psychopharmacological interventions or psychotherapy experienced a positive effect based on this scale compared to the control group.

Another randomised controlled study conducted in Turkey (43) assessed the effects of a 30-minute mindfulness-based breathing and musical therapy session on nurses caring for Covid-19 patients. The therapy was provided for groups of 4–6 participants. The control group spent 30 minutes in a calm and quiet environment. Both groups estimated their stress, work-related stress and psychological wellbeing before and after the session. The results showed that therapy had an immediate positive effect on stress, work-related stress and psychological wellbeing.

Another randomised controlled study from Turkey (40) evaluated the effects of a self-help method used by nurses caring for Covid-19 patients at a hospital. The method aims to achieve relaxation and balance by self-stimulating acupuncture points through gentle touch: emotional freedom techniques (44). The nurses participated in an online session lasting approximately 20 minutes. The control group spent 15 minutes in a calm environment. All participants estimated their stress, anxiety and exhaustion before and after the session. The results demonstrate a difference between the groups, and the intervention had a positive effect on stress, anxiety and exhaustion.

One American study (33) without a control group compared stress among hospital healthcare workers just before and immediately after a three-minute video of scenes from nature accompanied by classical music in a 360-degree virtual reality (VR) simulation. The reported stress levels were lower after the intervention than before.

Another American study (34) without a control group compared self-reported anxiety among nurses and other hospital healthcare staff both before and after a one-day retreat for reflection and contemplation. This study also found an improvement in terms of lower levels of anxiety following the intervention.

A study conducted in China (35) without a control group measured sleep quality, anxiety and depression among nurses at a Covid-19 hospital both before and after four weeks of daily relaxation and breathing exercises. Sleep quality and anxiety improved following the intervention, although depression was unchanged.

A study from the USA (37) compared sleep quality among doctors and advanced providers⁶ before and after four weeks of daily meditation. The results indicated improvement following the intervention. This study also included a control group that did not meditate. However, the analysis was only conducted over time for each group. Sleep quality was not compared between the intervention and control group, despite this being necessary to answer the purpose of the study.

4 Discussion

In summary, the search identified 64 articles that met the inclusion criteria. Of these, 23 were excluded due to poor methodological quality. Therefore, this systematic literature review draws on the results of 41 scientific studies. One of the articles is included in the presentation of the results for both questions one and two. Of these studies, 19 were conducted in Europe (3, 6–8, 10, 12, 13, 16, 18, 20, 21, 23, 26, 27, 39–43), 12 in North America (5, 14, 17, 19, 24, 25, 29, 30, 32–34, 37), seven in Asia (11, 22, 28, 31, 35, 36, 38) and three in South America (4, 9, 15). One of the European studies used data from Sweden and Denmark (21), two other studies used data gathered exclusively in Sweden (the same data collection for both articles) (3, 7).

4.1 Discussion of results

A summary and discussion of the results will now follow. We have used a theoretical model that describes the balance between demands and resources at work (45) and divided the results under the headings ‘Demands’ and ‘Resources’, with sub-headings for specific work environment factors. To the greatest extent possible, we have summarised how a certain work environment factor developed over time (question 1), how the factors correlated with health (question 2) and, where appropriate, the results of interventions aimed at work environment factors or health (question 3). A summary and discussion are presented under the heading ‘Demands’ based on the following work environment factors: Work with Covid-19 patients, workload, moral stress and infection risk and protective equipment. The following themes are presented under the heading ‘Resources’: Leadership and support, interventions on an individual level for enabling recuperation.⁶

4.1.1 Demands

The work environment factors that create a strain on employees are presented below. These factors are demands or occasionally interventions on an organisational level that aim to modify one or more work environment factors. The results relating to all questions (1–3) are summarised and discussed under the headings, ‘Working with Covid-19 patients’, ‘Workload’, ‘Moral stress’ and ‘Infection risk and protective equipment’.

4.1.1.1 Working with Covid-19 patients

The results from the studies (12, 16, 20, 22, 30) exploring how mental health was affected over time when treating and caring for Covid-19 patients (question 2) consistently indicate that this task generated a stress factor in the

⁶ Staff who perform similar tasks to doctors without being licenced physicians.

work environment thought to be significant to the mental health of healthcare workers.

Diagnosing, treating, caring for, taking prioritisation decisions and having experiencing patients dying are thought to be significant to the development of symptoms of mental health conditions such as burnout, post-traumatic stress, depression, generalised anxiety syndrome and substance use disorder. Below is a discussion of the studies included that address interventions in the form of resources and support to help staff cope with this troubling work over time.

4.1.1.2 Workload

Workload was the subject of a large portion of the studies investigating how work environments within healthcare changed as a result of the Covid-19 pandemic, as well as the work environment factors that correlate with staff health over time. The way the studies measured workload varied, for example as demands following the demand-control model (46), workload or strain following the effort-reward model. Workload has also been measured in terms of having been allocated extra responsibility in the workplace, such as overtime, or the studies investigating workload. The studies included in the compilation, of which one data set comes from a Swedish hospital, shows that workloads increased during the Covid-19 pandemic (3, 7). One study (7) comparing units and professionals found a greater workload increase among clinical staff in emergency medicine, compared to administrative staff elsewhere.

In addition, four studies (19, 20, 28, 31) indicated that heavy workloads were linked to developing symptoms of mental illness. Healthcare workers who reported a heavy workload were at a greater risk of developing symptoms of depression, burnout and PTSD over time. Staff who developed symptoms of burnout were also more likely to have previously reported working overtime and having been assigned extra responsibilities at work. The results of this systematic literature review focusing on the healthcare sector during the Covid-19 pandemic confirm the well-known existing link between high work-related demands and mental illness (47–51).

The literature search identified one study of interventions on an organisational level intended to influence workload (39). This study was conducted at a hospital in Italy. The intervention was intended to adapt procedures for Covid-19 care with regard to workload, skills-based staffing and design of the physical work environment. The results showed moderate improvements to work-related stress and quality of life among the nurses included in the study. However, it was not possible to differentiate between the effects of the intervention on workload. The evaluation was conducted immediately after the implementation of the intervention, therefore it is unclear whether the effects were sustained. A number of studies on interventions on an individual level aimed at managing work-related stress are presented under a separate heading later in the text.

In summary, the results of the compilation of the longitudinal studies included show that workload increased in parts of the healthcare sector during the Covid-19 pandemic, and these heavy workloads are associated with developing symptoms of mental illness over time. Only one study was identified that focused on work environment interventions intended to reduce workloads. The results of this study are non-specific and the follow-up period was limited.

4.1.1.3 Moral stress

Moral stress refers to the stress that arises when external factors prevent healthcare workers from doing what they believe is right at work. This also includes self-moral injury – having acted against their own moral compass and consequently feeling distress. Moral stress was only addressed in research question 2, i.e. how moral stress over time affects the risk of developing symptoms of mental illness. No studies included in this compilation investigated how moral stress changed as a result of the Covid-19 pandemic, nor did they look at interventions aimed to change moral stress factors related to work with patients. The three studies (14, 20, 29) that explored the health-related effects of moral stress and self-moral injury found that over time, those reporting this exposure at work during the pandemic ran a higher risk of developing a mental illness such as symptoms of burnout. There have been more studies on moral stress among healthcare workers in recent years, and several cross-sectional studies have previously reported a link between mental illness and moral stress (52). Hence, the results from this compilation of studies conducting repeated measurements of moral stress and mental illness during the Covid-19 pandemic confirm those from previous cross-sectional studies.

4.1.1.4 Infection risk and protective equipment

All of the longitudinal studies investigating how the risk of infection and access to personal protective equipment changed over time during the pandemic have compared access at varying stages. One European study (10) and one American study (5) showed that access to personal protective equipment was lowest at the start of the pandemic, but had increased when measured at a later stage. In contrast, one South American study found that access was consistently low at both measurement points (9). Consequently, there are significant regional variations, and access to personal protective equipment depended on factors that were difficult to influence in the short term during the critical situation that arose in many countries at the outbreak of the pandemic.

A number of studies were identified that address the risks of being infected with Covid-19 in the workplace (question 2). These have been included in the compilation. For example, the studies compare the risk of being infected outside of work against the risk of being infected at work (15, 17, 21, 23, 24, 27), the risk between different units (27), risk with and without patient contact (21, 23) and between high-risk exposure (contact with patient without using adequate protective equipment) (17, 24) and without.

The overall results are conflicting, indicating it is not possible to reach any uniform conclusions regarding the infection risks faced by staff under various conditions. A study using Swedish data (21) reported that the daily frequency of patient or client contact generated the greatest infection risk factor. A different study found that healthcare workers only risked being infected through patient contact when staff did not use adequate protective equipment (17). In contrast, other studies (23, 24) showed that personal protective equipment was not significant to contracting the virus.

However, the two longitudinal studies (12, 26) examining the link between lack of personal protective equipment – in turn creating a consistent fear of becoming infected or infecting others – and mental health among healthcare workers found that this correlated with symptoms of stress, anxiety, sleep disturbance, depression, generalised anxiety disorder, post-traumatic stress disorder or substance use disorder.

Two studies were identified that addressed workplace interventions regarding personal protective equipment and the risk of infection (question 3). One, a Swiss controlled study with high methodological quality (42), presented the effects of a digital training session created to increase ambulance workers' ability to choose the correct form of personal protective equipment. The study found a great level of improvement even among the control group that only received a copy of the relevant guidelines. One conclusion was that simply accessing and systematically following the guidelines was sufficient for generating significant improvements when choosing personal protective equipment. No follow up was conducted over time, meaning it is not possible to comment on the long-term effects of the digital training. A study from the USA (32) shows that the introduction of face shields as a complement to face masks for all hospital staff was linked to a decrease in Covid-19 infections among staff. Additionally, this measure resulted in a rapid reduction in number of infection cases compared to those in the community.

In summary, there are no clear-cut links between working in healthcare and an increased risk of infection based on the data included in this report. Community transmission was also thought to have contributed to healthcare workers contracting the virus. Access to personal protective equipment has likely been significant to the risk of infection, although conclusions are contradictory. The two studies suggest that there is a greater link between not being protected against infection and developing mental illness, than not being protected and contracting Covid-19.

4.1.2 Resources

The work environment factors forming a support for workers are presented below. Where relevant, interventions on an organisational or individual level aiming to modify one or more work environment factors are also accounted for. Results relating to all questions (1–3) are summarised and discussed under the headings 'Leadership and support' and 'Interventions on an individual level for enabling recuperation'.

4.1.3 Leadership and support

A number of studies explored how the Covid-19 pandemic affected the possibility of access to support at work and at different stages of the pandemic (question 1). The results are contradictory; there were reports of both reduced and unchanged support, or increased levels. All four studies (11, 14, 25, 28) focusing on the topic found that supportive or inclusive leadership together with organisational and workplace support generally correlated with a reduced risk of healthcare workers developing symptoms of mental illness. The results support the well-established links between good leadership (51, 53–55) and good support (48, 50) in the workplace and the link to lower risk of mental illness.

Two studies examining the effects of interventions focusing on leadership and support are included in the compilation. The quality of these studies was assessed as sufficiently high. The first was conducted in Taiwan (38), and evaluated how management implemented systematic improvement work among nurses at an emergency hospital. On three occasions, management identified work environment problems and staff needs and then took action. This included improved infection control measures as well as support efforts involving practical training for new nurses, adaptations to work schedules and group meetings to improve communication between doctors and nurses. The results showed that work-related stress reduced somewhat over time. The second study looked at Chinese nurses (36). It evaluated staff support in the form of professional guidance and time management training, i.e. planning work and leisure time based on personal values and circumstances. The intervention led to positive results on mental health. Neither of these studies conducted a follow-up over time, meaning it is not possible to comment on any long-term effects.

4.1.4 Interventions for individuals for facilitating recuperation

A large number of studies that assessed various stress management methods aimed at healthcare workers were identified in addition to the interventions on an organisational level presented under each work environment factor above. Of the total 12 intervention studies included in this systematic literature review, seven evaluated interventions on an individual level (33–35, 37, 40, 41, 43) designed to enable staff recuperation. Three were randomised control studies (40, 41, 43), two of which – both from Turkey – showed positive results on mental health following relatively short sessions, one lasting 20 minutes involving touch stimulation of acupuncture points (40) and one involving 30 minutes of breathing techniques and musical therapy (43). The effects of the interventions in both of these studies were measured immediately after the session. Therefore, it is not possible to reach any conclusions about their long-term effects. The third of these randomised controlled studies was conducted in Spain, and did not identify any effect of mobile app-based mindfulness exercises on mental health after two weeks (41).

Four non-randomised studies without control groups showed predominantly positive results over time (33–35, 37). Two studies from the USA reported

reduced stress after short periods in virtual reality (VR) environments including nature and music (33) as well as reduced anxiety following a retreat for contemplation (34). One Chinese (35) and one American (37) study looked at sleep quality. They found that this improved following four weeks of relaxation exercises (35) and two weeks of meditation (37).

The majority of the seven studies reported in this section involved nurses in direct contact with Covid-19 patients in Europe, North America or Asia. They had study populations ranging from 72 to 482 participants. None of these intervention studies were conducted in Sweden or the Nordic countries.

In summary, short interventions aiming to enable relaxation among healthcare workers can be said to have a directly positive effect on mental health. However, there are no long-term follow ups of the interventions. Hence, to ensure the generalisability of the results, there is a need for more Swedish and Nordic studies.

4.2 Discussion of methods

4.2.1 Strengths and limitations in the scientific data

One strength of the data is that it includes a relatively large number of observational studies with repeated measurements, meaning developments can be followed over time. Another strength is that several professions are included, such as doctors, nurses, ambulance workers and administrative staff. Nevertheless, the majority of participants in the studies are nurses. Consequently, the results can be generalised for nurses with greater certainty than for other healthcare professions.

An additional strength is that many of the studies analysing links between work environment factors and workers' health had measured the health variable at the start of the study and during follow ups. In these surveys, with starting data, it is possible to comment on whether the exposure led to changes in health over time with greater certainty. Other studies did not take into account the workers' health at the start of the study when performing the statistical analyses. Therefore, there is less certainty when commenting on causality.

Even if measurements were taken at different times, there is a risk of bias associated with the fact they are based on estimates from the same people. Consequent risks often involve an overestimation of the size of the link. In contrast, studies investigating the risk of Covid-19 infection both at and outside of work have used objective measurements in the form of SARS-CoV-2 antibodies.

One weakness is that many of the studies used self-reported data to measure both work environment factors and mental illness. There is a risk that a

participant's experience of mental health problems 'clouds' the situation, leading to the person estimating that their work environment is worse than if they did not have a mental illness. The same is true for the opposite; a person who is in good mental health may likely view their work environment as more positive, purely based on the way they feel. Hence, there is a risk that the correlation is stronger in the statistical analyses than it would have been if objective measurements of the work environment had been taken. Objective measurements have been used in studies linking the risk of Covid-19 infection both within and outside of the workplace in the form of antibody testing for SARS-CoV-2, meaning there is no such risk here.

A number of the studies have used established scales for measuring exposure in the work environment, which is a strength. This applies for measuring demands, control and support or effort-reward at work. However, the majority of studies measured the work environment factors using surveys which were not validated. This means that there is a level of uncertainty surrounding a number of these measurement methods in the compilation.

One weakness of the studies evaluating the effects of interventions on an organisational and individual level is that they measured the effects immediately after the outcome. Therefore, no follow-up measurements are available over a longer period. As a result, it is not possible to comment on the long-term effects of the interventions.

4.2.2 Strengths and limitations with the methods in this systematic literature review

This systematic literature review was created following the Prisma guidelines for systematic reviews. Six researchers and one research assistant participated by reading the article titles and summaries. The researchers then worked in three pairs to assess the full texts and quality of each study. The researchers in each pair conducted an independent appraisal and then compared their results with their partner. Three researchers were responsible for the presentation and synthesis of the results. They performed an additional review of each quality appraisal for each question. The research assistant oversaw the administrative elements such as documenting the appraisals and decisions of each study, creating drafts of each table and sections of the report. Three of the researchers had participated in a previous systematic literature review commissioned by the Swedish Agency for Work Environment Expertise (1, 56), and were well-acquainted with the questions and elements of the scientific data. The combination of this experience and administrative support enabled the quick creation of this systematic literature review. Narrow time frames and a large project group posed challenges with creating cohesive assessments of both inclusion and exclusion criteria as well as methodological quality. Therefore, the group has regularly met and worked systematically in different stages as described above.

The search strategy was delimited based on population, to only include healthcare workers. This was essential for its feasibility. However, this may mean

that studies including healthcare workers referred to by a different term may have been overlooked in the search. A further delimitation was restricting searches to PubMed, Web of Science and PsychINFO, which may mean that relevant studies not included in these databases may have been missed.

Qualitative and cross-sectional studies have already been included in a previous systematic literature review published by the Swedish Agency for Work Environment Expertise (1) that draws on the same questions as this report. The number of quantitative cross-sectional studies and interview studies was already large at the start of the Covid-19 pandemic, and the results in the first systematic literature review were in line with the results from around the world and between study designs. Therefore, updating the search to include qualitative studies was not deemed necessary. However, it is not possible to exclude the fact that there may be new valuable knowledge that this delimitation has overlooked.

4.3 Implementation in a Swedish context

The majority of studies in this systematic literature review are based on data from Europe or North America. This differs considerably from the studies included in the previous systematic literature review looking at the work environment and epidemics and pandemics (1). The previous systematic literature review was based predominantly on studies conducted in China or other Asian countries. This may be due to the pandemic having started in China, but also as the compilation included studies on SARS and MERS (where the major spread was in Asia). Stricter exclusion criteria for the design of this study may also have affected the review in comparison with the other. It may also be the case that more longitudinal studies have been conducted in Europe or North America since the start of the pandemic.

Although this literature search also included fewer studies using data from Sweden. Consequently, the matter of implementation into a Swedish context is also relevant for this literature compilation.

Healthcare services differ considerably around the world in terms of organisation, resources and strategies to limit the spread of Covid-19. Nevertheless, there are also a number of similarities, for example, many countries were unprepared for a pandemic, experienced high levels of community transmission in a short period and the best strategies to meet the challenges were unclear. Just as in the rest of the world, this led to healthcare services in Sweden coming under great pressure over a long period, with severely ill patients and insufficient knowledge about infection routes, treatment, and perspective on how the pandemic would develop over time.

The results of this systematic literature review are relatively uniform, regardless of where in the world a study was conducted. Working in direct contact with

infected patients, experiencing a heavy workload, moral stress and infection risk, as well as a lack of protective equipment are all work environment factors that can be said to be significant for a broad section of healthcare workers, regardless of how the system is organised or financed. Similarly, it is likely that the results regarding the importance of leadership and support as well as interventions for enabling recuperation among staff are applicable to Swedish conditions.

5 Conclusions

The overall purpose of this systematic literature review was to map and summarise international research published from the outbreak of Covid-19 until the start of May 2022 that looks at how the pandemic affected the work environment and healthcare workers' health over time. In addition, the compilation maps and summarises research on the effects of various interventions within healthcare that aim to improve the work environment or health.

Three research questions were formulated for the compilation and are accompanied below by the conclusions that could be reached based on the scientific data gathered from the start of the pandemic in November 2019 until the spring of 2022.

1. How did healthcare workers' work environment change during the Covid-19 pandemic?

- The results consistently show that workloads increased over time.
- There are contradictory results relating to workers' access to emotional support from management and external consultants.
- Results also conflict in terms of increased or decreased access to personal protective equipment over time.

2. What links between the work environment and workers' health can be identified within healthcare during the pandemic?

- An increased risk of developing a mental illness was linked to:
 - working with Covid-19 patients (diagnosing, treating, caring for, taking prioritisation decisions, and witnessing the deaths of Covid-19 patients);
 - heavy workload;
 - moral stress in the workplace.
- A decreased risk of developing a mental illness was linked to:
 - work-related support from managers and colleagues.

3. How successful were the interventions at improving healthcare workers' work environment or health during the Covid-19 pandemic?

- Interventions on an individual level (for example, meditation, breathing techniques and relaxation) had immediate positive effects on workers' mental health. However, these studies are few and their designs mean that no strong conclusions can be drawn as regards causality or long-term effects.

- Interventions on an organisational level (for example, changes to work procedures and staffing, as well as professional guidance) had immediate positive effects on workers' mental health. The study designs were such that it was not possible to reach conclusions on causality or the long-term effects.

Based on the questions above, is it possible to identify differences between groups of healthcare workers, such as between professions and genders?

- Very few studies compared the results between different groups within healthcare following the three questions. Some comparisons were made based on gender, age and professional group although these studies were few and results conflicting. Thus, no strong conclusions concerning the differences between professional groups, ages and genders can be reached.

6 Knowledge gaps and research needs

Extremely few longitudinal studies were conducted in Sweden and the other Nordic countries. In addition to the general demand for more evidence from this region, studies comparing the work environment in healthcare settings during the Covid-19 pandemic between different Nordic countries could contribute to increased knowledge about the effects different strategies for responding to pandemics could have on the work environment.

Only a handful of studies on organisational factors such as the division of resources, staffing and working hours were identified for each question. This includes both how these factors changed during the pandemic and how they impacted the health of healthcare workers. By developing our knowledge on how the healthcare sector is best organised so as employee health is not affected in the event of pandemics and crises, we can gain essential information ahead of similar situations in the future.

There is a need for more studies looking at resources, such as emotional support from line managers and colleagues. Existing scientific data does not provide a clear picture of how access to emotional support changed during the pandemic. This applies to both support from line managers and colleagues. There is a limited basis to support the common understanding that there are certain links between access to support and a decreased likelihood of developing a mental illness.

There were only a few individual studies looking at further exposures in the work environment, and more are needed to be able to draw conclusions. This applies to elements such as how shift work, skills and learning, and being placed in quarantine or isolated affect the development of mental illnesses. Few studies investigated further changes to moral stress during the Covid-19 pandemic, and moral stress is thought to be a significant precursor to mental illness. There is a demand for more studies on moral stress in healthcare settings during crises such as pandemics.

In many of the studies that addressed changes in the work environment and the impact on mental health, the period between the first and final measurements was often short. Longer periods are needed in order to be able to measure whether the changes are lasting. Several measurement points studying variation over time would also provide valuable knowledge.

Several methodological shortcomings were identified in the observation studies. Only a handful of studies were deemed as being of high quality. The majority had methodological flaws, meaning they were deemed to be

of moderate quality. These flaws included non-representative selections, non-validated measurements on the exposure and inadequate reporting on internal drop out and confounding. Several studies that take these factors into account are necessary in order to strengthen the scientific data relating to the questions.

The literature search did not include a delimitation for the type of illness addressed by the studies. Besides the studies addressing the risk of Covid-19, mental illness still dominates the results from the searches. This confirms the result from the previous systematic literature review conducted on behalf of the Swedish Agency for Work Environment Expertise (1), which also included qualitative and quantitative cross-sectional studies. The reason why the majority of studies in the compilation investigate mental illness among workers may be due to the fact it takes longer to develop serious physical conditions as a result of work-related strain. There appears to be a knowledge gap in terms of the effects of stress-related physical illness (such as cardiovascular diseases) following long-term stress within the healthcare sector during the Covid-19 pandemic.

The majority of interventions studied focused on interventions at the individual level, involving various stress-reduction techniques to help healthcare workers reduce stress caused by heavy workloads and other work environment factors. These involved relaxation, meditation and other steps an individual can take. Despite the valuable knowledge provided, there is still a need for more studies that evaluate the interventions at organisational level. Such studies are important for improving the conditions for the healthcare sector to be able to rapidly adapt procedures, staffing, communication channels and so on, in the event of future pandemics and other crises. Studying significance of support from managers and colleagues during pandemics and other crises by using intervention studies could also prove beneficial. Furthermore, the intervention studies had shorter follow-up intervals looking at mental illness. Even though immediate correlations between improved mental health among participants could be identified, there is a need for more knowledge on the long-term effects.

Referenser

1. Nyberg A, Demmelmaier I, Rajaleid K. Arbetsmiljö och hälsa i organisationer vid epidemier och pandemier orsakade av coronavirus Swedish Agency for Work Environment Expertise, 2022.
2. Hong QN, Fàbregues S, Bartlett G, Boardman F, Cargo M, Dagenais P, et al. The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. *Education for Information*. 2018;34(4):285-91.
3. Alexiou E, Steingrímsson S, Akerström M, Jonsdóttir IH, Ahlström L, Finizia C, et al. A Survey of Psychiatric Healthcare Workers' Perception of Working Environment and Possibility to Recover Before and After the First Wave of COVID-19 in Sweden. *Front Psychiatry*. 2021;12:770955.
4. Coelho LG, Costa PRF, Kinra S, Mallinson PAC, Akutsu R. Association Between Occupational Stress, Work Shift and Health Outcomes in Hospital Workers of the Recôncavo of Bahia, Brazil: The Impact of Covid-19 Pandemic. *Br J Nutr*. 2022:1-26.
5. Gray BM, Vandergrift JL, Barnhart BJ, Reddy SG, Chesluk BJ, Stevens JS, et al. Changes in Stress and Workplace Shortages Reported by U.S. Critical Care Physicians Treating Coronavirus Disease 2019 Patients. *Crit Care Med*. 2021;49(7):1068-82.
6. Hoogendoorn ME, Brinkman S, Bosman RJ, Haringman J, de Keizer NF, Spijkstra JJ. The impact of COVID-19 on nursing workload and planning of nursing staff on the Intensive Care: A prospective descriptive multicenter study. *Int J Nurs Stud*. 2021;121:104005.
7. Jonsdóttir IH, Degl'Innocenti A, Ahlström L, Finizia C, Wijk H, Akerström M. A pre/post analysis of the impact of the COVID-19 pandemic on the psychosocial work environment and recovery among healthcare workers in a large university hospital in Sweden. *J Public Health Res*. 2021;10(4):7.
8. Magnavita N, Soave PM, Antonelli M. Prolonged Stress Causes Depression in Frontline Workers Facing the COVID-19 Pandemic-A Repeated Cross-Sectional Study in a COVID-19 Hub-Hospital in Central Italy. *Int J Environ Res Public Health*. 2021;18(14).
9. Richaud MC, Eidman L, Rubilar JV, Lemos V, Mesurado B, Klos MC, et al. Perceived Concerns and Psychological Distress of Healthcare Workers Facing Three Early Stages of COVID-19 Pandemic. *Frontiers in Psychology*. 2022;13:14.
10. Sandal A, Toreyin ZN, Salturk C, Arbak PM. The Perspective of the Turkish Thoracic Society Members on Institutional Preparedness During the COVID-19 Pandemic in Turkey. *Turk Thorac J*. 2021;22(4):317-23.
11. Ahmed F, Zhao F, Faraz NA, Qin YJ. How inclusive leadership paves way for psychological well-being of employees during trauma and crisis: A three-wave longitudinal mediation study. *J Adv Nurs*. 2021;77(2):819-31.
12. Alonso J, Vilagut G, Alayo I, Ferrer M, Amigo F, Aragón-Peña A, et al. Mental impact of Covid-19 among Spanish healthcare workers. A large longitudinal survey. *Epidemiol Psychiatr Sci*. 2022;31:e28.
13. Canal-Rivero M, Armesto-Luque L, Rubio-Garcia A, Rodriguez-Menendez G, Garrido-Torres N, Capitan L, et al. Trauma and stressor-related disorders among health care workers during COVID-19 pandemic and the role of the gender: A prospective longitudinal survey. *Journal of Affective Disorders*. 2022;302:110-22.
14. Dale LP, Cuffe SP, Sambuco N, Guastello AD, Leon KG, Nunez LV, et al. Morally Distressing Experiences, Moral Injury, and Burnout in Florida Healthcare Providers during the COVID-19 Pandemic. *Int J Environ Res Public Health*. 2021;18(23).

15. Dávila-Conn V, Soto-Nava M, Caro-Vega YN, Paz-Juárez HE, García-Esparza P, Tapia-Trejo D, et al. Seroepidemiology of SARS-CoV-2 in healthcare personnel working at the largest tertiary COVID-19 referral hospitals in Mexico City. *PLoS One*. 2022;17(3):e0264964.
16. De Kock JH, Latham HA, Cowden RG, Cullen B, Narzisi K, Jerdan S, et al. The mental health of NHS staff during the COVID-19 pandemic: Two-wave Scottish cohort study. *BJPsych Open*. 2022;8:10.
17. Doernberg SB, Holubar M, Jain V, Weng Y, Lu D, Bollyky JB, et al. Incidence and prevalence of COVID-19 within a healthcare worker cohort during the first year of the SARS- CoV-2 pandemic. *Clin Infect Dis*. 2022.
18. Karsli E, Yilmaz A, Kemancı A, Canacik O, Ozen M, Seyit M, et al. The effect of N95 respirators on vital parameters, PETCO(2), among healthcare providers at the pandemic clinics. *Ir J Med Sci*. 2022:1-8.
19. Kelker H, Yoder K, Musey P, Jr., Harris M, Johnson O, Sarmiento E, et al. Prospective study of emergency medicine provider wellness across ten academic and community hospitals during the initial surge of the COVID-19 pandemic. *BMC Emerg Med*. 2021;21(1):36.
20. Kok N, van Gurp J, Teerenstra S, van der Hoeven H, Fuchs M, Hoedemaekers C, et al. Coronavirus Disease 2019 Immediately Increases Burnout Symptoms in ICU Professionals: A Longitudinal Cohort Study. *Crit Care Med*. 2021;49(3):419-27.
21. Laursen J, Petersen J, Didriksen M, Iversen K, Ullum H. Prevalence of SARS-CoV-2 IgG/ IgM Antibodies among Danish and Swedish Falck Emergency and Non-Emergency Healthcare Workers. *Int J Environ Res Public Health*. 2021;18(3).
22. Li X, Zhou Y, Xu X. Factors associated with the psychological well being among front line nurses exposed to COVID 2019 in China: A predictive study. *Journal of Nursing Management*. 2021;29(2):240-9.
23. Milazzo L, Lai A, Pezzati L, Oreni L, Bergna A, Conti F, et al. Dynamics of the seroprevalence of SARS-CoV-2 antibodies among healthcare workers at a COVID-19 referral hospital in Milan, Italy. *Occup Environ Med*. 2021.
24. Morcuende M, Guglielminotti J, Landau R. Anesthesiologists' and Intensive Care Providers' Exposure to COVID-19 Infection in a New York City Academic Center: A Prospective Cohort Study Assessing Symptoms and COVID-19 Antibody Testing. *Anesth Analg*. 2020;131(3):669-76.
25. Reitz KM, Terhorst L, Smith CN, Campwala IK, Owoc MS, Downs-Canner SM, et al. Healthcare providers' perceived support from their organization is associated with lower burnout and anxiety amid the COVID-19 pandemic. *PLoS One*. 2021;16(11):e0259858.
26. Sampaio F, Sequeira C, Teixeira L. Impact of COVID-19 outbreak on nurses' mental health: A prospective cohort study. *Environ Res*. 2021;194:7.
27. Sikkens JJ, Buis DTP, Peters EJG, Dekker M, Schinkel M, Reijnders TDY, et al. Serologic Surveillance and Phylogenetic Analysis of SARS-CoV-2 Infection Among Hospital Health Care Workers. *JAMA Netw Open*. 2021;4(7):e2118554.
28. Th'ng F, Rao KA, Ge L, Mao D, Neo HN, Molina JA, et al. A One-Year Longitudinal Study: Changes in Depression and Anxiety in Frontline Emergency Department Healthcare Workers in the COVID-19 Pandemic. *Int J Environ Res Public Health*. 2021;18(21).
29. Wilson CA, Metwally H, Heavner S, Kennedy AB, Britt TW. Chronicling moral distress among healthcare providers during the COVID-19 pandemic: A longitudinal analysis of mental health strain, burnout, and maladaptive coping behaviours. *Int J Ment Health Nurs*. 2022;31(1):111-27.

30. Yamane D, Zarabian K, Devine K, Benjenk I, Farrar K, Park OL, et al. Hospital-Based Healthcare Worker Perceptions of Personal Risk Related to COVID-19: One Year Follow-Up. *J Am Board Fam Med.* 2022;35(2):284-94.
31. Yang BJ, Yen CW, Lin SJ, Huang CH, Wu JL, Cheng YR, et al. Emergency nurses' burnout levels as the mediator of the relationship between stress and posttraumatic stress disorder symptoms during COVID-19 pandemic. *Journal of Advanced Nursing.* 2022;11.
32. Al Mohajer M, Panthagani KM, Lasco T, Lembcke B, Hemmige V. Association between universal face shield in a quaternary care center and reduction of SARS-COV2 infections among healthcare personnel and hospitalized patients. *Int J Infect Dis.* 2021;105:252-5.
33. Beverly E, Hommema L, Coates K, Duncan G, Gable B, Gutman T, et al. A tranquil virtual reality experience to reduce subjective stress among COVID-19 frontline healthcare workers. *PLoS One.* 2022;17(2):e0262703.
34. Cunningham T, Çayir E. Nurse Leaders Employ Contemplative Practices to Promote Healthcare Professional Well-being and Decrease Anxiety. *J Nurs Adm.* 2021;51(3):156-61.
35. Liu Y, Jiang TT, Shi TY, Liu YN, Liu XM, Xu GJ, et al. The effectiveness of diaphragmatic breathing relaxation training for improving sleep quality among nursing staff during the COVID-19 outbreak: a before and after study. *Sleep Med.* 2021;78:8-14.
36. Sun L. Intervention Effect of Time Management Training on Nurses' Mental Health during the COVID-19 Epidemic. *Psychiatr Danub.* 2021;33(4):626-33.
37. Thimmapuram J, Pargament R, Bell T, Schurk H, Madhusudhan DK. Heartfulness meditation improves loneliness and sleep in physicians and advance practice providers during COVID-19 pandemic. *Hosp Pract (1995).* 2021;49(3):194-202.
38. Yang BJ, Yen CW, Lin SJ, Huang CH, Wu JL, Cheng YR, et al. The effects of an emergency nurse-led stress-reduction project during the first 120 days of the COVID-19 pandemic in Taiwan. *Journal of Nursing Management.* 2022;30(2):367-74.
39. Zaghini F, Fiorini J, Livigni L, Carrabs G, Sili A. A mixed methods study of an organization's approach to the COVID-19 health care crisis. *Nurs Outlook.* 2021;69(5):793-804.
40. Dincer B, Inangil D. The effect of Emotional Freedom Techniques on nurses' stress, anxiety, and burnout levels during the COVID-19 pandemic: A randomized controlled trial. *Explore (NY).* 2021;17(2):109-14.
41. Fiol-DeRoque MA, Serrano-Ripoll MJ, Jiménez R, Zamanillo-Campos R, Yáñez-Juan AM, Bennasar-Veny M, et al. A Mobile Phone-Based Intervention to Reduce Mental Health Problems in Health Care Workers During the COVID-19 Pandemic (PsyCovidApp): Randomized Controlled Trial. *JMIR Mhealth Uhealth.* 2021;9(5):e27039.
42. Suppan L, Abbas M, Stuby L, Cottet P, Larribau R, Golay E, et al. Effect of an E-Learning Module on Personal Protective Equipment Proficiency Among Prehospital Personnel: Web-Based Randomized Controlled Trial. *J Med Internet Res.* 2020;22(8):e21265.
43. Yıldırım D, Çiriş Yıldız C. The Effect of Mindfulness-Based Breathing and Music Therapy Practice on Nurses' Stress, Work-Related Strain, and Psychological Well-being During the COVID-19 Pandemic: A Randomized Controlled Trial. *Holist Nurs Pract.* 2022;36(3):156-65.
44. Church D BA. The effect of a brief EFT (Emotional Freedom Techniques) self-intervention on anxiety, depression, pain and cravings in healthcare workers. *Integr Med ClinJ.* 2010;9:40-4.

45. Bakker AB, Demerouti E. The Job Demands Resources model: state of the art. *J Manage Psychol*. 2007;22(3):309-28.
46. Karasek R, Theorell T. *Healthy work: stress, productivity, and the reconstruction of working life*. New York, N.Y. : Basic Books; 1990.
47. Duchaine CS, Aubé K, Gilbert-Ouimet M, Vézina M, Ndjaboué R, Massamba V, et al. Psychosocial Stressors at Work and the Risk of Sickness Absence Due to a Diagnosed Mental Disorder. *JAMA Psychiatry*. 2020;77(8):842.
48. Harvey SB, Modini M, Joyce S, Milligan-Saville JS, Tan L, Mykletun A, et al. Can work make you mentally ill? A systematic meta-review of work-related risk factors for common mental health problems. *Occup Environ Med*. 2017;74(4):301-10.
49. Milner A, Scovelle AJ, King TL, Madsen I. Exposure to work stress and use of psychotropic medications: a systematic review and meta-analysis. *J Epidemiol Community Health*. 2019;73(6):569-76.
50. Shoman Y, El May E, Marca SC, Wild P, Bianchi R, Bugge MD, et al. Predictors of Occupational Burnout: A Systematic Review. *Int J Environ Res Public Health*. 2021;18(17).
51. Theorell T, Hammarstrom A, Aronsson G, Traskman Bendz L, Grape T, Hogstedt C, et al. A systematic review including meta-analysis of work environment and depressive symptoms. *BMC Public Health*. 2015;15:738.
52. Lamiani G, Borghi L, Argentero P. When healthcare professionals cannot do the right thing: A systematic review of moral distress and its correlates. *J Health Psychol*. 2017;22(1):51-67.
53. Aronsson G, Theorell T, Grape T, Hammarström A, Hogstedt C, Marteinsdottir I, et al. A systematic review including meta-analysis of work environment and burnout symptoms. *BMC Public Health*. 2017;17(1).
54. Nyberg A. Det goda chefskapet. I Döös M, Waldenström K, eds. *Chefskapets former och resultat. Två kunskapssammanställningar om arbetsplatsens ledarskap*. Stockholm: VINNOVA; 2008.
55. Nyberg A. Destructive Leadership – Processes and Consequences. I Romanowska J, Nyberg A, Theorell T, eds. *Developing leadership and employee health through the arts*. Switzerland: Springer International Publishing; 2016. pp. 55-97.
56. Nyberg A, Rajaleid K, Demmelmaier I. The Work Environment during Coronavirus Epidemics and Pandemics: A Systematic Review of Studies Using Quantitative, Qualitative, and Mixed-Methods Designs. *Int J Environ Res Public Health*. 2022;19(11).



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