**Protocol for a systematic review of relative risks for Covid-19 related to working within occupational sectors where workplace attendance is essential**

**Introduction**

Risk of SARS-CoV-2 infection has been strongly linked to occupation, with specific occupational sectors such as health care(1), social care(2), food production, construction(3) and transport(1), thought to be particularly affected. There is debate around whether or not Covid-19 should be classified as an occupational illness (4)

Risk of SARS-CoV-2 infection will vary by level of exposure and there are various workplace features that are likely to increase exposure to the virus. One key exposure variable is contact with or being in the vicinity other people, and several sources have aimed to classify occupations according to the number, proximity and type of contacts (5). Other factors thought to be related to workplace exposure include ventilation, temperature, commuting and outdoor working. Mitigation factors have been put into place in many workplaces to reduce these exposures such as facemasks, Personal Protective Equipment (PPE), homeworking arrangements, screens and onsite testing but their use is varied and so their effectiveness remains unclear (6-8). To add to the complexity, occupational risks are likely to be confounded by factors outside the workplace such as ethnicity, housing, and social behaviour (9, 10).

To better understand the potential risks by occupational sector we will investigate the reported relative risks of Covid-19 infection, mortality and related outcomes for employees in employment sectors where remote working is known to be difficult or impossible.

**Methods**

We will perform a systematic review of observational studies reporting Covid-19 risk for employees categorised by job type or sector, with a particular focus on sectors where workers have been present in the workplace throughout the majority of the Covid-19 pandemic, as these are the sectors where workplace transmission is most likely to have taken place. We expect to see two main types of studies (a) broad overviews of occupational risks reporting data on multiple occupations or sectors (b) studies that focus on one or two key occupations or sectors (e.g. healthcare workers). All studies published in the peer-reviewed, pre-print and other literature from March 2020 onwards will be considered. This would include reports from Government Departments and Agencies.

**Research questions**

**Primary**

Is there an increased risk of Covid-19 mortality and other health-related outcomes for workers in sectors with essential workplace attendance compared to other workers or the general population? Which work sector has the greatest increased risk?

**Secondary**

How do any increased risks vary by stage of pandemic?

How do increased risks relate to mitigation/control measures in place?

How do any increased risks vary for subgroups within each sector?

**Inclusion criteria**

We will include any study that met the following criteria in terms of population, exposure, comparator and outcome;

Types of study: Prospective or retrospective observational studies including longitudinal cohorts, cross sectional studies, case-control studies, or population registry studies. Randomised controlled trials of interventions will not be included. We will only include studies where the focus is on occupational risks, we will not include studies with another focus that measure occupation as a demographic or adjustment variable.

Population: Any population that includes adults of working age from any country.

Exposure: Any classification of workplace or sector where workplace attendance could be considered ‘essential’. This would include occupations classified as ‘keyworker’ ‘essential worker’ or similar using any definition applied by the authors.

For the sector specific synthesis we will focus on groupings using the sectors listed in Table 1 where working from home is difficult/impossible. We will accept any definition of these sectors as defined by study authors. Where a study reported data on multiple different job titles within at least one of the sectors of interest, we included it and looked for all relevant job titles. Where sector groupings are combined with other sectors (e.g. food production and agriculture) or a grouping straddles multiple sectors (e.g. food delivery drivers) we will include the study and record the definition of the grouping used. These groupings follow largely the detailed groupings used by Mutambudzi et al. (11) but with the addition of ‘Construction’ because this sector is of particular interest to the review team (as part of the PROTECT UK National Core Study (https://sites.manchester.ac.uk/covid19-national-project/).

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| Sector | Description |
| Healthcare | Healthcare professionals, other healthcare associate professionals and medical support staff. |
| Social care | Staff involved in residential, day care, community care, welfare services. Social workers, clergy and undertakers. |
| Food | Workers involved in food production, storage and retail. |
| Construction | Building, building supplies and associated trades. |
| Transport | Drivers, management and support staff involved in transport and distribution. Postal workers. |
| Education | Teachers, lecturers and support staff in any educational setting. |
| Police and protective services | Police, Fire, prison, security, refuse. Cleaning services. |

Comparator: Any relevant comparator that allows an assessment as to whether or not working in the occupational sector elevates the risk of Covid-19 outcomes. This includes other occupational groups, the general population, or the same occupational group prior to the Covid-19 pandemic.

Outcome: Covid-19 infection (using any degree of severity or definition as defined by study authors), Covid-19 antibodies relating to a previous infection, death relating to Covid-19 (including measures of excess mortality), hospitalisation due to Covid-19 or diagnosis of long Covid. We will include only studies that reported the likelihood of a Covid-19 outcome relative to another occupational group or the general population using either an odds ratio, relative risk or hazard ratio (i.e. relative risks) or that will allow the calculation of this (e.g. prevalence estimates in each sector). We will exclude outcomes relating to Covid-19 workplace outbreaks.

Type of study: Any observational study suitable for answering our research question (e.g. case-control study, cohort study, cross-sectional)

**Search strategy**

We searched the following sources for relevant studies

1. A comprehensive literature search using Ovid Medline and Web of Science (see search terms in appendix).
2. Studies cited by any articles identified in the literature search
3. Studies listed in the UK SAGE report on ‘COVID-19 Risk by Occupation and Workplace’
4. Studies listed in the UK Industrial Injuries Advisory Council Report reviewing the available evidence concerning the risks of contracting COVID-19 in occupational settings
5. Studies collected in a repository of research relating to COVID-19 and occupation by researchers working on the PROTECT project

**Screening**

Initially titles and abstracts will be screened for inclusion. A sample of at least 50 titles will be double screened for each reviewer, to ensure consistency, and the remainder will be single screened.

Full texts will be reviewed for inclusion by two reviewers. We will use a consensus method to reconcile any discrepancies, using a 3rd reviewer to settle any disagreements that remain after discussion.

Covidence will be used to manage both stages of screening.

**Data extraction**

We will create a data extraction template which we will pilot on two papers before finalising. We will use double data extraction with 2 researchers independently extracting data and entering into Covidence. We will use a consensus method to reconcile and discrepancies, using a 3rd reviewer to settle any disagreements that remain after discussion.

For the broad overviews of occupational risks reporting data on multiple occupations or sectors we will extract a short summary of their main findings.

For each included study, we will extract data on the design, data source, definition of sector groupings, time period (for pandemic wave), definition of the outcome measure, type of publication, reference category, country, population, any information on restrictions/mitigation measures (including vaccines), any information on variants and adjustment variables. We will also extract data on the number of participants per group and any relevant sector specific relative effect measure with either a 95% confidence interval and/or standard error. Where relative risks were adjusted for multiple different sets of adjustment factors we will extract the one that adjusted for the greatest number of variables, noting what the adjustment factors were. We will consider the adjustment set when assessing study quality. Where necessary, relative risks (or similar) and confidence intervals will be estimated from graphical displays. Where a study has not reported relative effect but has reported sufficient detail to enable us to calculate a relative effect (e.g. number of cases and population in both sector groups and a relevant reference group) we will calculate the relative effect and confidence interval. Where studies report relative estimates separately for different sub-groups or time periods we will extract all relevant measures.

**Narrative overview**

For the broad overviews of occupational risks reporting data on multiple occupations or sectors we will provide a tabulated narrative review on their findings in terms of which occupations/sector groupings appeared to show the greatest increased risk.

**Statistical Methods for sector specific synthesis**

We will present relative risks and 95% confidence intervals on a forest plot, with a separate plot for each sector listed in table 1. Due to expected heterogeneity in outcome definition, comparator, population, stage of the pandemic and sector definition we will not combine results. Relative risks will be our preferred effect measure. We will not convert effect measures to the same scale (e.g. odds ratios to relative risks) due to uncertainties in estimates of control group risk, however hazard ratios and odds ratios may be considered to be estimates of relative risks under certain conditions. All plots will be produced using the *metan* function in STATA 14.0. We will produce a separate plot for each sector, and grouped results by type of outcome, summary measure and study design to enable comparison and triangulation. We will produce 3 sets of forest plots per sector

1. Overall result from each study (using combined results from each study where possible)
2. Results including any sub-groups by time period/length of follow-up
3. Results including any available subgroup data by demographic or workplace factors (e.g. patient facing v non patient facing)

**Outputs**

We plan to publish the protocol and extracted data on Figshare. We plan to publish our main findings in a peer reviewed open access journal.

**Appendix 1**

Searches to be repeated monthly up to initial publication, and 6 monthly after that.

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions(R) <1946 to September 13, 2021>

1 (COVID-19 or SARS-COV-2 or CORONAVIRUS).tw.

2 (occupation\* or worker\* or workplace\* or workforce or industry or job\* or employment).tw.

3 (death\* or fatal\* or risk\* or infection\* or mortality or case\* or hospitali#ation\*).tw.

4 1 and 2 and 3

5 limit 4 to (english language and yr="2020 -Current")

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