Public Health England

Protecting and improving the nation's health

Face coverings in the community and COVID-19

A rapid review (update 1)

Contents

Main messages

1. The purpose of this rapid review is to identify and examine new evidence on the role of face coverings in relation to COVID-19 transmission. This review includes 31 studies (8 preprints). It is an update of an earlier rapid review in which 15 studies (7 preprints, 4 now published) were included (7 observational and 8 laboratory, original search date: 25 March to 5 June 2020). From the updated search (5 June to 22 September 2020) 16 new studies were identified (10 observational studies (5 preprints) and 6 laboratory studies). Modelling studies were excluded from the update as more observational studies were available.
2. Seventeen observational studies examined the effectiveness of face coverings. These studies consistently reported that the use of face coverings in the community reduced the spread of COVID-19. The studies used varied methods and were from diverse geographical regions including the US, Europe and Asia.
3. Most studies examined the effects of a national or regional face coverings policy, and limited evidence from specific community settings was identified. Face covering interventions were typically implemented alongside other interventions (for example, 'stay at home' measures) or behaviours (for example, social distancing), and whilst some studies considered this in their analysis it is possible that factors other than the use of face coverings influenced the results. As a result, the effectiveness of face coverings if used in isolation from other interventions and behaviours is unclear.
4. The observational studies are mostly ecological, so in addition it is not possible to determine i) the extent to which the protective effect may be due to source control, wearer protection and/or a combination of both or ii) the effects of different types of face coverings.
5. Fourteen laboratory simulations provided mechanistic evidence that various types of face coverings can filter droplets and aerosols to some extent, and that medical masks may offer better protection than fabric alternatives provided they fit well. Only three of these studies investigated human participants. Notably, none of these simulations used SARS-CoV-2 in their experiments.
6. Further studies of higher quality are needed to corroborate these findings on face coverings, to assess the contribution of face coverings to reducing community transmission relative to other interventions (such as reduced social contact and social distancing) and to determine the effectiveness of face coverings within specific community settings, that is, public transport. The evidence will continue to be monitored.

Background

Medical (also known as surgical) face masks play a role in controlling infection in clinical settings when used as part of a comprehensive package of infection control measures, such as hand hygiene and social distancing practices. The World Health Organization (WHO) have issued guidance that governments should encourage the general population to wear masks in specific situations and settings and as one part of a comprehensive approach to reducing transmission of COVID-19. Specifically, the guidance advises that in areas with community transmission of COVID-19 non-medical masks should be used by the general population in public settings, and medical masks should be used by certain vulnerable groups, where social distancing cannot be achieved, based on levels of risk (1).

Medical masks are intended to be worn by healthcare staff in order to protect patients, and must meet the design and safety requirements of the European Commission's Medical Device Regulations (MDD/MDR) (2). Non-medical masks, also called 'face coverings' (1) are typically made of fabric or cloth, can be homemade or commercially produced, and may be reusable or disposable. Face coverings are thought to reduce respiratory virus transmission largely through intercepting and limiting the spread of virus-laden droplets produced by the mask wearer ('source control', and this is how they have traditionally been used in healthcare settings) and, to a lesser extent, filtering the air the mask-wearer inhales ('wearer protection') (3). The WHO guidance acknowledged that fabric face coverings vary in quality and are not tested so are not considered an appropriate alternative to medical masks for wearer protection of healthcare workers, and therefore should only be considered as source control in community settings, for specific activities where social distancing may not always be possible (for example, on public transport) (1).

In England, a face covering is defined as '…something which safely covers the nose and mouth'. Current regulations (with some exemptions) mandate the use of face coverings by the general public in most indoor public settings, including shops and supermarkets, and on public transport (4) and for some staff in public facing roles.

During the early stages of the COVID-19 pandemic evidence examining the effectiveness of face coverings in community settings was largely drawn from the use of medical masks in reducing transmission of influenza and other coronaviruses (specifically Severe Acute Respiratory Syndrome-CoV-1, SARS-CoV-1 and Middle East Respiratory Syndrome, MERS). The evidence for their effectiveness was inconclusive, although this could have been because it was derived from different settings (pandemic versus non-pandemic contexts) and based on different types of studies. Some systematic reviews and meta-analyses reported that face coverings were ineffective in reducing the transmission of influenza within the community (5,6) or concluded that the evidence was not strong enough to support their widespread use (7). However, others deduced that face coverings may be effective in reducing transmission of respiratory infections (8,9). It was also suggested that the protective effects were increased when face coverings were worn by both the infectious individual and the secondary contact thereby combining wearer protection and source control (7). None of these early reviews identified studies directly related to COVID-19.

Due to the rapid availability of new studies and the potential role of face coverings in tackling COVID-19, a rapid review (10) was conducted to identify new studies with a focus on the use of face coverings within community settings in the context of COVID-19. In relation to effectiveness, evidence suggested that face coverings may reduce transmission of COVID-19, but the evidence was limited and weak due to a reliance on modelling studies, preprints, and potential bias in observational studies. A further similar review also scored the quality of evidence as low (11), although others have gone further and reported a lack of sufficient evidence (12). Given the lack of evidence on effectiveness, there was a need to also examine potential efficacy of different types of face coverings when tested under controlled conditions. Overall, laboratory studies provided mechanistic evidence that materials such as cotton or polyester might block droplets with a filtering efficiency similar to medical masks when folded in 2 or 3 layers (10). Whilst other researchers have published systematic and rapid reviews over recent months on this topic, their searches have covered the same (or an overlapping) time period as our previous review (13,14) and some have extended inclusion to either healthcare settings (15) or other respiratory infections (16,17). This, alongside delayed publishing, has resulted in different numbers and types of studies being reviewed. As a result, and with new evidence continuing to be generated, an update of this review was required.

Objective

This is an update of a previous rapid review (10). The purpose of this review was to identify and assess direct evidence from the COVID-19 outbreak on:

1. the effectiveness of face coverings when used in the community, and
2. the efficacy of different types of face coverings

Where studies are designed to measure the effectiveness or efficacy of face coverings for either wearer protection or source control, or both, this is reported.

Definitions

‘Community’ refers to non-healthcare settings, including (but not limited to) public spaces, households, shops, and public transport.

‘Face coverings’ are broadly defined as any type of face covering that covers the mouth or nose (including medical masks and other types of face covering). Where specific types of face covering are reported, this will be specified.

'Wearer protection' refers to protection conferred to the wearer through reducing their exposure to the virus. 'Source control' refers to the reduction in virus emitted from an infectious individual which may confer protection to others.

Methodology

This report employed a rapid review approach to address the review questions. Literature searches were undertaken to identify primary evidence related to the COVID-19 outbreak, published (or available as preprint) between 25 March and 22 September 2020. The 25 March was selected to supplement searches conducted by Chu and others (8) on this date as part of a comprehensive systematic review in which no studies on COVID-19 were identified.

The initial search conducted as part of the original review (10) (see Figure A.1 for PRISMA) was conducted on 5 June 2020. This search was updated as part of a broader review on face coverings (including face shields) on 22 September 2020 (see Figure A.2 for PRISMA). The evidence on face shields is reported separately. This review reports on evidence identified through both searches.

Studies comparing the effectiveness of medical masks as compared with N95 respirators (which are designed purely for surgical use), studies examining use of medical masks in healthcare settings, and studies focusing solely on face covering compliance were excluded. Modelling studies were also excluded from this update given the likelihood that further observational studies were expected to have been conducted.

Full details of the methodology are provided in Annexe A. A protocol was produced a priori and is available in Annexe C.

Evidence

Search results

The original search returned 1,063 records and one additional paper was identified by searching reference lists of relevant systematic reviews. After removal of duplicates, 626 records were screened by title and abstract. Of these, 57 full-text articles were assessed for eligibility and 28 were included in the review. In this review update, following exclusion of 13 modelling studies, 15 studies were eligible for inclusion: 7 observational studies (mainly ecological) and 8 laboratory studies. From the original search, 7 of the 15 articles were preprint (not peer-reviewed), although 4 of these have since been published. The PRISMA for the original search is provided in Figure A.1.

On 22 September 2020, the update search returned 2,919 records and one additional paper was identified via routine evidence monitoring. After removal of duplicates, 2,032 records were screened by title and abstract. Of these, 179 full-text articles were assessed for eligibility and 16 were included in this review: 10 were observational studies (mainly ecological) and 6 were laboratory studies; 5 of the 16 articles were preprints (not peer-reviewed). The PRISMA for the update search is provided in Figure A.2.

In total, 31 studies are included in this review: 17 observational studies provide evidence for the first review question, while 14 laboratory studies provide evidence for the second review question.

Question 1. What is the effectiveness of face coverings to reduce the spread of COVID-19 in the community?

Evidence from observational studies (Table B.1)

Evidence on the effectiveness of face coverings to reduce the spread of COVID-19 in the community was provided by 17 observational studies. None reported on the adherence or type of face covering used within each population. Of these, 12 were population-level ('ecological') studies where the unit of observation was the population (18 to 29), 3 were individual-level studies and 2 were descriptive (6 were preprints (18 to 20,22 to 24)). A comprehensive summary of all studies, containing more information on study designs and biases, methods used, more detailed findings, and attempts to adjust for confounding is provided in Table B.1.

Population-level studies

In the previous review, data from 5 ecological studies suggested that the use of face coverings in community settings may be effective in reducing the spread of COVID-19 (23,24,27 to 29), however this evidence was considered limited and weak due to the small number of studies available, risk of bias and residual confounding associated with the ecological study designs and a reliance on modelling studies of which many were preprints. Most of the ecological studies had been conducted at community level in Asia, or at country level, and it was thought that cultural differences may have limited the transferability of results to the UK population, for example, in relation to acceptability of face covering use in the community (as Asian populations had prior experience of infectious disease outbreaks and thus an embedded culture of masking).

Of the 7 ecological studies unique to this update; one study used inter-country comparisons (19); 4 compared states or regions within the United States (US) (21,22,25,26); and 2 were based on European populations examining regional differences within Italy (20) and Germany (18). These studies typically considered 'effectiveness' of face coverings in the community in relation to implementation of policies mandating the use of face coverings (from herein 'face covering policy'), or guidelines encouraging their use, compared with no policy or guideline. Full details of these studies can be found in Table B.1. Consistent with our previous review, the ecological studies reported reductions in levels of COVID-19 with increased use of face coverings.

A cross-sectional analysis (preprint) comparing the use of face coverings across 24 countries (including Asian and European countries) reported that widespread self-reported use of face coverings in public places was associated with an expected 7% (95% CI 4-8%) decline in the daily COVID-19 growth rate (19).

Three US-based studies examined the effectiveness of face coverings by comparing states (or counties) with a face covering policy in place with those without such a policy. All 3 studies consistently found that face covering policies in public places were beneficial against the spread of COVID-19, although some inconsistencies in findings were reported when policies targeted employment settings only. A study of the 15 US states with highest prevalence of COVID-19 reported a slower increase in levels of COVID-19 in 7 of 9 states following the introduction of a face covering policy compared to 6 states with no policy (25), the most significant slowing was observed in the 2 states with stricter enforcement measures. These analyses appear to be unadjusted for confounding factors, but in the remaining 2 states with face covering policy, the faster increase in levels of COVID-19 was thought to be a consequence of mass gatherings, protests and an increase in testing all of which occurred at the same time. A further study compared 16 regions with a face covering policy in public places and 20 states where face covering policies were only directed towards some employees (for example, barbers) to 15 states with no face covering policy (26). This study found a reduction in daily new COVID-19 cases when face covering policies were directed at the public, but not when policies were for employees only, compared to states with no policy. However, another study found that face covering policy for employees only did reduce the growth rate of infections and deaths by an estimated 9% to 15% (21). Differences in methods used to calculate rates of COVID-19 infections (daily vs weekly) and to compare regions (direct comparison vs pre-post mandate changes for each region first) may explain these different findings.

A fourth US-based study, Radar and others (22) examined self-reported wearing of face coverings, and similarly found a significant association between the percentage of reported use of face coverings and community transmission control (that is, reproduction number at a specific timepoint, Rt value of less than 1) where a 10% increase in the use of face coverings was associated with more than 3-times the likelihood of achieving transmission control. Increased use of face coverings was independent of face covering policy and was found to have started earlier, indicating that policy alone may not be the only driver of increased use of face coverings.

Two European-based ecological studies had been reported. One was conducted in 8 demographically similar regions of Italy (preprint) and identified significant reductions in COVID-19 transmission in 4 of 5 regions with face covering interventions (face coverings policy (2 regions) or distribution of free face coverings (2 regions)) that did not occur in the 2 control regions (20). The other study compared the first region in Germany to introduce face coverings

(Jena, when no other public health measures had been introduced or eased) with an artificial control region (18) and found that the early introduction of face coverings in Jena led to 13% and 23% lower number of COVID-19 cases after 10 and 20 days (respectively) post intervention, after controlling for other factors likely to effect spread and dynamics of COVID-19 cases. Regions that introduced face coverings later in the pandemic showed an average 2.3% reduction after 10 days, which was higher in a subgroup of larger cities (4.2%). The lower effect was thought to be because behavioural changes such as wearing of face coverings had already started to occur in the other regions before the formal introduction of face covering policies.

Ecological studies, such as those described here, can be particularly useful for evaluating changes in health policy, as any observed association measured at the population level will include direct and indirect impacts of the policy. For example, additional changes in behaviour associated with increased awareness, that also serve to reduce or increase transmission, and aspects such as compliance. However, there are major drawbacks to ecological study designs, so although a useful starting point in answering this question (as relatively quick and cheap to run), findings must be viewed with caution. The main limitation is that populations often differ in many ways other than the use of face coverings and the number of COVID-19 cases: mandated face covering policies were often not implemented in isolation, so may be highly correlated with other transmission-control policies (for example, ‘stay at home’ measures) which are also likely to have impacted transmission rates. Four studies controlled for community mobility (that is, movements or travel to different places outside of the home) and reported a beneficial effect of face coverings (21,22,27,28), however residual confounding is likely. Most studies either adjusted for other confounding factors (19,21 to 24,28) or used comparable populations, (18,20,25 to 27) but alternative explanations for reductions in COVID-19 transmission cannot be ruled out. The other main limitation of ecological studies is that results seen at the population level may not apply at an individual level, so inferences about the relationship between use of face coverings among individuals and transmission cannot be made. As with all observational studies, measurement error may bias the results.

Main findings: there is consistent evidence from ecological studies that policies mandating the use of face coverings in communities may be effective in reducing transmission of COVID-19, although evidence was inconsistent when targeting employees only. Studies have now been conducted in Europe, the US and Asia, although direct evidence from the UK continues to be lacking. A limitation with ecological studies is that populations may differ in ways other than their use of face coverings, and even with attempts to control for confounding in study design and analyses, there may be residual confounding and risk of bias.

Individual-level studies

One retrospective cohort study, included in the previous version of this review, investigated secondary attack rates (the probability that infection occurs among susceptible people) in households in Beijing (30). Whilst this study reported wearing of face coverings to be effective in reducing transmission, this was only measured in the home, and it was not possible to distinguish between the effects of wearer protection and source control (and was limited to one study).

New to this update, are 2 analytical studies where the unit of observation was the individual, both conducted in Asia; one retrospective case-control study in Thailand (31) that investigated 1050 secondary contacts and one retrospective cohort study in China (32) that investigated 197 secondary contacts. Both studies followed individuals who had been in close contact with someone later confirmed to have had COVID-19 to investigate the effect of face coverings on limiting transmission. The Thai retrospective case-control study reported on the use of face coverings by the contacts, therefore in relation to wearer protection, and found lower odds of COVID-19 transmission when the face covering was worn for the duration of the contact compared to not wearing a face covering (adjusted odds ratio [OR] = 0.23, 95% confidence interval [CI]: 0.09 to 0.60). However, no such association was identified when contacts reported 'sometimes' wearing a face covering (31). The Chinese retrospective cohort study examined the use of face coverings by the infectious individual, therefore in relation to source control, and found that significantly fewer close contacts developed COVID-19 ($p < 0.001$) (32).

The results of these studies may be influenced by selection bias (for example, participation in the questionnaire, or testing was voluntary, and volunteers may not be representative of the population); and recall bias although structured interviews were used to try and limit this. Stigma associated with not wearing a face covering in transmission studies could have led to inaccurate reporting. Both of these types of biases could influence the results in either direction (reporting either an increased or decreased effect compared with the true effect). Additional contact with individuals with COVID-19 that were not part of the study could have led to COVID-19 transmission (as opposed to contact with cases identified within the study). If COVID-19 transmission is associated with wearing of face coverings outside of the study, this could lead to an apparent greater effect estimate than is true (however this would only be seen if face coverings remained protective to some extent).

Main findings: Three studies suggest that masks may reduce transmission of COVID-19, both as wearer protection and as source control (1 study each, 1 both), but this is based on small studies. Methods used to conduct the studies may mean that other factors influenced the results.

Descriptive studies

One descriptive case report from Iran was included in the previous version of this review (33). This case-report was judged as being at high risk of bias, and results could not be relied upon. One descriptive study is new to this update: A US investigation of transmission associated with a hairdresser's in Missouri observed retrospectively that no transmission of COVID-19 had occured from 2 symptomatic hair stylists wearing face coverings and 139 clients they had interacted with whilst symptomatic (34). The salon operated a mandatory face covering policy suggesting that face coverings were effective as either source control and/or wearer protection. However, only half of clients agreed to be tested and clients who had visited the salon while the hair stylists were presymptomatic were not followed up – it is possible that individuals not tested went on to develop COVID-19 (34). As this study has low response rate and no control group, it is judged as being very low quality and at very high risk of bias, therefore does not add meaningfully to the analytical evidence already described.

Q2. What is the efficacy of different types of face coverings designed for use in community settings?

Evidence from laboratory studies (Table B.2)

Evidence on the efficacy of different types of face coverings was provided by 14 laboratory studies, of which one is a preprint (35). A comprehensive summary of all studies is provided in Table B.2. Eight of these studies were synthesised in the previous review. There was considered to be limited and weak evidence to suggest that 2 or 3 layers of materials such as cotton and polyester might block droplets with a filtering efficiency similar to medical masks. Due to the heterogeneity between studies, including differences in testing methods, aerosol generations, materials used, information provided on the material, it was not possible to directly compare the results between studies, nor to reliably assess the efficacy of each material as a function of the number of layers. Overall, laboratory studies provided mechanistic evidence that materials such as cotton and polyester can block droplets reasonably well and that 2 or 3 layers of cotton (high density), polyester (or a mix of both such as in a T-shirt), silk, chiffon, flannel, or combinations of these materials, might provide similar filtering efficiency to commercial medical masks. Even though these studies have been conducted, or at least published, during the COVID-19 outbreak, they do not constitute direct evidence from COVID-19 as none of them assessed the efficacy of different cloth masks with participants infected with SARS-CoV-2.

New evidence from laboratory studies

Six new laboratory studies were identified to address the efficacy of different types of face coverings (36 to 41). The studies were conducted by laboratories in the United States of America (36,38 to 41) and Germany (37). Four studies used conventional fluid mechanics or respirator-testing approaches (37 to 39,41), one study used custom-built aerosol-generating apparatus (40) designed to simulate the production of larger aerosols by coughing, and 3 studies incorporated human participants wearing face coverings into at least part of their design (36,37,39). Various materials were tested: 2 studies tested materials obtained from commercially available masks (36,39); 3 studies predominantly tested commonly-available household materials and fabrics (38,40,41); and one study tested both masks and household materials (37). Different combinations of materials have been assessed including water-absorbing (hydrophilic) materials and material that does not easily absorb liquid (hydrophobic). All 6 studies included medical masks for comparison, see Table B.2 for specifications of the masks used in each study.

Different fabrics varied in their ability to filter droplets and/or aerosols of different sizes. Most studies that compared masks to other coverings found that medical masks offered better protection than other material face-coverings. Combining multiple layers of different materials seemed to improve filtration efficiency across the range of particle sizes and decreased the chance of large droplets produced by a cough being dispersed (36,38 to 41). Mask fit was considered an important determinant of filtration efficiency (to minimise leakage) (37,39); one study suggested that masks can be improved by the addition of a nylon stocking overlayer, and that cone shaped masks worked better than medical-style masks (39). Repeated washing and wearing of masks was reported to reduce their filtration efficiency but this was dependent on the material used (38,40).

Data presented in these studies were obtained under idealised laboratory conditions, as opposed to real-life settings where other factors may influence results. Only 2 of these studies (37,39) considered the effect of mask fit on performance whereas the majority were conducted under conditions designed to minimise air leakage. In addition, the 3 studies (36,37,39) that incorporated human participants into their testing strategy only used 4 people or less.

Whilst these studies have been conducted during the COVID-19 outbreak and with a focus on application to COVID-19, none have assessed the efficacy of different cloth face coverings with participants infected with SARS-CoV-2.

Main findings: All face covering materials tested were deemed to offer some protection through filtration of aerosol and droplet transmission compared with no barrier at all, and mouth-and-nose cover reduced droplet spread from the wearer. However all evidence derives from laboratory conditions and only simulates the SARS-CoV-2 virus, so may not take into account real-life conditions in the community.

Limitations

The literature search for this review update now spans 6 months of studies published between 25 March and 22 September 2020. The evidence remains limited to observational studies and laboratory studies, for questions 1 and 2 respectively, but is stronger than our previous rapid review given that there are more studies. In addition the evidence for question 1 is now based on more observational studies (as opposed to modelling) with the majority now having been published (23 out of 31 publications). The 8 preprints should be considered of uncertain value as they have not been peer reviewed, nor subject to publishing standards and may be subject to change. As with all reviews, the evidence identified may be subject to publication bias, whereby null or negative results are less likely to have been published by the authors. There were insufficient included studies to be able to evaluate this.

Overall the studies identified are limited based on their design (no intervention studies; risk of bias and residual confounding in observational studies; and laboratories studies that provide only theoretical evidence). This limits the strength of conclusions that can be drawn. Whilst effort has been made to highlight known sources of bias, a formal risk of bias or quality assessment tool has not been used due to rapid methods. In addition, the evidence has not been graded meaning it has not been possible to describe the strength of evidence in a transparent way.

Finally, multiple other factors play an important role in the effectiveness and efficacy of face coverings including the safe handling of face coverings, the impact of face covering use on other behaviours (such as social distancing), and the extent to which a face covering fits. A broader understanding of these factors would help in interpreting the evidence.

Conclusion

The findings presented in this review are stronger than in the previous review, due to the fact that more studies have been identified from multiple different settings, there are fewer preprints, a reduced reliance on modelling studies (which were excluded from this update) and many of the observational studies have attempted to reduce bias in their design and confounding in their analyses.

Consistent evidence from observational studies indicates that community-wide use of face coverings may reduce the spread of COVID-19 when initiated at various stages of the pandemic. Due to the nature of the evidence, it is not possible to determine if the protective effect is due to source control, wearer protection or both. Although the ecological studies do not measure compliance or the effectiveness of different types of face coverings at an individual level, one advantage of population-based studies is that they can evaluate combined direct and indirect effects of the introduction of face covering policies, as well as the wearing of face coverings among both infectious individuals and contacts. There is more heterogeneity in design of ecological studies in this review: evidence in the previous review was limited to community-level studies within Asia and inter-country comparisons, whereas this review supplements these two designs with inter-state comparisons within America and inter-regional studies within Europe (Italy and Germany). These studies may be vulnerable to different biases or be influenced by other factors (confounding) however they are still fairly consistent in their findings. The retrospective case-control and cohort studies provide some evidence for the effectiveness of face coverings when worn by a contact of a COVID-19 case or infectious individual respectively on reducing transmission of COVID-19.

Evidence from laboratory studies on the efficacy of different types of face coverings (15 studies in total), although more plentiful, remains weak, and consists of simulations only, with only 3 using a small number of human test subjects. Despite heterogeneity in method design, testing and materials used, findings were mainly consistent, reporting that face coverings of varying materials are more effective than no covering, and multi-layered coverings more effective than single-layer. In terms of comparisons of home-made to surgical/medical-grade masks, most found the latter to have higher efficacy, whereas some studies found no difference.

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Annexe A: Methodology

Literature search

This report employed a rapid review approach to address the review questions:

1. What is the effectiveness of face coverings when used in the community?
2. What is the efficacy of different types of face coverings for use in community settings?

Protocol

A protocol was produced by the project team a priori, specifying the research question and the inclusion and exclusion criteria. The protocol is available in Annexe C.

Sources searched

Ovid Medline, Ovid Embase, medRxiv, WHO COVID database and arXiv.

Search strategy

Searches were conducted for papers published between 25 March 2020 and 22 September 2020. An initial search was conducted on 5 June 2020 (original search) focused specifically to identify studies on face coverings. This was then updated as part of a broader review on face coverings and face shields/visors on 22 September 2020 (update search). The evidence on face shields and visors is reported separately.

Search terms covered main aspects of the research question, including terms related to the intervention. The search strategies used for Ovid Medline are presented below for both the original search and the update search.

Search strategy Ovid Medline (original search)

1. mask*.tw,kw.
2. (face-mask* or facemask*).tw,kw.
3. ((face or head) adj2 cover*).tw,kw.
4. (face-cover* or facecover*).tw,kw.
5. (cloth* adj2 (cover* or protect*)).tw,kw.
6. physical barrier*.tw,kw.
7. physical intervention*.tw,kw.
8. non-pharmaceutical.tw,kw.
9. (mouth adj2 (cover* or protect*)).tw,kw.

10. (nose adj2 (cover* or protect*)).tw,kw.
11. Masks/
12. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13. exp coronavirus/
14. exp Coronavirus Infections/
15. ((corona* or corono*) adj1 (virus* or viral* or virinae*)).ti,ab,kw.
16. (coronavirus* or coronovirus* or coronavirinae* or CoV or HCoV*).ti,ab,kw.
17. (2019-nCoV or 2019nCoV or nCoV2019 or nCoV-2019 or COVID-19 or COVID19 or CORVID-19 or CORVID19 or WN-CoV or WNCoV or HCoV-19 or HCoV19 or 2019 novel* or Ncov or n-cov or SARS-CoV-2 or SARSCoV-2 or SARSCoV2 or SARS-CoV2 or SARSCov19 or SARS-Cov19 or SARSCov-19 or SARS-Cov-19 or Ncovor or Ncorona* or Ncorono* or NcovWuhan* or NcovHubei* or NcovChina* or NcovChinese* or SARS2 or SARS-2 or SARScoronavirus2 or SARS-coronavirus-2 or SARScoronavirus 2 or SARS coronavirus2 or SARScoronovirus2 or SARS-coronovirus-2 or SARScoronovirus 2 or SARS coronovirus2).ti,ab,kw.
18. (respiratory* adj2 (symptom* or disease* or illness* or condition*) adj10 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.
19. ((seafood market* or food market* or pneumonia*) adj10 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.
20. ((outbreak* or wildlife* or pandemic* or epidemic*) adj1 (Wuhan* or Hubei or China* or Chinese* or Huanan*)).ti,ab,kw.
21. or/13-20
22. 12 and 21

Search strategy Ovid Medline (update search)

1 exp coronavirus/
2 ((corona* or corono*) adj1 (virus* or viral* or virinae*)).ti,ab,kw.
3 (coronavirus* or coronovirus* or coronavirinae* or Coronavirus* or Coronovirus* or Wuhan* or Hubei* or Huanan or "2019-nCoV" or 2019nCoV or nCoV2019 or "nCoV-2019" or "COVID-19" or COVID19 or "CORVID-19" or CORVID19 or "WN-CoV" or WNCoV or "HCoV-19" or HCoV19 or CoV or "2019 novel*" or Ncov or "n-cov" or "SARS-CoV-2" or "SARSCoV-2" or "SARSCoV2" or "SARS-CoV2" or SARSCov19 or "SARS-Cov19" or "SARSCov-19" or "SARS-Cov-19" or Ncovor or Ncorona* or Ncorono* or NcovWuhan* or NcovHubei* or NcovChina* or NcovChinese*).ti,ab,kw.
4 (((respiratory* adj2 (symptom* or disease* or illness* or condition*)) or "seafood market*" or "food market*") adj10 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.
5 ((outbreak* or wildlife* or pandemic* or epidemic*) adj1 (China* or Chinese* or Huanan*)).ti,ab,kw.
6 "severe acute respiratory syndrome*".ti,ab,kw.
7 or/1-6
8 visor*.tw,kw.
9 faceshield.tw,kw.

10 (face adj5 protect*).tw,kw.
11 (face adj5 shield*).tw,kw.
12 (face adj5 barrier*).tw,kw.
13 shield.tw,kw.
14 vizor*.tw,kw.
15 mask*.tw,kw.
16 (face-mask* or facemask*).tw,kw.
17 ((face or head) adj2 cover*).tw,kw.
18 (face-cover* or facecover*).tw,kw.
19 (cloth* adj2 (cover* or protect*)).tw,kw.
20 physical barrier*.tw,kw.
21 physical intervention*.tw,kw.
22 non-pharmaceutical.tw,kw.
23 (mouth adj2 (cover* or protect*)).tw,kw.
24 (nose adj2 (cover* or protect*)).tw,kw.
25 Masks/
26 or/8-25
27 7 and 26

Inclusion and exclusion criteria

Article eligibility criteria are summarised in Table A.1.

Table A.1. Inclusion and exclusion criteria

	Included	Excluded
Population	Human	Non-humans studies
Settings	All community settings, including households.	Healthcare settings
Context	COVID-19 disease	Other diseases
Intervention/ exposure	All types of face covering including (but not limited to) handmade and commercial cloth masks	Studies comparing effectiveness of surgical masks to N95 respirators
Outcomes	• effectiveness of face coverings • transmission of SARS-CoV-2 • SARS-CoV-2 infection • basic reproduction number • mask filtration capacity/droplet transmissions	
Language	English	

	Included	Excluded
Date of publication	25 March 2020 to 22 September 2020	
Study design	• experimental or observational studies • case series and case reports • laboratory studies	• systematic reviews • guidelines • opinion pieces • modelling studies
Publication type	Published and preprint	

Screening

Title and abstract screening was done by 2 reviewers but only partially in duplicate: 10% of the eligible studies were screened in duplicate, disagreements were resolved by discussion and the remainder were screened by one reviewer.

Full text screening was done by one reviewer and checked by a second.

Figure A.2 illustrates this process for the updated search.

Data extraction and quality assessment

Summary information for each study was extracted and reported in tabular form.

This was undertaken by one reviewer and checked by a second.

Data extraction was done by one reviewer and checked by a second.

Due to the rapid nature of the work, a validated risk of bias tool was not used to assess study quality of primary studies. However, papers were evaluated based on study design and main source of bias (mainly population, selection, exposure and outcome).

A formal grading of evidence was not undertaken, however if evidence was considered to be limited (due to the number of studies) or weak (due to research design or quality) this was highlighted. Preprint or publication status was also considered in determining this.

Variations across populations and subgroups, for example cultural variations or differences between ethnic, social or vulnerable groups were considered where evidence was available.

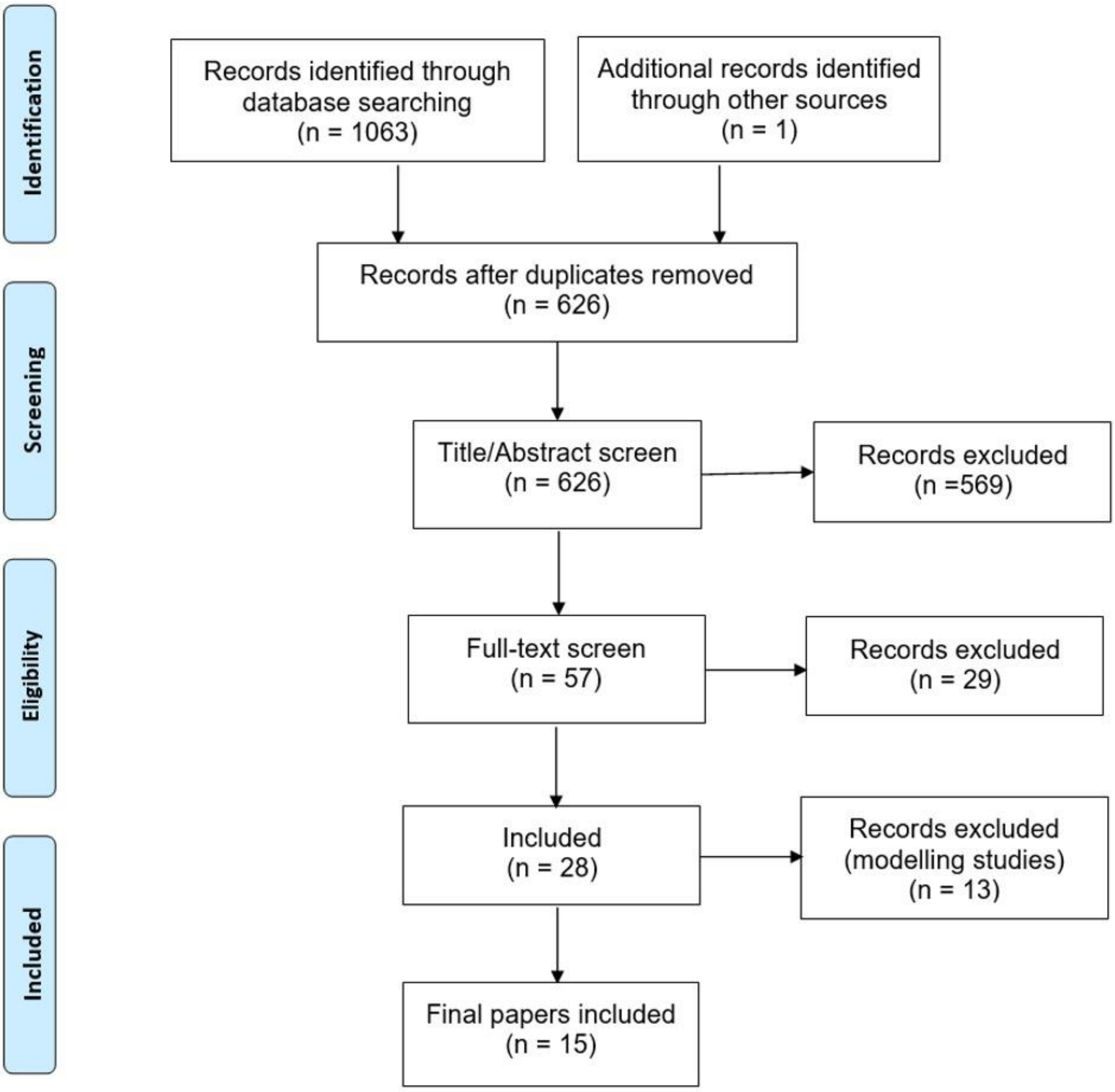

Figure A.1: PRISMA diagram for original search (search dates 1 Jan 2020 to 5 June 2020)

Figure A.1 PRISMA diagram alt text

A PRISMA diagram showing the flow of studies through the previous face coverings review.

There were n = 1,063 records identified through database searching, reduced to n = 625 records after duplicates removed, and n = 1 record identified through searching reference lists, meaning n = 626 were screened on titles and abstracts.

Of these, n = 569 records were excluded, leaving n = 57 records which underwent full-text screening.

Of these, n = 29 records were excluded, leaving n = 28 included papers.

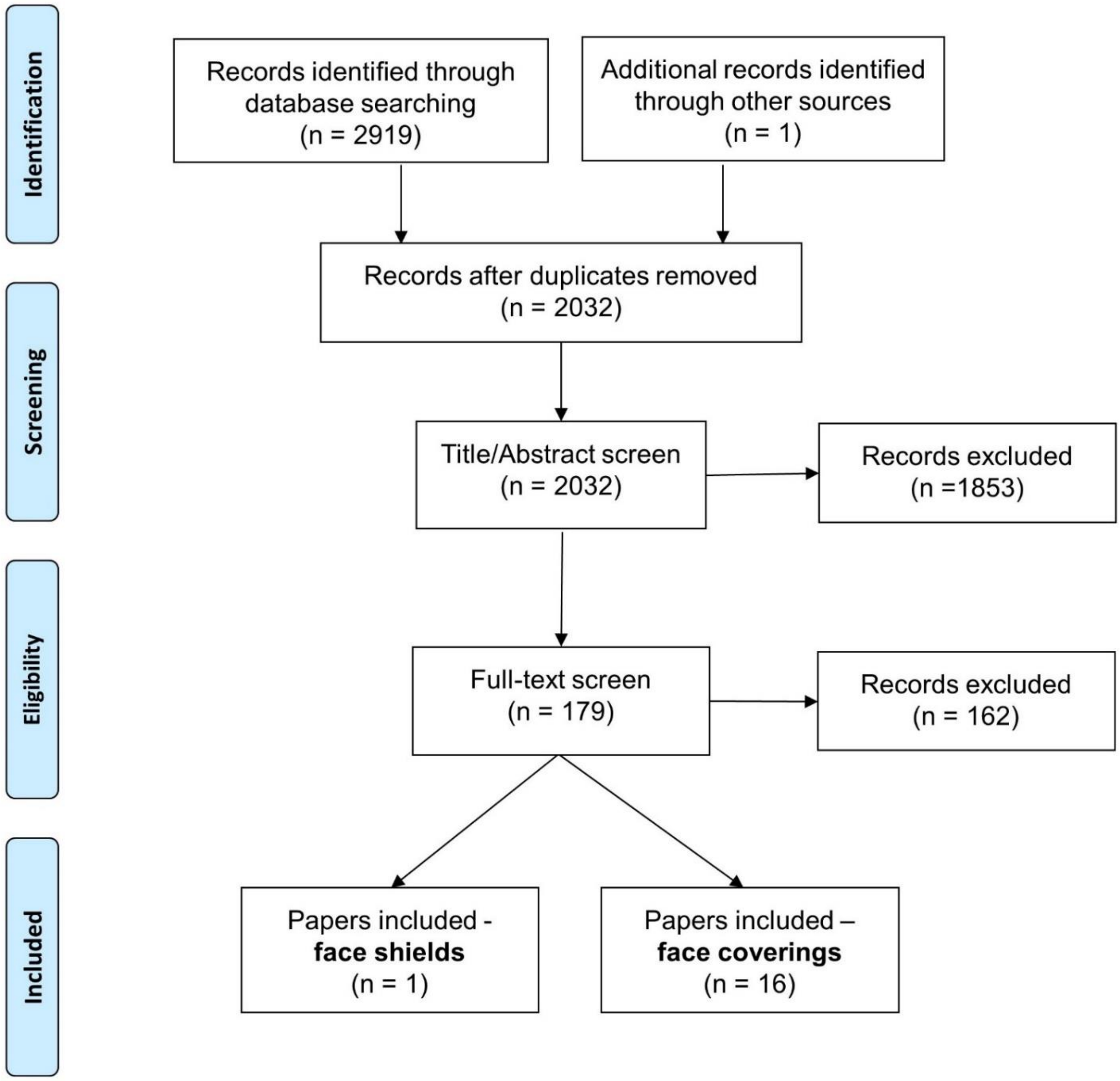

Figure A.2: PRISMA diagram for updated search (search dates 5 June 2020 to 22 Sept 2020)

Figure A.2 PRISMA diagram alt text

A PRISMA diagram showing the flow of studies through this review.

There were n = 2,919 records identified through database searching and n = 1 record identified through other sources, reduced to n = 2,032 records after duplicates removed and n = 2, 032 records screened on titles and abstracts.

Of these, n = 1,853 records were excluded, leaving n = 179 records which underwent full-text screening.

Of these, n = 162 records were excluded, leaving n = 1 included paper on face shields and n = 16 included papers on face coverings.

Annexe B: Data extraction

Table B.1. Observational studies
This table is split into 4 tables

Acronyms used: CI = confidence interval, HKSAR = Hong Kong Special Administrative Region, NPI = non-pharmaceutical intervention, OR = odds ratio, RT-PCR = reverse transcriptase polymerase chain reaction, SIQR = susceptible, infected, quarantined, recovered

Table B.1a: Population-level observational studies: new evidence

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
Mitze and others (18) PREPRINT Face coverings Considerably Reduce COVID-19 Cases in Germany: A Synthetic Control Method Approach	Study type: Ecological Population: Germany. Jena region where face coverings were introduced on 6 April 2020 at a point when they had 127 COVID-19 cases per 100,000. Analyses extended to incorporate 32 regions who introduced face coverings afterwards, and a subgroup of 105 larger cities (8 intervention). Settings: Community in 401 German regions (32 intervention regions). Objective: To analyse the effect of face coverings becoming mandatory on public transport and in shops on the spread of COVID-19	Data analysis: Synthetic control methods (suitable for ecological studies where there is one intervention region and multiple control regions) used to create weighted average control group that followed the same COVID-19 trajectory before mandatory face coverings were introduced in the intervention region. COVID-19 cases in the intervention region (Jena) was compared to the synthetic comparison group. The analyses were extended to incorporate 32 additional regions where face coverings were introduced later. Data source: COVID-19 cases registered with the Robert Koch Institute (official statistics). Data on regional characteristics from the INKAR database; 38,095 observations between 28 January 2020 to 1 May 2020 (95-day period). Effects examined in one region (Jena, first to implement face covering policy) and all 32 intervention regions.	Early introduction of face coverings in Jena led to 23% lower number of COVID-19 cases than in the synthetic comparator regions at 20 days post-intervention (13% at 10 days) with a greater decrease among people aged at least 60 years. In all intervention regions, reduction at 10 days was 2.3% in all regions and 4.2% in cities subgroup (20-day data not available) compared with comparator	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Actual levels of face covering wearing was not collected. Group-level association does not always reflect magnitude and/or direction of individual-level association. Bias: Inconsistencies in testing, reporting and recording of the data could lead to information and selection bias. Confounding: Jena may differ from other regions in other respects. Sensitivity checks conducted. Placebo-in-space tests conducted using same analyses for regions without interventions on face coverings to check if driven by other factors rather than face coverings. Controlled for factors likely to effect spread and dynamics of COVID-19 cases such as population demographic and healthcare information. Unclear if 'cities' subgroup was decided a priori. All country in lockdown at the time of intervention, reduces likelihood that other measures influenced the results.
Aravindakshan and others (19) PREPRINT Face covering wearing during	Study type: Ecological study, with a reduced-form econometric modelling technique (statistical modelling).	Data analysis: Reduced form econometric model used to compare in-country differences in face covering use (percentage of the population who report using a face covering in public places), mobility, and the implementation of non-	Self-reported face covering usage in public places was associated with a decline in the COVID-19 growth rate (that is, new cases).	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Group-level association does not always reflect magnitude and/or direction of individual-level association.

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
the COVID-19 pandemic.	Population: 24 countries (February 2020 to July 2020) when at 20% of peak new cases Settings: Country level or community. Objective: To investigate the association between population-wide self-reported face covering usage in public places and population-wide growth rate of COVID-19 cases.	pharmaceutical interventions to detect an effect on the daily growth rate of COVID-19. Data source: Percentage of the population who report using a face covering in public places collected via Imperial College-YouGov weekly multi-country survey, 21 February 2020 to 8 July 2020 from 26 countries (2 countries excluded from analysis). Google community mobility reports. CoronaNet-Project for data on NPI implementation. Data on active daily cases from the Johns Hopkins School of Public Health: 7 day moving average of cumulative confirmed COVID-19 cases and recovered cases was used to compute daily growth rate.	Widespread face covering wearing in a country was associated with an expected 7% (95% CI: 3.94% to 7.53%) decline in the daily COVID-19 growth rate. The combined effect of self-reported face covering wearing, reduced mobility, and non-pharmaceutical interventions was associated with an average decline in daily growth rate of 28.1% (95% CI: 24.2% to 32%). If 100% of the population wore face coverings, there could be a 4.95% (95% CI: 2.26% to 7.53%) drop in daily growth rate after 9 days, when compared to none of the population wearing face coverings (adjusted robust estimate).	Bias: Inconsistencies in testing, reporting (including self-reported mask wearing), and recording of the data could lead to information and selection bias. Self-reported face-covering use may be subject to biases such as recall bias, and other information bias (such as a stigma associated with not wearing a face-covering). Confounding: Controlled for each country's community mobility, testing capability, education and time (initialising the model at 20% of peak new cases) but could be residual confounding. Computed a control function for actual face covering wearing from reported and ran robustness checks. Countries enacted multiple NPIs simultaneously which makes it difficult to identify the effectiveness of NPIs separately. Analysis was conducted at the country level due to data restrictions but there will be heterogeneity within a country.
Pederson and others (20) PREPRINT Data-driven estimation of change points reveals correlation between face mask use and accelerated curtailing of the COVID-19 epidemic in Italy	Study type: Ecological Population: 8 regions of Italy with highest numbers of COVID-19 cases between 24 February 2020 and 19 July 2020. Settings: Regional level in Italy or community. Objective: To compare population-wide data from 5 regions with face covering interventions (a policy mandate or free face coverings); and 3 regions	Data analyses: Used a SIQR* model to identify changes in COVID-19 transmission rates. Data source: Data used to compare findings available from: • GitHub • COVID-19 mobility	Reduction in COVID-19 transmission rate for 4 out of 5 regions who had face covering interventions implemented (2 regions had introduced mandatory face covering use in public places, and 2 regions were distributing free face coverings in public places), as well as the region with a ban on gatherings. The reduction in COVID-19 transmission rate was shown by a statistically significant change (Emilia-Romagna, Piedmont, Tuscany and Veneto (all $p < 0.001$), and Liguria ($p = 0.015$). ANOVA, AIC, BIC and Davies' test were used) occurring in the gradient, β, in mid-April (the time point expected to be related to implementation of the interventions). This reduction in transmission rate (statistically significant change in β) did not occur in the 2 control	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Actual levels of face covering wearing was not collected. Group-level association does not always reflect magnitude or direction of individual-level association. Bias: Inconsistencies in testing, reporting, and recording of the data could lead to information and selection bias. Confounding: No clear controls for confounding factors reported, but stated regions were demographically similar.

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
	without (one with ban on gatherings of more than 2 and 2 controls without a ban).		regions that had neither a face coverings intervention or ban on gatherings.	Community mobility had increased and there were no weather changes so these were thought to be unlikely alternative explanations for results.
Li and others (25) Understanding transmission and intervention for the COVID-19 pandemic in the United States	Study type: Ecological Population: 15 states in the US with the highest level of COVID-19 at the time of data collection between 1 March 2020 and 18 May 2020. Settings: Regional level in US or community. Objective: To compare population-wide data from 9 states with mandated face covering policies (policies varied in content from mandatory face coverings in employment settings only to some that included public transport and/or all public places) with population-wide data from 6 states without any mandated face covering policy.	Data analyses: Comparison of COVID-19 epidemic curves between states. Analyses of daily new infections and of cumulative infection curves. Data source: Confirmed COVID-19 cases for the states were recorded from the State Department of Health or Public Health or State Government website and from the US CDC COVID Data Tracker.	At the start of the pandemic all 15 states analysed showed an initial sub-exponential growth in confirmed COVID-19 cases. Following National stay-at-home orders, the COVID-19 growth curve slowed to linear (correlation coefficient around 1), which represented a dynamic equilibrium between mitigation measures and transmission. For all 6 states without any mandated face-covering policy, the curve remained linear for the one to 2 months until the end of the analysis period (May 18). However, for 7 out of the 9 states where mandated face covering policies were introduced the epidemic curve changed from linear, representing slower growth, shortly after initiation of the face covering mandates. The most significant slowing occurred in New York and New Jersey (both had strict enforcement measures). This slowing was estimated to be equivalent to a prevention of 17% of total infections. The remaining 2 states showed an upward trend shortly after the face covering mandate was implemented (although mass gatherings and increased testing thought to be the reason).	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Actual levels of face covering wearing was not collected. Group-level association does not always reflect magnitude or direction of individual-level association. Bias: Inconsistencies in testing, reporting, and recording of the data could lead to information and selection bias. Confounding: Analyses appear to be unadjusted for confounding. Authors noted that mass protests and increased testing could be responsible for upward trends seen in some states shortly after the face covering mandates were implemented.
Chernozhukov and others (21) IN PRESS Causal Impact of Masks, Policies, Behavior on Early Covid-19 Pandemic in the U.S	Study type: Ecological Population: States in the US Settings: Regional level in US / community Objective: To compare population-wide data from states with policies where face covering wearing is mandatory for employees at work compared to population-wide data from	Data analyses: Comparison of weekly growth rates of confirmed incident COVID-19 cases and deaths from COVID-19 between states. Models (SIQR model) predicted direct effects of face covering-wearing policies (by controlling for social distancing behaviours by using community mobility data as a proxy for social distancing) and combined direct and indirect effect of implementing policies. Data source: Daily Covid-19 cases and deaths from The New York Times. If missing values in the New York Times, then reported cases and deaths	Mandating the use of face coverings for employees reduced the growth rate of COVID-19 infections and deaths by an estimated 9% to 15% (direct effects, while controlling for community mobility). Data from the counterfactual experiment, which took into account both direct and indirect effects (by not controlling for additional behaviour changes) of the policy, suggests that if all states had adopted mandatory face covering policies on 14 March 2020, then the cumulative number of deaths by the end of May could have been 19% to 47% lower.	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Actual levels of face covering wearing was not collected. Group-level association does not always reflect magnitude or direction of individual-level association. Bias: Inconsistencies in testing, reporting, and recording of the data could lead to information and selection bias. Confounding: Controlled for state-level confounders, including population size,

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
	states with no policy on face covering wearing	use from the Center for Systems Science and Engineering at Johns Hopkins University, and Covid Tracking Project. The number of tests in each state from Covid Tracking Project. Data on state policies taken from a document published by Raifman and others (2020).		unemployment rate, poverty rate, amount of illness and state governor's party affiliation.
Lyu and Wehby (26) Community Use Of Face Masks And COVID-19: Evidence From A Natural Experiment Of State Mandates In The US	Study type: Ecological Population: 51 regions or states in the US (31 March to 22 May 2020). Settings: Regional level in US or community. Objective: To compare population-wide data from 15 states plus Washington D.C. where face covering is mandatory in public settings; 20 states where face covering is mandatory for employees only; and 15 states without any face covering mandates.	Data analyses: percentage change in cumulative COVID-19 cases from the previous day was used to calculate the daily growth rate. Daily growth rate pre-face covering mandate initiation was compared with daily growth rate post-face covering mandate initiation for each region; then states with face covering mandates were compared to states without face covering mandates (difference in difference design) and 95% confidence intervals calculated. The 16 jurisdictions where face coverings were mandatory in public settings (for those who could medically tolerate) were compared to the 15 states without face covering mandates at the time. The 20 states where face coverings were mandatory for employee settings (face coverings to be worn at work) were also compared to the 15 states without face covering mandates. Data source: Daily county-level data on confirmed COVID-19 cases between 25 March and 22 May obtained from The New York Times (collated from state and local health agency reports). State-level testing data from The COVID Tracking Project. Area characteristics from Census data	After mandating face coverings in public, there was a decline in daily case rate of 2% from 21 days ($p<0.05$), and an estimate that 230,000 to 450,000 cases may have been averted by May 22 because of these mandates. There was no evidence of decline in daily COVID-19 growth rates in areas with employee-only mandates but not public mandates.	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Actual levels of face covering wearing was not collected. Group-level association does not always reflect magnitude or direction of individual-level association. Bias: Inconsistencies in testing, reporting, and recording of the data could lead to information and selection bias. Confounding: Controls for differences between states and counties (for example, population density and age, poverty, other mitigation and social distancing policies and state-level COVID-19 testing rates) were incorporated into the models. Results are conditional to other existing social distancing measures which may differ between states.
Radar and others (22) PREPRINT Mask Wearing and Control of SARS-CoV-2 Transmission in	Study type: Ecological Population: 378,207 individuals from US who filled out online surveys between 3 June 2020 and 27 July 2020 (country-wide). Settings: Community	Data analyses: Association between self-reported face covering-wearing and SARS-CoV-2 transmission control measured using daily estimated reproduction number aggregated to a weekly average (Rt). Data source: Self-reported data on likelihood to wear a face covering to shop, or with friends/family, and self-reported social distancing was collected via Survey Monkey. The	There was a negative association between the average percentage of people that report wearing a face covering and area-level Rt. After adjustments for confounding, there is an association between percentage reporting face covering wearing and transmission control in the community (that is, $Rt<1$): OR=1.14 (95% CI: 1.07 to 1.2).	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Group-level association does not always reflect magnitude or direction of individual-level association. Bias: Inconsistencies in testing, reporting (including self-reported mask wearing), and

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
the United States	Objective: To investigate the association between population-wide self-reported face covering-wearing, social distancing and community transmission of COVID-19, as well as the effect of state-wide face covering-wearing mandates on uptake of face covering wearing.	questionnaire for this study was offered to those who had participated in other online surveys, therefore a convenience sample.	A 10% increase in face covering-wearing was associated with an over three-fold increase in odds of transmission control: OR=3.53 (95% CI: 2.03 to 6.43). Communities with high face covering wearing and social distancing had the highest predicted probability of a controlled epidemic. Increases in face covering wearing were independent of government face covering-wearing mandates and were found to have started earlier, indicating that increased face covering-wearing behaviour is not solely driven by policies or mandates.	recording of the data could lead to information and selection bias. Self-reported face-covering use may be subject to biases such as recall bias, and other information bias (such as a stigma associated with not wearing a face-covering). Confounding: They adjusted for social distancing and other confounders like increased wearing of face coverings and lower Rt due to previous high levels of transmission in an area.

Table B.1b: Population-level observational studies: evidence from previous review

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
Cheng and others, 2020 (27) The role of community-wide wearing of face covering for control of coronavirus disease 2019 (COVID-19) epidemic due to SARS-CoV-2	Study type: ecological Population: Hong Kong Special Administrative Region (HKSAR). Objective: to assess the effect of community-wide face covering usage to control COVID-19 in HKSAR. Settings: community.	Patients with respiratory symptoms at outpatient clinics or hospital wards were screened for COVID-19 per protocol. Epidemiological analysis was performed for confirmed cases. Compliance of face covering usage was monitored by 69 University staff members during their morning commute among the first 50 persons they saw and over 3 consecutive days (6 to 8 April 2020). Incidence of COVID-19 (per million population) in HKSAR was compared to that of non-face covering-wearing countries which are comparable with HKSAR in terms of population density, healthcare system, BCG vaccination and social distancing measures but not community-wide face covering.	Within first 100 days (31 December 2019 to 8 April 2020), 961 COVID-19 patients were diagnosed in HKSAR. Compliance of face covering usage in April: 10,050 persons were observed, of which 337 (3.4%) did not wear face covering. 11 COVID-19 clusters were observed in recreational ‘face covering-off’ settings compared to only 3 in workplace ‘face covering-on’ settings (p=0.036). The incidence of COVID-19 in HKSAR was significantly less than that of the selected countries in Asia, Europe (including UK), and North America, where face covering usage was not universally adopted in the community. The authors concluded that community-wide face covering wearing may contribute to the control of COVID-19.	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Actual levels of face covering wearing was not collected. Group-level association does not always reflect magnitude or direction of individual-level association. Bias: Inconsistencies in testing, reporting, and recording of the data could lead to information and selection bias. Confounding: No information provided on whether the results were adjusted for potential confounding factors.
Hunter and others, 2020 (42) PREPRINT	Study type: ecological Population: 30 European countries (including UK).	Data analysis: 2 sets of analyses conducted: 1) multi-level mixed effects regression analysis, using a mixed effects negative binomial regression model with cases or deaths on a specific day as the outcome variable, country population as the	The exposure-response relationships estimated by the models show that the use of face coverings initially seemed to have had a protective effect but that, after day 15 of the face covering advisories or requirements, the number of cases started to rise.	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Actual levels of face covering wearing was not collected. Group-level association does not

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
Impact of non-pharmaceutical interventions against COVID-19 in Europe: a quasi-experimental study	Settings: country-level or community. Objective: to analyse the different approaches to and timing of restrictions in the different countries and identify what effects such restriction may have had on the control of the epidemic.	exposure variable, country as a mixed effect, and days from start of the epidemic as a fixed effect. 2) R modelling using Bayesian generalised additive mixed models to adjust for spatial dependency in disease between nation states. Data source: the European Centre for Disease Control for data on case numbers (up to 24 April 2020), the Institute of Health Metrics and Evaluation website and published sources for dates of initiation of various control strategies.	Similar patterns were observed for the relationship between face coverings and deaths. The authors noted that there was even a suggestion that they may actually increase risk, but they estimated that the data on face coverings were too preliminary to be reliable (due to recent introduction) and should not be used to inform public policy. The authors concluded that the wearing of face coverings or coverings in public was not associated with any independent additional impact.	always reflect magnitude or direction of individual-level association. Bias: Inconsistencies in testing, reporting, and recording of the data could lead to information and selection bias. Confounding: Hard to separate out individual intervention effects due to collinearity and to many interventions having been implemented in different ways and at different points in the local epidemic. A number of factors were adjusted for in the model, but residual confounding cannot be ruled out.
Kenyon, 2020 (43) PREPRINT Widespread use of face coverings in public may slow the spread of SARS CoV-2: an ecological study	Study type: ecological Population: 49 countries (including UK). Settings: country-level or community. Objective: to assess if there is ecological level evidence that countries that promoted face covering usage in public had a lower number of COVID-19 diagnoses per capita.	Hypothesis: population level usage of face coverings may be negatively associated SARS CoV-2 spread. Statistical analysis: linear regression was used to assess at country level the association between COVID-19 diagnoses per inhabitant and the national promotion of face coverings in public (coded as a binary variable), controlling for the age of the COVID-19 epidemic and testing intensity. Data source: European Centre for Disease Control (up to 29 March 2020) and national documents and guidance.	Out of the 49 countries, 8 advocated wearing face coverings in public: China, Czechia, Hong Kong, Japan, Singapore, South Korea, Thailand and Malaysia. In multivariate analysis, face covering use was negatively associated with number of COVID-19 cases per inhabitant (coefficient = -326, 95% CI: -601 to -51, p=0.021). The analyses were repeated excluding Czechia (only country to introduce universal face coverings late in the epidemy), which slightly strengthened the association between COVID-19 cases and face covering usage. The authors concluded that whilst these results are susceptible to residual confounding, they do provide ecological level support to the individual level studies that found face covering usage to reduce the transmission and acquisition of respiratory viral infections.	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Actual levels of face covering wearing was not collected. Group-level association does not always reflect magnitude or direction of individual-level association. Bias: Inconsistencies in testing, reporting, and recording of the data could lead to information and selection bias. Confounding: Lack of accurate data to control for confounders such as contact tracing or isolation. It was not possible to quantitate the intensity of face covering use per country, resulting in a crude binary classification of face covering usage. Results were adjusted for only 2 factors and are likely to be subject to residual confounding.
Leffler and others, 2020 (44)	Study type: ecological Population: 198 countries. Settings: country-level or community.	Hypothesis: in countries where face covering use was either an accepted cultural norm or favoured by government policies on a national level, the per-capita mortality might be reduced, as compared with remaining countries.	In some Asian countries, face coverings were used extensively by the public from the beginning of the outbreak. Despite the fact that the outbreak tended to appear quite early in these countries, they had experienced a low per-capita coronavirus mortality by 9 May 2020.	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Actual levels of face covering wearing was not collected. Group-level association does not

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
Association of country-wide coronavirus mortality with demographics, testing, lockdowns, and public wearing of face coverings (Update June 2, 2020)	Objective: to assess the impact of face coverings on per-capita COVID-19-related mortality.	Statistical analysis: significant predictors of per-capita coronavirus mortality in the univariate analysis were analysed by stepwise backwards multivariable linear regression analysis. Potential predictors analysed included age, sex ratio, obesity prevalence, temperature, urbanization, smoking, duration of infection, lockdowns, viral testing, contact tracing policies, and public face covering-wearing norms and policies. Data source: Worldometers Database (9 May 2020). Countries were included if either: 1) coronavirus testing data were available by May 9, 2020. 2) testing and lockdown policies had been graded by the University of Oxford Coronavirus Government Response Tracker. Additional data were obtained from the European Centre for Disease Control and other public databases. Assumption made: the date of each country's initial infection was estimated as the earlier of: i) 5 days before the first reported infection, or ii) 23 days before the first death.	Multivariable analyses with obesity data (194 countries): • 'duration since face coverings were recommended' significant predictor of the logarithm of each country's per-capita coronavirus mortality ($p<0.001$) • in countries not recommending face coverings, the per-capita mortality tended to increase each week by 47.4%; in countries recommending face coverings: 9.0%; under lockdown (without face coverings): 38.7% Multivariable analyses with obesity and testing data (179 countries): • 'duration since face coverings were recommended' continued to be a significant predictor ($p\leq0.001$) • 49.1% increase in per-capita mortality each week in countries without face coverings; in countries where face coverings were recommended: 13.1% Multivariable analyses with containment, testing and health policies data (161 countries): • 'duration that face coverings were recommended' was independently predictive of per-capita mortality • weekly increase in per-capita mortality was 26.68%; when face coverings were worn: 0.4% The authors concluded that these results support the universal wearing of face coverings by the public to suppress the spread of the coronavirus.	always reflect magnitude or direction of individual-level association. Bias: Inconsistencies in testing, reporting, and recording of the data could lead to information and selection bias. Confounding: A number of factors were adjusted for in the model, but residual confounding cannot be ruled out. The list of the 198 countries included was not provided, although it can be assumed that UK was one of them.
Zeng and others, 2020 (29) Epidemiology reveals face covering wearing by the public is crucial for COVID-19 control	Study type: ecological Population: China, South Korea, Italy and Spain. Settings: country-level or community. Objective: to analyse the epidemiological features of China, South Korea, Italy and Spain to find out the	Data analysis: the generalized additive model was used to generate the epidemiological curves (daily infection and daily reported) and simulate infection curves with reported incubation period. Data source: from publicly available sources: face covering usage was assessed based on national policies or news articles. Assumptions made: the interval from symptom onset to report was around 8 days and the median	In China, mandatory face covering wearing by the public likely played an important role in stopping the spread of the disease. The combination of the measures taken (face covering wearing, city lockdown and medical resources) collectively contained the epidemic and dramatically reduced the number of infected cases. In South Korea, the epidemic was predominantly confined to spread within religious groups and not to the wider community. This may be because of the general practice of face covering wearing by the	Study type: Ecological studies are susceptible to information bias (rely on third-party data) and confounding. Actual levels of face covering wearing was not collected. Group-level association does not always reflect magnitude or direction of individual-level association. Bias: Inconsistencies in testing, reporting, and recording of the data could lead to information and selection bias.

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
	relationship of major public health events and epidemiological curves.	of the incubation period was 5.2 days (95% CI: 4.1 to 7.0).	public, based on 1) sales numbers and 2) 10 days after government instructed face-wearing by the public, the number of daily reported cases declined. The authors noted that the epidemic could not be satisfactorily contained in in Italy and in Spain, due to the shortage of medical resources, non-mandatory advice on wearing of face coverings and the people are not adapted to wearing face coverings. The authors concluded that their analysis supports the importance of face covering wearing by the public.	Confounding: This study seems to be mainly based on visual assessment of the epidemiological curves with the date of introduction of the different measures; confounding factors were not considered. The conclusions for Spain and Italy seem to be more an opinion than based on data.

Table B.1c: Individual-level observational studies: new evidence

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
Doung-ngern and others (31) Case-Control Study of Use of Personal Protective Measures and Risk for SARS-CoV 2 Infection, Thailand	Study type: Retrospective case-control. Participants: 1,050 contacts of COVID-19 cases from 3 major clusters in boxing stadiums, nightclubs and an office in Thailand during March 2020 (Study duration 1 March 2020 to 27 May 2020). Settings: Community (boxing stadiums nightclubs and an office). Objective: To investigate the effectiveness of personal protective measures (wearing a face covering, handwashing, and social distancing) during a contact with an asymptomatic (potentially infectious) pre-symptomatic case of COVID-19 affects likelihood of transmission of COVID-19 to the contact (assessment of the use of	Outcome: Whether the contact developed COVID-19. Exposure: Face covering-wearing of the contact. Data collection: Contacts of COVID-19 cases (defined as having activities together or being in the same location during March 2020) were identified using contact tracing records and were questioned (30 April 2020 to 27 May 2020) about face covering-wearing and other infection control practices during contact periods with the case. Relevant questions included dates, locations, duration, and distance of contact as well as wearing a face covering during contact and the type of face covering (non-medical, medical or a combination). 211 of the contacts who were asymptomatic at the time of contact with the COVID-19 case went on to develop COVID-19 (tested positive by RT-PCR, cases). 839 of the contacts did not develop COVID-19 symptoms or test positive (controls). Statistical analyses: Odds ratios (ORs) and 95% confidence intervals (CIs) estimated Logistic regression with random	Wearing face coverings at all times for the duration of contact was independently associated with a lower risk of subsequently developing COVID-19, compared to not wearing face coverings (OR = 0.23, 95% CI: 0.09 to 0.60). Wearing a face covering for some of the duration (but not all) of the contact was not associated with lower risk of developing COVID-19 (OR = 0.87, 95% CI: 0.41 to 1.84). It was noted that those who wore face coverings for the duration of the contact were also more likely to practice social distancing and hand washing, which may have influenced the results. The type of face covering worn was not independently associated with infection (p = 0.54).	Study type: Retrospective case-control because disease was known at entry into the study and exposure status was unknown at entry. Exposure ascertainment was obtained retrospectively. Bias: The controls are representative of the population from which the cases were drawn, although response rate unclear could be susceptible to selection bias if this were low. As participants report on past face covering usage during a past event, susceptible to recall bias, and other information bias (such as a stigma associated with not wearing a face-covering). Errors in recall might differ between the cases and controls. Confounding: Adjustments for confounding were made, but could be residual confounding. It was noted that those who wore face coverings for the duration of the contact were also more likely to practice social distancing and hand washing, which may have influenced the results.

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
	face coverings as wearer protection).	effects 27% missing values were excluded from analysis. Mask type was conducted as a separate analysis in the multilevel mixed-effects logistic regression model for SARS-CoV-2 infection and interaction between mask type and compliance with mask-wearing was also tested.		
Hong and others (32) Mask wearing in pre-symptomatic patients prevents SARS-CoV-2 transmission: An epidemiological analysis	Study type: Retrospective (historical) cohort. Participants: 41 individuals with pre-symptomatic COVID-19 recently returned from Wuhan and their close contacts (January 2020 to February 2020). Settings: Community Objective: To investigate the effectiveness of face coverings worn by pre-symptomatic COVID-19 cases at preventing transmission to close contacts (assessment of the use of face coverings as source control).	Outcome: Whether the contact of a pre-symptomatic COVID-19 case developed COVID-19 Exposure: Face covering-wearing of the pre-symptomatic COVID-19 case (as source control). Data collection: Electronic medical records and self-reported questionnaire data was collected from 28 of the pre-symptomatic cases that reported that they had worn face coverings (and 123 of their close contacts) and 13 pre-symptomatic cases that reported that they had not worn face coverings (and 74 of their close contacts). The term 'close contact' and type of mask worn were undefined. Familial or other (for example, neighbour, friend, couple, living together) relationships were shown for a cluster of 21 sequential COVID-19 cases. Statistical analyses: Mann-Whitney U test or $\chi 2$ test with Fisher's exact probability performed for continuous or categorical variables respectively. Statistically significant results showed a two-sided $p < 0.05$.	Of the 123 close contacts of pre-symptomatic COVID-19 cases who reported wearing face coverings, 10 became infected with COVID-19. Of the 74 close contacts of pre-symptomatic COVID-19 cases who reported not wearing face coverings, 14 became infected with COVID-19. COVID-19 transmission significantly higher for those in close contact where the infected person did not wear a face covering (19.0% of contacts) compared to when infected person did wear a face covering (8.1% of contacts) ($p < 0.001$).	Study type: Retrospective cohort because exposure status was known at entry into the study and disease status of contacts was unknown at entry. Bias: Response rate unclear could be susceptible to selection bias if this were low. May be susceptible to information bias (such as a stigma associated with not wearing a face-covering. Errors in recall might differ between the exposed and unexposed.
Hendrix and others (34) Absence of Apparent Transmission of SARS-CoV-2 from Two Stylists After Exposure at a Hair Salon with a Universal Face Covering Policy - Springfield,	Study type: Descriptive (retrospective) Participants: 139 clients of 2 hair stylists experiencing COVID-19 symptoms at a hair salon in the US Settings: Community (hair dressing salon) (May 2020) Objective: To describe the transmission of COVID-19 from 2 symptomatic COVID-19 cases (hair stylists) to their clients while a	Outcome: Positive COVID-19 test of the clients/contacts. Exposure: Face covering-wearing of both hair stylist and client/contact. Unable to assess as no control group. Data collection: Clients were identified via contact tracing and tested for COVID-19 by RT-PCR Response rate (for agreeing to COVID-19 test) of the clients/contacts was 48.2%. Statistical analyses: There was no non-face covering-wearing comparator used, therefore no analysis or statistics were possible.	No transmission of COVID-19 occurred for the 48.2% of clients/contacts tested. Unable to test an association as there was no control group used (for example, a salon without a face covering-wearing policy). Contact tracing was not performed for the phase when the hair stylists were pre-symptomatic so COVID-19 transmission during this time is unknown.	A descriptive study with no control group, therefore no analysis was possible, or assessment of other factors which may have affected transmission. Overall, this study is judged as being very low quality and at very high risk of bias.

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
Missouri, May 2020	mandatory face covering policy was in place for both hair stylists and clients (assessment of the use of face coverings as source control and wearer protection).			

Table B.1d: Individual-level observational studies: evidence from previous review

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
Fan and others, 2020 (45) The epidemiology of reverse transmission of COVID-19 in Gansu Province, China	Study type: epidemiological study or case report. Participants: 311 citizens evacuated from Iran to the quarantine centre of Gansu Province; 82% were students, median age 23 years old. Settings: community. Objective: to report the epidemiological characteristics and the clinical features of these 31 citizens to provide critical and objective information to help control the spread of COVID-19 to other provinces and countries.	Screening (temperature, symptom questionnaire and epidemiological history) and SARS-CoV-2 test (RT-PCR, oral or nasopharynx swab) performed at the airport upon arrival. Those testing positives were admitted to hospital, and the others were isolated for 14-days. Demographic data, including sex, age, occupation, nationality and exposure history were provided by Gansu Provincial Centre for Disease Control and Prevention, and clinical data were provided by Lanzhou Pulmonary Hospital and Gansu Provincial Hospital. Geographical analysis (spatial distribution) and statistical analysis performed.	37 out of 311 returnees (12%) tested positive. All were international Chinese students from 2 universities (one in Qom province and one in Golestan province). Higher rate of infection observed amongst the returnees from Qom (15%) and Golestan provinces (30%), compared to Tehran (3%). Note: at the time of evacuation, Qom and Tehran reported larger number of infections in local population (over 400) compared to Golestan province (100 to 199). Significant positive correlation between the incidence of infection and male sex ($\chi2=11.615$, $p=0.001$), younger age (16 to 30 years) ($p=0.014$), Hui and other races ($p=0.026$), or residing in a dormitory ($\chi2=4.088$, $p=0.043$). Wearing a face covering while in Iran also increased the risk for COVID-19 infection: 24% amongst those wearing face covering vs 10% in those not wearing face coverings ($\chi2=7.902$, $p=0.005$). Authors' comments on these results: • source of infections may be from University (dormitories in shared facilities) and/or Mosques • it is possible that those wearing face coverings i) were involved in higher risks activities for example, dormitories, classes, mosques or ii) neglected other measures for example, social distancing and hygiene; or that iii) face coverings may not have been P2 or N95 and may not have been used adequately	Scarce literature about demographics and clinical aspects of COVID-19 in Iran. Spatial risk factors in Iran and potential risk in China difficult to assess due to the low number of cases and short study period. No information provided on whether the results were adjusted for potential confounding factors, for example, not clear whether the association between face covering and increased risk would still be significant if controlled for 'residing in a dormitory'. The population studied here is not representative of the general population (international students). Overall, this study was judged as being at high risk of bias.

Reference	Study design	Methods	Findings in relation to face covering use in the community	Risk of bias
Wang and others, 2020 (46) Reduction of secondary transmission of SARS-CoV-2 in households by face covering use, disinfection and social distancing: a cohort study in Beijing, China	Study type: retrospective cohort study. Participants: 335 people in 124 families with at least one laboratory-confirmed case of COVID-19 in Beijing, China. Setting: households. Objective: to study the use of NPIs such as face coverings, social distancing and disinfection in the household setting to inform community epidemic control and prevent transmission of COVID-19 in households.	Families with and without secondary transmission were compared for various measured risk factors, preventive interventions and exposures in order to analyse the predictors of household transmission. Duration: 28 February to 27 March 2020 Outcome: secondary transmission of SARS-CoV-2 within the family. Data collection: 3-part structured questionnaire (by telephone?). Data on primary case extracted from epidemiological reports from the Beijing Center for Disease Prevention and supplemented by telephone interview. Statistical analyses: multivariable logistic regression model to identify risk factors associated with SARS-CoV-2 household transmission.	Secondary attack rate in family: 23.07% (77 of 335) 4 factors were significantly associated with secondary transmission: • increased risk: primary case having diarrhoea; and daily close contact with primary case • reduced risk: frequent use of chlorine or ethanol-based disinfectant in households and family members (including the primary case); wearing a face covering at home before the primary case developed illness Face covering use by the primary case and family contacts before the primary case developed symptoms was 79% effective in reducing transmission (OR=0.21, 95% CI: 0.06 to 0.79). Wearing a face covering after illness onset of primary case was significantly protective in univariate analysis but not in multivariate analysis.	Telephone interview has limitations, for example, recall bias. Based on its design (retrospective cohort), this study might be less subject to bias than ecological studies, among other due to: • exposure assessed at individual level rather than based on national policies • the results may be subject to residual confounding, but probably less than the ecological studies The results from this study, conducted in Chinese households, might not be applicable to the UK context.

Table S2. Laboratory studies
This table is split into 3 tables

Acronyms used: CI = confidence interval, OR = odds ratio, TPI = threads per inch

Table B.2a: Laboratory studies using simulators: new evidence

Reference	Method and materials	Experiment characteristics	Findings
Maher and others (38) A fluid mechanics explanation of the effectiveness of common materials for respiratory masks	Mask types: potential materials for homemade masks and medical grade masks. Mask materials: Single layer: original and washed cotton, non-woven fabric (fabric 1), micro fibre cloth; HVAC filter; shower curtain; vacuum bag. Multilayer: surgical mask; original and washed R95; 2-layer cotton, cotton/HVAC, cotton/fabric 1, cotton/coffee filter; 3-layer cotton/coffee filter/cotton, cotton/coffee filter/fabric 1. Objective: To assess filtration efficiency of different types and combinations of materials considered for homemade masks, and the effect of washing on filtration efficiency.	Experimental set-up: Aerosols illuminated using a laser light sheet plane and droplets (less than 2 µm) imaged by Particle Image Velocimetry. Filtration effects assessed by measuring aerosol droplet (1 µm) concentrations upstream and downstream of the material. Breathability was examined by measuring the pressure difference across the tested materials using manometers. Aerosol simulation details: Di-Ethyl-Hexyl-Sebacat tracer particles aerosolised using an aerosol generator.	2-layer combinations (cotton/HVAC filter and cotton/non-woven fabric) had average filtration efficiency (across different particle sizes) of 90% to 91%. Filtration effects were increased by combining layers of materials compared to single-layer materials. Filtration effects of 3 of 4 materials tested following washing decreased slightly (2% to 4%, no change for micro fibre cloth) .
Parlin and others (40) A laboratory-based study examining the properties of silk fabric to evaluate its potential as a protective barrier for personal protective equipment and as a functional material for face coverings during the COVID-19 pandemic	Mask types: potential materials for homemade masks and medical grade masks. Mask materials: Cotton (pillowcase, handkerchief, fabric); polyester/ nylon blend (pillowcase); polyester (pillowcase, bag); silk (scarves black, white, mulberry pillowcase); Silk moth cocoon (natural wild silk & sericin); robin moth cocoon (natural wild silk & sericin); paper towel (white, brown); Kimtech Science Kimwipe (virgin wood fibres). Surgical (non-woven melt-blown and polypropylene: 3-ply, spun-bound, melt-blown) masks included for comparison. Objective: To examine the hydrophobicity of materials (cotton, polyester, silk) both when used as an additional outer layer for respirators and when constructed into face coverings by measuring their resistance to the penetration of small and aerosolized water droplets. To assess the ability of fabrics to maintain hydrophobicity after repeated cleaning by dry heat sterilisation.	Experimental set-up: Tested material groups for contact angle, saturation propensity, gas exchange rates (breathability) and droplet penetration resistance. Contact angle, saturation propensity and droplet penetration resistance were assessed by pipetting droplets of water onto the fabrics and imaging using a digital camera. Gas exchange was measured by evaporation of water through fabric whilst on a balance. Compared the performance of sewn masks made from layers of cotton, polyester, or silk materials with commercially available surgical masks in their resistance to aerosolized spray. Aerosol simulation details: in-house custom cough aerosol simulator with no aerosol size description.	All 1- or 2-layer fabrics significantly prevented droplet penetration (compared to no fabric barrier) with no significant differences in penetration prevention between the fabric groups ($p>0.05$) or for silk before and after repeated sterilisation. Materials made of silk were found to be hydrophobic even after repeated sterilisation.
Zangmeister and others (41) Filtration Efficiencies of Nanoscale Aerosol by Cloth Mask Materials Used to Slow the Spread of SARS-CoV-2	Mask types: potential materials for homemade masks and medical grade mask materials. Mask materials: Cotton (wide range, including clothing fabric, bandana, quilter's cotton, bed sheet, hand towel, flannel, muslin); wool (apparel wool); synthetic and synthetic blends (including clothing fabric, soft spun, sueded, chiffon, hand towel); synthetic/cotton blends (clothing fabric, flannel); polypropylene containing materials (HEPA vacuum bag); paper (perforated coffee filter, embossed paper towels); 4-layered samples of	Experimental set-up: Aerosol filtration efficiency of different materials was measured using particle counters up and downstream of the material. Aerosol simulation details: Charge-neutralised size-selected (50 nm to 825 nm) aerosolised NaCl produced by an aerosol generator.	The cloth materials that showed the best filtration efficiency had moderate yarn counts with visible raised fibers. Multilayered cloth masks offer increased protection compared to single-layer masks. None of the cloth masks performed as well as an N95 mask.

Reference	Method and materials	Experiment characteristics	Findings
	different materials. Surgical (an N95 filter, N95 fabric, a high- and low-density medical wrap) mask materials tested for comparison. Objective: To measure the filtration efficiency and differential pressure across cloth-based materials relevant for use as face coverings.		

Table B.2b: Laboratory studies using human participants: new evidence

Reference	Method and materials	Experiment characteristics	Findings
Fischer and others (36) Low-cost measurement of face mask efficacy for filtering expelled droplets during speech	Mask types: commercially available cloth, homemade, or medical grade masks and mask materials. Mask materials: 3-layer surgical mask; fitted N95 masks with and without exhalation valve; knitted mask; 2-layer polypropylene apron mask; 3-layer cotton/polypropylene/cotton mask; 1-layer Maxima AT mask; 2-layer cotton, pleated style masks (n=3); 2-layer cotton, Olson style mask; 1-layer cotton, pleated style mask; 1-layer polyester/spandex, 0.022 g/cm2; 2-layer bandana, 0.014 grams per cm^2; Swath of polypropylene mask material; Control experiment, no mask. Objective: To demonstrate a simple optical measurement method to evaluate the efficacy of masks in reducing respiratory droplets expelled during regular speech (Source control).	Experimental set-up: Human participants (n=4) speaking normally into a box containing an expanded laser beam. A mobile phone camera was used to record the droplets (more than 0.5µm) produced, which are counted using a simple computer algorithm. Aerosol simulation details: Not applicable	Some layered mask types (for example, 2-layer polypropylene apron mask and 3-layer cotton/polypropylene/cotton mask) demonstrate filtration efficacy approaching that of standard surgical masks. Some mask alternatives (neck gaiters or bandanas) provide very little protection. Speaking through some masks (particularly the neck gaiter) dispersed larger droplets into a multitude of smaller droplets, which could potentially be airborne longer and pose more of a transmission risk. While wearer protection is not compromised by the valved N95 mask, it is not suitable for source control and protection of persons surrounding the wearer. The best performing mask was the fitted, non-valved N95 mask.
Kahler and Hain (37) Fundamental protective mechanisms of face masks against droplet infections	Mask types: potential materials for homemade masks and medical grade masks and mask materials. Mask materials: Microfibre cloth; fleece; toilet paper (4 ply); paper towel; vacuum cleaner bag; Coffee filter. Surgical, FFP3 with valve, hygienic, and Halyard H600 3.1 medical grade masks tested for comparison. Objective: To examine: the flow field generated by coughing with and without a surgical mask; the filtering properties of household materials and medical masks; the effect of gaps around edges of medical masks. (Source control and wearer protection).	Experimental set-up: Aerosols were illuminated using a laser light sheet plane and droplets (less than 2 µm) imaged by Particle Image Velocimetry. A human participant coughed with and without wearing a mask to examine the flow field produced in a room seeded with around 1 µm Di-Ethyl-Hexyl-Sebacat tracer particles. Aerosol filtration effects of mask materials were assessed using a flow channel and 0.3-2µm droplets. Mask materials were tightly fitted to the flow channel and images of the aerosol taken up and downstream of the material. Flow visualizations using smoke were employed to demonstrate the effect of gaps around the mask (surgical and FFP2) edge.	Masks prevent fomite transmission by face touching, limit spread of droplets from the wearer to others in the room (source control) and prevent inhalation of droplets by the wearer (wearer-protection). Only tight fitting FFP2, N95, and KN95 or better particle filtering respirator masks achieve significant source control and wearer-protection, however, in the absence of such masks even simple mouth-and-nose cover masks reduce droplet spread so may offer some protection as source control. All materials tested (apart from FFP3 mask and vacuum cleaner bag) display insufficient filtration of small droplets. The vacuum cleaner bag was not breathable enough for mask use.

Reference	Method and materials	Experiment characteristics	Findings
		Aerosol simulation details: Di-Ethyl-Hexyl-Sebacat tracer particles aerosolised using an aerosol generator.	
Mueller and others (39) Quantitative Method for Comparative Assessment of Particle Removal Efficiency of Fabric Masks as Alternatives to Standard Surgical Masks for PPE	Mask types: commercially available medical grade and other masks, cloth or homemade masks. Mask materials: Makrite model 9500-N95; surgical (3 types); surgical style cloth with 2 to 6 layers (6 types); anti-allergy surgical style 4-layer mask with black "charcoal" layer; 2 commercially produced dust mask; fabric cone-shaped with 2 to 6 layers (6 types); duck-bill shaped with 6-layers; Woven nylon stocking (as an additional over-layer to improve fit). Objective: To develop a standardized quantitative method to assess the aerosol (less than 10 mm) filtration efficiency of facemasks (sewn fabric and standard surgical masks). To independently evaluate the contribution of mask fit and mask materials to efficacy. (Wearer protection).	Experimental set-up: Tests were conducted with one human test subject breathing normally with the mouth closed in a room seeded with aerosolised NaCl. Particle counters were used to count particles (less than 1µm) both in the ambient air and air inside of the mask breathing zone. Aerosol simulation details: NaCl particles aerosolised using an aerosol generator.	Medical masks removed 53% to 75% of particles (less than 300nm) from air when worn as designed but up to 90% when held to the face under a nylon layer. Cloth masks ranged in particle removal efficiency from 28% to 91% when worn as designed and masks with higher particle removal efficiency tended to have a filter layer in addition to two layers of cotton or non-woven fabric. Cone-shaped masks provided a better fit compared to surgical-style masks.

Table B.2c: Laboratory studies: evidence from previous review

Reference	Method and materials	Experiment characteristics	Findings
Aydin and others, 2020 (47) Performance of fabrics for home-made masks against spread of respiratory infection through droplets: a quantitative mechanistic study	Mask types: cloth or homemade. Mask materials: 10 different fabrics (100% cotton, 100% polyester, several combinations of cotton and polyester, used dishcloth, and silk) assessed, 3-layered commercial medical mask used as a benchmark material. Objective: to evaluate medical masks along with 10 regular household fabrics for their droplet blocking efficiency against high and low velocity droplets in a laboratory setting (source control).	Experimental set-up: the droplets that penetrate the fabric were collected in a petri dish placed 25 mm from the fabric. A high-speed camera was also used to record the motion of the droplets. Aerosol simulation details: A metered-dose inhaler loaded with a suspension of 100 nm-diameter fluorescent beads (consistent with SARS-CoV-2 virus size 70-100nm diameter) in distilled water was used to generate droplets. High-speed videos of the ejected droplets were recorded at 2.5cm (high initial velocity) and 30cm (low velocity) from the fabric. Image analysis was used to estimate droplet size and velocity. Breathability was also measured (set-up not described here).	Blocking efficiency at 25mm of selected materials: • medical mask: 98.5% • used shirt (100% cotton): 96.8% • New undershirt (100% cotton) : 1 layer: 81.9%; 2 layers: 94.1%; 3 layers: 98.9% • new quilt cloth (100% cotton): 71.7% • used shirt (75% cotton, 25% polyester): 72.5% • used shirt (70% cotton, 30% polyester): 93.6% • new t-shirt (60% cotton, 40% polyester): 1 layer: 83.1%; 2 layers: 98.1%; 3 layers: more than 98.1% • new quilt cloth (35% cotton, 65% polyester): 81.8 % • new bed sheet (100% polyester): 94.8% • used silk shirt: 92.9 % • used silk shirt: 98.7 % The authors concluded that most household fabrics can block both high and low impact droplets reasonably well with just one layer. With 2 or 3 layers of these fabrics, blocking efficiency and breathability is comparable or better than of the medical mask tested.

Reference	Method and materials	Experiment characteristics	Findings
			The authors also discussed the underlying mechanism of droplet blocking by predominantly hydrophilic home fabrics as opposed to medical masks made of hydrophobic fabric.
Carnino and others, 2020 (48) Pretreated household materials carry similar filtration protection against pathogens when compared with surgical masks	Mask types: cloth or homemade. Mask materials: kitchen paper towel, laboratory paper towel and the middle filter layer of a standard surgical mask. Objective: to assess the filtration ability of readily available materials pre-treated with a salt-based solution.	Experimental set-up: fluorescently labelled particles of 70 nm to 90 nm (similar size to SARS-CoV-2) were placed in contact with the material to test, and particle penetration through the material was then assessed using a fluorescence microscope. Salt-based soaking treatment was 30g of sodium chloride (NaCl) was dissolved in 100ml of distilled water (90ºC and 400rpm with stirring) before addition of detergent (1 mL of TWEEN20). The material to test was soaked for 5 minutes in this solution and then soaked overnight. 2 samples of each material were tested.	Fluorescence images show that the 3 materials don't properly filter the particles when untreated Materials treated with NaCl and TWEEN20 show decreased penetration of nanoparticles Materials treated with NaCl only were less effective in filtering the particles than when treated with NaCl and TWEEN20, but were still showing a notable decrease in particle penetration compared to untreated materials Additional tests using E. Coli bacteria suggested that presoaking the filter materials in either solution effectively prevents penetration of larger bacteria as well.
Foschini and others, 2020 (49) PREPRINT Aerosol blocking assessment by different types of fabrics for homemade respiratory masks: spectroscopy and imaging study	Mask types: medical and cloth or homemade. Mask materials: N95 mask, surgical mask, confectioner mask, 97% cotton fabric, 100% cotton fabric, unwoven fabric, multi-use wipes, legging fabric, elastane fabric, paper coffee, paper towel, etc. Objective: to assess the relative efficiencies of commercial respiratory masks (medical masks) and homemade fabric masks.	Experimental set-up: 2 optical methodologies were used to quantify the percentage of aerosol retention by the fabric through optical scattering measurements: one using white light scattering measurement before and after the mask, one using spatial frequency domain imaging technique. Aerosol simulation details: a piezoelectric nebulizer was used to create the aerosol from distilled water. The aerosol was then transported through a line attached to a vacuum cleaner, to which a valve for pressure and flow control were added. Size of aerosols generated was not specified.	Aerosol blocking efficiency (average of both results): • N95 mask: 99.95% • Surgery mask: 99.7% • Coffee filter: 99.6% • 2-layer cotton: 66% • 2-layer knitted cotton: 64.2% • confectioner mask: 51% • 1-layer cotton: 46.5% • 2-layer TNT: 46.3% • 2-layer multi-use wipes: 46.3% • 1-layer multi-use wipes: 34.9% • 1-layer knitted cotton: 34.9% • 1-layer TNT: 26.05% • Paper towels excluded due to integrity problems with increased humidity. Overall, both techniques showed that fabrics and meshes having some elasticity showed less performance than cotton, because the elastic will deform and increase air passage. Legging fabric performed well but was not included in the results due to low breathability.
Konda and others, 2020 (50)	Mask types: cloth or homemade. Mask materials: 15 different types of fabrics tested, including cotton, silk, chiffon, flannel, various synthetics, and their	Experimental set-up: the aerosol is sampled before and after it passes through the material being tested. The pressure difference is measured by a manometer and the aerosol flow velocity is measure by a velocity meter. Particle sizes and	Single layer: filtration efficiencies ranged from 5% to 80% and 5% to 95% for particle sizes of less than 300 nm and over 300 nm, respectively. Materials such as satin and synthetic silk did not provide strong filtration protection (less than 30%).

Reference	Method and materials	Experiment characteristics	Findings
Aerosol Filtration Efficiency of Common Fabrics Used in Respiratory Cloth Masks	combination. N95 respirators and surgical masks tested for comparison. Objective: to assess the performance of various commonly available fabrics used in cloth masks and to evaluate filtration efficiencies as a function of aerosol particulate sizes in the 10 nm to 10 µm range (respiratory infection: droplets less than 5 µm considered primary source of transmission and droplets less than 1 µm tend to stay as aerosol in environment for up to 8 hours).	concentration are measured using particle analyzers (OPS and Nanoscan), and the resultant particle concentrations are used to determine filter efficiencies. Test specimen (mask) is held in place using a clamp for better seal. Two circular holes with a diameter of 0.635 cm are used to simulate the effect of gaps (improper fit of the mask) on the filtration efficiency. Aerosol simulation details: particles in the range of 10 nm to 10 µm produced by an NaCl aerosol generator and passed through the material to test. Flow rates: 1.2 and 3.2 CFM, representative of respiration rates at rest (around 35 L/min) and during moderate exertion (around 90 L/min), respectively. Each sample was tested 7 times.	Cotton, the most widely used material for cloth masks, performs better at higher weave densities (threads per inch, TPI): a 600 TPI cotton showed more than 65% efficiency at less than 300 nm and more than 90% efficiency at more than 300 nm, while a 80 TPI cotton had efficiencies varying from around 5% to around 55% across the entire range of particle sizes. Cotton quilt also provided excellent filtration (more than 80% for less than 300 nm and more than 90% for more than 300 nm). Fabrics with moderate electrostatic discharge values (silk with 1, 2 and 4 layers, chiffon and flannel) were also assessed. In all cases, the performance in filtering nanosized particles less than 300 nm is superior to performance in the 300 nm to 6 µm range and particularly effective below around 30nm, consistent with the expectations from the electrostatic effects of these materials. 4-layer silk composite offers over 80% filtration efficiency across the entire range, from 10 nm to 6 µm. Hybrid approaches (600 TPI cotton and 2-layer silk; 600 TPI cotton and 2-layer chiffon; 600 TPI cotton and 1-layer flannel) combined effects of electrostatic and physical filtering, all resulting in increased efficiency: more than 80% (for particles less than 300 nm) and more than 90% (for particles more than 300 nm). These cloth hybrids are slightly inferior to the N95 mask above 300 nm, but superior for particles smaller than 300 nm. Gaps (as caused by an improper fit of the mask) can result in over a 60% decrease in the filtration efficiency, with similar trends observed in surgical masks and cotton/silk hybrid sample, and at both high and low flow rates.
Ma and others, 2020 (51) Potential utilities of mask-wearing and instant hand hygiene for fighting SARS-CoV-2	Mask types: medical and homemade masks. Mask materials: 1-layer polyester cloth, 1 1-layer polyester cloth and 4-layer kitchen paper, medical masks, N95 masks. Objective: to evaluate the efficacy of 3 types of masks and instant hand wiping using the avian influenza virus in place of SARS-CoV-2 (wearer protection).	Experimental set-up: open syringes were wrapped with the tested masks. The air containing the aerosols was inhaled into and out of the syringes through the piston movement 100 times, to mock human breath. The syringes were filled with alcohol to collect the virus passing through the masks, then quantified by RT-PCR. Aerosol simulation details: a nebulizer was used to produce aerosols with a median diameter of 3.9 µm (65% of the aerosol had diameters less than 5.0 µm). The aerosols contained the avian influenza virus (diameter: 80 nm to 120 nm). Each treatment was conducted independently for 4 times.	N95 masks, medical masks, and homemade masks made of 4-layer kitchen paper and one-layer cloth could block 99.98%, 97.14%, and 95.15% of the virus in aerosols compared with the polyester cloth. Instant hand wiping using a wet towel soaked in water containing 1.00% soap powder, 0.05% active chlorine, or 0.25% active chlorine from sodium hypochlorite removed 98.36%, 96.62%, and 99.98% of the virus from hands, respectively. Based on their results and on the experience from 7 countries, the authors propose the approach of mask-wearing plus instant hand hygiene to slow the exponential spread of the virus.

Reference	Method and materials	Experiment characteristics	Findings
Rodrigues-Palacios and others, 2020 (52) Textile Masks and Surface Covers – A 'Universal Droplet Reduction Model' Against Respiratory Pandemics	Mask types: cloth or homemade. Mask materials: 6 household textiles, including 100% combed cotton (T-shirt material), 100% polyester microfiber 300-thread count fabric (pillow case), two loosely woven 'homespun' 100% cotton fabrics (140 GSM, 60x60-thread count; and 115 grams per square metre, 52x48-thread count), and 'dry technology' 100% polyester common (sport jerseys). Medical masks and surgical cloth material tested for comparison. Objective: to assess household textiles to quantify their potential as effective environmental droplet barriers (source control).	Experimental set-up: droplets passing through the tested material were quantified using Petri-dished placed on a table every 30 cm (from 0 to 180cm). Plates remained open for 10 minutes to allow droplet landing. Sneeze simulation details: household spray bottles were filled with aqueous suspension of probiotics; nozzles were adjusted to produce cloud and jet-propelled droplets that match the visual architecture of droplet formation. Droplet size: 20 µm to 900µm (peak at 70 µm to 100 µm) Each experiment was conducted in duplicate.	All textiles reduced the number of droplets reaching surfaces, restricting their dispersion to less than 30cm, when used as single layers. When used as double-layers, textiles were as effective as medical mask/surgical-cloth materials, reducing droplet dispersion to less than 10cm, and the area of circumferential contamination to around 0.3%. The least-effective textile as single-layer (most-'breathable', 100%-cotton homespun-115 material) achieved a 90% to 99.998% droplet retention improvement when used as two-layers. To note that the droplets used in this study were larger than those used in most experiments.
Wang and others, 2020 (53) Selection of homemade mask materials for preventing transmission of COVID-19: a laboratory study	Mask types: cloth or homemade. Mask materials: 17 materials (T-shirt, fleece sweater, outdoor jacket, down jacket, sun-protective clothing, jeans, hairy tea towel, granular tea towel, non-woven fabrics shopping bag, vacuum cleaner dust bag, diaper, sanitary pad, non-woven shopping bag, vacuum cleaner bag, pillowcase (3 different types), medical non-woven fabric, and medical gauze) and 15 combinations of paired materials. Objective: to combine the comprehensive literature and expert advice to screen the materials of homemade masks with good accessibility, and, through laboratory performance testing, to select materials suitable for homemade masks to protect against respiratory infectious diseases.	Material selection: Pubmed and Embase were systematically searched to identify civilian homemade mask materials under the epidemic of H5N1 and SARS, including T-shirts, scarves, tea towels, pillowcases, antibacterial pillowcases, vacuum cleaner dust bags, linen, silk, etc. 6 papers were identified, and a panel of 8 experts (from different fields) determined the candidate materials. Experimental set-up: standard procedures were implemented, using a TSI 8130 Automated Filter Tester to test particle filtration efficiency. Material pre-treatment: 24 hours in an environment with a relative humidity of 85% and at 38C; test conducted within 2 hours after pre-treatment. Aerosol simulation details: 0.075 plus or minus 0.02 µm (count median diameter) NaCl aerosols. Flow rate: 30 L/min 5 samples were tested for each material. Materials were tested in 4 areas: • pressure difference • particle filtration efficiency • bacterial filtration efficiency • resistance to surface wetting Findings reported are mainly related to the particle filtration testing.	Only one material (medical non-woven fabric) met the standards of particle filtration efficiency (at least 30%), pressure difference (at most 49Pa) and resistance to surface wetting. None met the standard of bacterial filtration efficiency (at least 95%). 3 double-layer materials (double-layer medical non-woven fabric; medical non-woven fabric plus non-woven shopping bag; medical non-woven fabric plus granular tea towel) mand othersl the standards of pressure difference, particle filtration efficiency, and resistance to surface wetting, and were close to the standard of the bacterial filtration efficiency. Particle filtration efficiency results of interest 11 Single-layer homemade masks: • t-shirt: 11% to 13% • fleece sweater: 6% • hairy tea towel: 22% to 24% • granular tea towel: 11% to 13% • non-woven shopping bag: 12% to 16% • pillowcase: 0% • medical non-woven fabric: 40% to 44% • medical gauze 4 layers: 2% • medical gauze 8 layers: 3% • medical gauze 12 layers: 6% • medical gauze 16 layers: 13% to 15% Particle filtration efficiency Double-layer homemade masks: • fleece sweater and T-shirt: 11% to 13% • non-woven shopping bag and T-shirt: 29% to 31%

Reference	Method and materials	Experiment characteristics	Findings
			• medical non-woven fabric and Fleece sweater: 34% to 36% • medical non-woven fabric 2-layer: 53% to 55%
Zhao and others, 2020 (54) Household materials selection for homemade cloth face coverings and their filtration efficiency enhancement with triboelectric charging	Mask types: cloth or homemade. Mask materials: common household materials of natural and synthetic origin, such as cotton, polyester, silk, nylon and cellulose. Personal protective equipment material (respirator media and 2 medical face mask media) tested for comparison. Objective: to evaluate the filtration efficiency and pressure drop of natural and synthetic materials using a modified procedure for N95 respirator approval.	Experimental set-up: modified version of the NIOSH standard test procedure, using Automated Filter Tester 8130A. Fabric samples were not preconditioned in any way. Aerosol Simulation Details: 0.075 plus or minus 0.02 µm (count median diameter) NaCl aerosols. Flow rate: 32L/min 3 samples were tested for each material (except for cotton, only twice). Optical images obtained by SEM to assess the microscopic structure of the materials. (not reported here). Testing was also performed after triboelectric charging (by rubbing the sample for 30s using latex gloves) to positively impact the filtration properties of the materials.	Filtration efficiency: • respirator media: 96% • medical face mask media: 19% to 33% • polypropylene spunbond: 6% • Polypropylene spunbond 5 layers: 24% • Cotton T-shirt: 5% if woven, 22% if knit • Cotton sweater (knit): 26% • Polyester (knit, toddler wrap): 18% • Silk (napkin, woven): 5% • Nylon (exercise pants, woven): 23% • Cellulose (paper towel, bonded): 10% • Cellulose (tissue paper, bonded): 20% • Cellulose (copy paper, bonded): 99.8% Authors' comments: • some of the cotton materials had similar filtering properties to some grades of medical face masks • the cotton should be woven/knit at a high density. If a lower density cotton is used, it may be best to use multilayers • paper towel or tissue paper may be suitable to use as a disposable media in some homemade facial coverings, such as between cotton for an increase in filtration efficiency Tribolelectric charging: all 3 cotton samples had a decreased or unchanged filtration efficiency, while all other samples had an increase in filtration efficiency. The authors commented that the differences in results compared to (50) may arise from differences in instrumentation, testing method, and source of material.

Annexe C: Protocol

Review questions

1. What is the effectiveness of face coverings (including masks, face shields and visors) in reducing the transmission of COVID-19 in community settings?
2. What is the efficacy of different types of face coverings (masks/face shields/visors)?

Eligibility criteria

	Included	Excluded
Population	Human	Non-human studies
Settings	Masks: All community settings, including households Visors and shields: all settings	Healthcare settings (masks only)
Context	COVID-19 disease	Other infectious diseases
Intervention / exposure	All types of face covering, including (but not limited to) handmade and commercial cloth masks (cloth, cotton, gauze, etc), medical masks, face shields and visors	Studies comparing effectiveness of surgical masks to N95 respirators
Outcomes	• transmission of SARS-CoV-2 • SARS-CoV-2 infection • basic reproduction number • mask filtration capacity or droplet transmissions	
Language	English	
Date of publication	20 August 2020 to 22 September 2020	
Study design	• experimental or observational studies • modelling studies • laboratory studies • case series and case reports	• systematic reviews • guidelines • opinion pieces • surveys on face covering compliance unless transmission is also included (this exclusion was added during full text screening)
Publication type	Published and pre-print	

Sources of evidence

Medline, Embase, medRxiv preprints, WHO COVID-19 Research Database, arXiv preprints.

Search terms

1. mask*.tw,kw.
2. face?mask*.tw,kw.
3. ((face or head) adj2 cover*).tw,kw.
4. face?cover*.tw,kw.
5. (cloth* adj2 (cover* or protect*)).tw,kw.
6. physical barrier*.tw,kw.
7. physical intervention*.tw,kw.
8. non-pharmaceutical.tw,kw.
9. (mouth adj2 (cover* or protect*)).tw,kw.
10. (nose adj2 (cover* or protect*)).tw,kw.
11. Masks/
12. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13. exp coronavirus/
14. exp Coronavirus Infections/
15. ((corona* or corono*) adj1 (virus* or viral* or virinae*)).ti,ab,kw.
16. (coronavirus* or coronovirus* or coronavirinae* or CoV or HCoV*).ti,ab,kw.
17. (2019-nCoV or 2019nCoV or nCoV2019 or nCoV-2019 or COVID-19 or COVID19 or CORVID-19 or CORVID19 or WN-CoV or WNCoV or HCoV-19 or HCoV19 or 2019 novel* or Ncov or n-cov or SARS-CoV-2 or SARSCoV-2 or SARSCoV2 or SARS-CoV2 or SARSCov19 or SARS-Cov19 or SARSCov-19 or SARS-Cov-19 or Ncovor or Ncorona* or Ncorono* or NcovWuhan* or NcovHubei* or NcovChina* or NcovChinese* or SARS2 or SARS-2 or SARScoronavirus2 or SARS-coronavirus-2 or SARScoronavirus 2 or SARS coronavirus2 or SARScoronovirus2 or SARS-coronovirus-2 or SARScoronovirus 2 or SARS coronovirus2).ti,ab,kw.
18. (respiratory* adj2 (symptom* or disease* or illness* or condition*) adj10 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.
19. ((seafood market* or food market* or pneumonia*) adj10 (Wuhan* or Hubei* or China* or Chinese* or Huanan*)).ti,ab,kw.
20. ((outbreak* or wildlife* or pandemic* or epidemic*) adj1 (Wuhan* or Hubei or China* or Chinese* or Huanan*)).ti,ab,kw.
21. or/13-20
22. 12 and 21
23. limit 22 to dt=20200325-20200605

Screening

Screening on title and abstract will be undertaken in duplicate by 2 reviewers for at least 10% of the eligible studies, with the full screen undertaken by one reviewer. Disagreement will be resolved by discussion. Screening on full text will be undertaken by one reviewer and checked by a second.

Data extraction

Summary information for each study will be extracted and reported in tabular form. This will be undertaken by one reviewer and checked by a second reviewer.

Risk of bias assessment

Due to the rapid nature of the work, validated tools will not be used for primary studies; however, papers will be evaluated based on study design and main source of bias (mainly population, selection, exposure and outcome).

Synthesis

A narrative synthesis will be provided.

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