THE UNIVERSITY of EDINBURGH
Edinburgh Medical School

Master of Public Health

Dissertation

THE POTENTIAL ROLE OF FACEMASKS IN MITIGATING THE TRANSMISSION OF COVID-19 IN ROHINGYA REFUGEE CAMPS IN BANGLADESH

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ABSTRACT

Background:

COVID-19 has affected populations around the globe differently. The worst affected populations are those living in poverty, home and statelessness, with limited or no access to personal protective equipment (PPE), poor medical aid and prevalence of pre-existing health conditions and comorbidities. The Rohingya refugee population living in camps are a particularly vulnerable group. With a population of almost 900,000 refugees distributed at several camps in Bangladesh, most non-pharmaceutical interventions (NPIs) such as social distancing and quarantine are not possible due to overcrowded housing provisions and a lack of proper infrastructure. A shortage of soap and water makes maintaining hand hygiene challenging. There is an added shortage of skilled healthcare workers and medical supplies. Such shortages and health inequalities can result in a devastating death toll if COVID-19 transmission is not controlled.

With most NPIs being ineffective, the provision and use of facemasks at the camps could make a significant difference. Due to a shortage of commercial facemasks, homemade facemasks could be a suitable alternative and their effectiveness and implementation needs to be considered and explored for this specific community.

Aim:

The aim of this dissertation is to evaluate the role of facemasks, homemade and commercial, in mitigating transmission of COVID-19 within Rohingya refugee camps.

Methods:

This rapid review dissertation uses data from three individual UNCOVER rapid reviews the author was involved in: the effectiveness of facemasks in mitigating transmission of COVID-19 in community settings; the effectiveness of homemade facemasks in mitigating spread of infection; and lastly, transmission, outcomes and consequences of COVID-19 among refugees and migrant populations. The dissertation interlinks the findings from these reviews and builds on them to address the research question.

Results:

The research concluded that both commercial and homemade facemasks can significantly reduce droplet transmission (via large droplets more than 50 μm), and thus their use has potential to reduce transmission in Rohingya refugee camps by preventing the wearer from transmitting infection. There is limited literature on small droplet or aerosol (<50 μm) transmission of the virus and its possible methods of prevention and requires further research.

Conclusion:

It is observed that facemasks alone cannot significantly reduce spread of infection by various modes of transmission. However, facemasks in combination with other NPIs such as social distancing and hand washing can substantially reduce transmission.

However, facemasks can make a difference in mitigating droplet transmission at Rohingya refugee camps and should be encouraged. Homemade facemasks are a suitable and cost-effective alternative to commercially manufactured facemasks, and interventions focusing on providing materials for homemade masks should be prioritised by policymakers.

STATEMENT OF ORIGINALITY

I hereby declare that this dissertation has been composed by me and is based on my own work as well as my work done for UNCOVER, Usher Institute's academic body of researchers. To ensure interrater reliability for the purpose of future publication of results, UNCOVER team members have provided the following contribution in the literature selection and quality appraisal stages:

1. Checking excluded studies and duplicate studies during title and abstract screening and selection
2. Checking excluded studies during full-text screening and selection of the agreed relevant records
3. Independent quality appraisal of included studies

Signature: (SIGNED)

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ABBREVIATIONS

COVID-19	Coronavirus infectious disease 2019
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
UNCOVER	Usher Network for COVID Evidence Reviews
WHO	World Health Organisation
NPIs	Non-pharmaceutical interventions
PPE	Personal protective equipment
SARS	Severe Acute Respiratory Syndrome
MERS	Middle-east Respiratory Syndrome
ILI	Influenza like illness
RCTs	Randomised Controlled Trails
BAME	Black, Asian and minority ethnic
RTIs	Respiratory tract infections
CASP	Critical Appraisal Skills Programme
CINAHL	Cumulated Index to Nursing and Allied Health Literature

CHAPTER ONE: INTRODUCTION

1.1. COVID-19 AND UNCOVER Rapid Reviews

COVID-19, a newly discovered infectious disease caused by a new coronavirus named SARS-CoV-2, has become a complex public health challenge in various parts of the world (WHO-COVID-19). To understand and control the disease, unprecedented amounts of research are being conducted world-wide on a wide range of research areas surrounding this disease and its causative virus, generating vast amounts of data. The disease had evolved from an outbreak to a rapidly advancing pandemic involving a novel virus, and decisionmakers face an urgent need for the best available evidence on a wide range of clinical and public health questions to enable them to make rapid policy decisions. In response, University of Edinburgh's Usher Institute academic staff and students came together to create the Usher Network for COVID Evidence Reviews (UNCOVER), an academic body of researchers, experts and students who extract relevant and reliable data and report high quality evidence on key public health topics on COVID-19 which can be used by citizens as well as policymakers. The UNCOVER group conduct rapid reviews as well as scoping reviews that focus on population health and can be used by anyone researching clinical as well as para-clinical aspects of COVID-19 (UNCOVER homepage).

Rapid reviews are informed by systematic reviews methodology, adapted for a limited timeframe by omitting certain stages/components of the process. There is a lack of standardization of the rapid review process, with no definitive criteria for performing a rapid review. UNCOVER has therefore developed its rapid review methodology, principles and methods based on a literature review of best practice rapid review methodology, balancing rigour and time (UNCOVER methodology). As a student working for UNCOVER, I had the opportunity to work on rapid reviews covering specific topics such as the effectiveness of facemasks in community settings, behavioural aspects of facemasks, homemade facemasks, and transmission of the virus among refugee and migrant populations all over the globe. Senior academics led the reviews, set the parameters and guided the process. As the global situation of COVID-19 shifted, the topic of the reviews also kept up with the new emerging trends. The purpose of this dissertation is to build on the work of the UNCOVER rapid reviews that I was involved in, in order to investigate the role of face coverings in mitigating the transmission of SARS-CoV-2 among the Rohingya refugee populations. Rohingyas are one of the most persecuted minorities in the world that live in

statelessness. With an estimated population of about 1 million people globally, Rohingyas are a Muslim ethnic minority group situated mostly in Bangladesh, Malaysia and Thailand (Milton et al., 2017). Most of the refugees are settled in Bangladesh refugee camps due to provision of better living conditions and humanitarian relief as well as religious similarities. However, the situation at these camps is still below normal human standards. The living conditions inside these overcrowded camps remain poor, with unhygienic environments, endemic malnutrition and high cases of physical, mental and sexual abuse (Ahmad, 2014).

This chapter includes a brief introduction to the pandemic and its cause, the SARS-CoV-2 virus; followed by introduction of the topic of this dissertation – the role of facemasks and their importance among vulnerable populations, specifically the Rohingya refugee camps. The importance of this topic as a public health issue will also be discussed, along with main aims and objectives. This dissertation will use the UNCOVER reviews I was involved in (demonstrated in Table 1) as a starting point, develop and update the work and apply the findings from the reviews to a specific population- the Rohingya refugees.

Title of UNCOVER Review	**Review research questions**	**How this Dissertation builds on the reviews**
Rapid review: Does the use of face masks in the general population make a difference to spread of infection? [5th April - 7th April 2020]	• Can the use of face masks prevent transmission of COVID-19? • Do masks reduce viral shedding by respiratory droplets and/ or aerosols? • Is there a difference between different types of masks (e.g. surgical or home-made masks)? • What are the behavioural aspects of face mask use by the general population?	• Will facemasks be able to reduce transmission of COVID-19 for living conditions specific to Rohingya refugee communities? • What are the barriers and enablers to the use of facemasks to reduce transmission in Rohingya refugee communities in Bangladesh?

		• What is the ability to safely dispose these facemasks?
Rapid Review: Are homemade facemasks effective at reducing transmission of COVID-19 in community settings? [14th April - 19th April 2020]	• Do homemade or improvised facemasks prevent the transmission of respiratory viruses? • What materials work (what are the virus filtration properties of different materials)? • What design(s) of mask work (in terms of fit and comfort)? • Can these masks be safely washed and reused?	• Can homemade facemasks be manufactured or provided at these refugee camps- what are the available resources? • Are these facemasks safely reusable or washable?
What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review. [8th June 2020 - present] This is ongoing UNCOVER review.	• What is the prevalence, severity and mortality of COVID-19 among refugees, asylum-seekers and undocumented migrants. • What are the risk factors which can affect the transmission of COVID-19 or other respiratory viruses (such as living conditions, ability to comply with public health measures, etc). • What is the wider impact of COVID-19 (for example, its impact on international mobility, access to employment, creation or reinforcement of stigma and so on). • Highlighting country-specific experiences of refugees, asylum seekers and undocumented migrants – whether these relate to migrants' country of origin, or of transit or destination.	• What is the prevalence, severity and mortality of COVID at Rohingya refugee camps and how will facemasks be useful? • What are the main risk factors for disease spread at Rohingya refugee camps? What are the most suitable non-pharmaceutical interventions (NPIs) at these camps, along with facemasks?

Table 1: List of conducted UNCOVER reviews, content covered and how they relate to this dissertation.

1.2. From an Outbreak to a Global Pandemic

December 2019 witnessed a rise in cases of an unknown viral illness causing moderate to severe respiratory symptoms in the Hubei province of China (WHO, 2020a). Within weeks, this outbreak began to spread to other parts of the world. It was named 'COVID-19' by World Health Organisation (WHO) on 11th February 2020 (WHO,2020b). COVID stands for coronavirus infectious disease, and 19 refers to 2019, when the virus was first recognized as spreading from human to human (WHO,2020b). Such an unprecedented series of events have caused a ripple effect on many aspects of billions of human lives, damaging world economies and challenging the healthcare systems of various countries (Nicola et al., 2020). The geographical spread of COVID-19 from Hubei province in China to all over the globe has been swift. Although China exhibited one of the most aggressive disease containment approaches in history which reduced the number of cases substantially, the rest of the world witnessed a sharp rise in cases (Wu and McGoogan, 2020). There are numerous reasons attributed to this escalation.

It is imperative for any government to take early action to combat the threat of a rising epidemic. Evidence suggests that some nurses and doctors in Wuhan, China became aware of a SARS-like illness in early December and started requesting PPE (personal protective equipment), particularly facemasks and gloves. The early warning signs of a viral outbreak were not given much attention by authorities in China. The lack of efficient investigation and control measures followed by a lack of transparency became a barrier for controlling the 'mysterious virus'. Whilst the virus was spreading rapidly in the Hubei province of China, international as well as domestic travel became an important contributor to the rapid spread of the virus. Nearly 5 million people fled Wuhan before the government imposed travel bans (Surveillances, 2020, Chen et al., 2020b). It took only 30 days from the start of the outbreak for the disease to spread to other locations outside Wuhan (Chen et al., 2020b). Cases began to rise all over the globe. Poor on-site screening equipment at airports allowed mass movement of infectious travelers (Chen et al., 2020a). Stricter control of mass movements should have been a priority, although this would not have been sufficient to control disease spread. A key feature of this disease which makes it particularly challenging to control is that cases are infectious before symptoms develop (pre-symptomatic) or even without exhibiting any symptoms at all (asymptomatic) (Chen et al., 2020a).

Diagnosis of COVID-19 requires precise and reliable tests. As this was a new disease, designing, approving and manufacturing diagnostic tests was a challenge in itself. While some countries such as South Korea and Singapore managed to effectively design and deploy diagnostic tests, other countries like USA, South Africa and Japan have struggled to keep up with the high demand for testing (Subbaraman, 2020). Figure 1 shows unequal testing among various countries, last updated on 23rd March 2020. This lack of diagnostic testing only added to the world-wide burden of COVID-19 cases.

Figure 1: Unequal testing of COVID-19 among different countries (updated on 23rd March 2020)
Source: Our World in Data (https://ourworldindata.org/coronavirus-testing)

Health support systems in many countries were not prepared for this deadly disease and faced enormous difficulties in coping with the continuous rise of COVID-19 cases. Lack of PPE only added to the burden, causing many healthcare workers to also succumb to the virus (Wang et al., 2020). Among the total number of deaths from COVID, a significant number were healthcare workers and frontline workers (Sim, 2020). It also quickly became apparent that those from ethnic minorities in the UK were

disproportionately affected, with two thirds of deceased healthcare workers belonging to ethnic minority groups (Rimmer, 2020)(see figure 2). This also led to an overall shortage of frontline workers in many parts of the country (J Fagan et al., 2020).

An amalgamation of these factors contributed to a local outbreak turning into a world-wide pandemic.

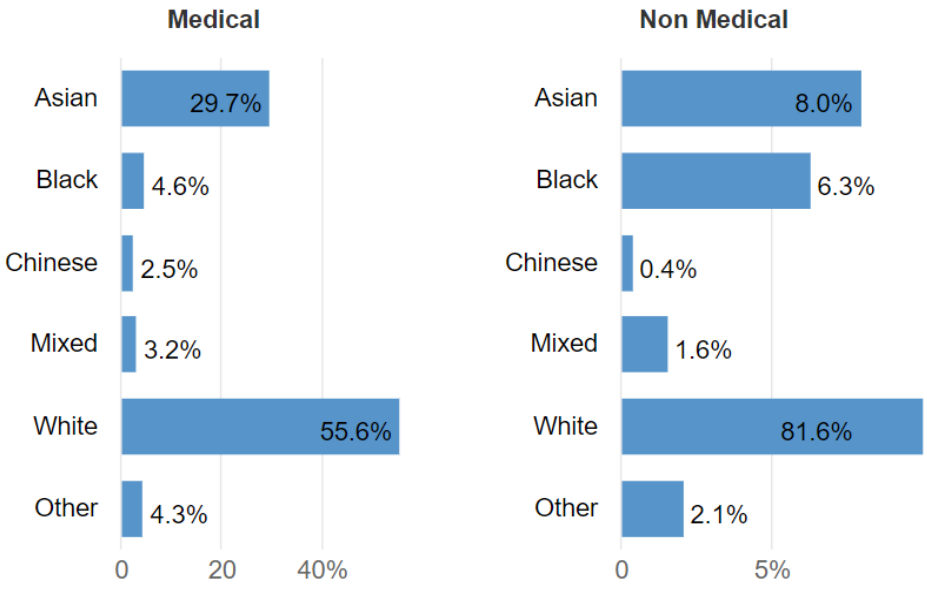

Figure 2: Percentage of NHS staff by ethnicity and type of role

Source: NHS workforce by ethnicity, updated on 7th August 2020

1.3. COVID-19 pathophysiology

Coronaviruses have been known to affect humans since the 1960s (Monto et al., 2014) . To date, seven coronaviruses have been identified as affecting humans and have caused respiratory symptoms along with fever and flu like symptoms in humans (Monto et al., 2014). COVID-19 is caused by a newly discovered coronavirus called Sars-CoV-2 . Most people infected by this virus experience mild to moderate respiratory symptoms along with dry cough, fatigue and fever, and require no special treatment (Jutzeler et al., 2020). However, people with underlying medical illnesses such as diabetes (Das et al., 2020), cardiovascular diseases (Wu et al., 2020) and immunocompromised cases can experience severe debilitating illness. Initial studies on symptoms of the virus confirmed such findings. However, with time, new studies suggesting new symptoms began to emerge. For example, some people experienced less common symptoms such as aches and pains, loss of taste or smell and skin discoloration (Ortiz-Prado et al., 2020). Apart from these short-term effects of the virus, long-term

pulmonary effects have also been observed in patients, including those with mild to moderate symptoms. Although most of these patients are able to return to normal life, long term disability is common among viral pneumonia patients. They can show signs of lung damage as well as other organ damage (Salehi et al., 2020). There is increasing evidence on COVID being a multi-system disease and causing long term repercussions. There are some accounts of patients as well as doctors who talk about the long term effects of COVID, termed as 'Long COVID' (Mahase, 2020). There are cases of recovered patients going back to hospitals for lingering symptoms such as chronic fatigue, dyspnoea and joint pain. For example, researchers at a hospital in Rome reported nine out of ten patients who recovered continued to experience at least one symptom a day even after 60 days from onset of the illness. Many patients reported a reduced quality of life (Carfì et al., 2020). There is a need for additional research of long COVID.

1.4. The Role of Facemasks

As the pandemic grew in proportion, so did the demand for PPE. Although WHO guidelines recommended the use of facemasks (Organization, 2020), a clear gap between the demand and supply of surgical facemasks was witnessed in many parts of the world, especially for healthcare workers. While some countries made facemasks mandatory for citizens, others gave more importance to other preventive measures such as hand washing and social distancing. Thus, a widespread debate on whether facemasks are effective and help with prevention of COVID-19 began.

The debate about the role of facemasks has evolved and is still constantly evolving, raising questions such as do they protect the wearer against a respiratory viral illness? Do they protect people around the wearer? Do they prevent non-droplet modes of transmission? Should they be worn indoors as well as outdoors and if worn, will they give the wearer a false sense of security and encourage greater risk-taking behaviour? Other additional concerns also persisted, for example, would homemade facemasks be equally effective as surgical facemasks? What are the best materials for making these masks? How comfortable are facemasks and can they be worn for long periods and/or in warm weather? How will people react to being asked to wear facemasks? With numerous such questions being asked, the debate on facemasks took interesting shifts and led to different angles of research, as mentioned below.

A lack of COVID related research on facemasks during the initial stages was felt, as the aggravation of the outbreak into a pandemic did not give researchers enough time or data to produce high quality evidence specific to Sars-CoV-2. This led to researchers looking at proxy evidence: existing RCT (randomized controlled trial) evidence on the effectiveness of facemasks against influenza, influenza like illness (Bandiera et al.) and SARS, as RCTs are considered high-quality epidemiological evidence (Rosner, 2012). These studies primarily focused on protecting the wearer from infected individuals and not vice-versa.

As the pandemic progressed, new evidence started emerging about modes of transmission of the SARS-CoV-2 virus. Researchers faced a sense of urgency to publish their research when they realized asymptomatic and pre-symptomatic transmission was causing the virus to inadvertently spread by people who did not realise they were ill, contributing to the disease burden (Eikenberry et al., 2020, Yu and Yang, 2020). The role of facemasks in preventing this transmission took two shifts. Initially the research on facemasks focused on their effectiveness at protecting the wearer from the disease, rather than people around the wearer. Based on the RCT evidence on facemasks and influenza-like illnesses (Bandiera et al.), there was no strong evidence of effectiveness in this regard. However, the advancing pandemic led to adopting the precautionary principle- in the absence of clear evidence, one should adopt the least risky option; in this case, wearing facemasks may be less risky than not wearing facemasks. The second shift in focus was away from protecting the wearer, towards protecting other people from an infected wearer by reducing the extent of droplet spread. Experimental studies based on fluid dynamics using droplets supported this principle (Bandiera et al., 2020).

One of the most advantageous points of UNCOVER was working with experts outside public health, such as fluid dynamic experts. Fluid mechanics is a branch of physics that studies fluid behaviour at rest and in motion. It plays an important role in the pandemic as it studies virus-laden particles and their transmission via droplets, of which the smallest ones are called aerosols (Mittal et al., 2020). It is important for assessing whether NPIs such as facemasks and social distancing are effective against transmission of the virus. New evidence on transmission routes of the virus is rapidly emerging, sometimes questioning if present preventive interventions such as facemasks, hand hygiene and social distancing would be enough to avoid infection. Although such NPIs cannot stop transmission completely, they can help mitigate the spread of the virus. In public health terms, an intervention may not have a large impact on risk at the level of the individual, but if it reduces risk by even a small amount, when multiplied up to the population level, this can be significant. Thus, NPIs need to be investigated

thoroughly to assess their level of impact in a specific setting- the Rohingya refugee camps, an important aim of this dissertation. Modes of transmission of SARS-CoV-2 are discussed below.

***Droplet Transmission*:** Transmission of the virus can occur through several routes, the most common one being large droplet transmission, as opposed to small droplet transmission (i.e. aerosol transmission). Evidence from studies on fluid mechanisms suggest that droplets ranging from 0.1 µm to 1 mm are capable of transmitting viral particles and can be generated by coughing, sneezing or even breathing. Large droplets generated from sneezing can travel 8 m before landing on the ground, droplets generated by coughing can travel up to 2 m before falling on the ground, while droplets generated from speaking land 1 m or less. These droplets land on commonly used surfaces such as tables, doors and chairs, which when touched by someone, can infect that person if they come in contact with their nose, mouth and eyes. The reverse, that is, an infected person touching their eyes, nose or mouth and then touching objects such as tables and chairs is also true and another route of infection (UNCOVER indoor transmission rapid review).

Most face coverings can effectively stop large droplets from landing on surfaces, thus preventing contamination of the environment around the wearer. There are many studies that conducted laboratory experiments to test the efficacy of facemasks. Some important ones are mentioned herewith.

Bandiera et al. (2020) studied the effectiveness of surgical facemasks and single-layer cotton facemasks on successfully mitigating transmission by large droplets (see Figure 3). It showed that a person wearing even a basic facemask and standing 5cm away from another person is exposed to much lesser number of droplets as compared to a person not wearing any face covering and standing 2 m away. A person wearing a face covering is also likely to transmit less droplets to his surrounding environment in a horizontal direction. What I like about the methodology in this paper is that the authors evaluated the efficiency of masks speaking for 20 minutes. Also, from their results it should be possible to calculate the particle sizes emitted by people speaking, which would have helped understand aerosol transmission as well. The problem here is that they continue to search for large particles, while the aerosol particle count would also increase by prolonged speaking- perhaps also being a cause of infection, a possible confounder. However, it is an interesting result that states very few larger particles seem to escape the

masks and mostly in a downward direction, and thus masks have a significant protective effect to others around the wearer. It is a pre-print study and has not been peer-reviewed, and thus has not been evaluated yet. Another major limitation of this study was the failure of the results to apply to non-droplet transmission, in which case, the findings of the study may overestimate the effectiveness of facemasks. Finally, it is a study conducted under strictly controlled laboratory conditions and so the results may not be replicable in the real world.

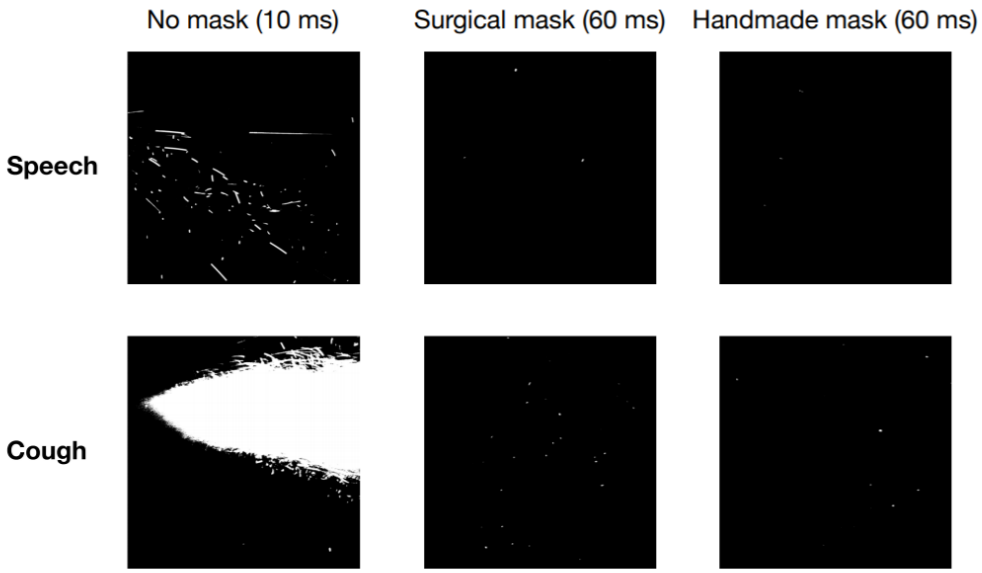

Figure 3: Laser Imaging of Respiratory Droplets in Flight.

Examples of images captured at a position directly in front of the mouth for speaking (upper row) and coughing (lower row), without mask (1st column), with the handmade mask (2nd column) and with the surgical mask (3rd column).

Source: Lucia Bandiera, Geethanjali Pavar, Gabriele Pisetta, Shuji Otomo, Enzo Mangano, Jonathan R. Seckl, Paul Digard, Emanuela Molinari, Filippo Menolascina, Ignazio Maria Viola. medRxiv 2020.08.11.20145086; doi: https://doi.org/10.1101/2020.08.11.20145086

Another experimental study by Fischer et al. (2020) studied droplet transmission and a cost-effective method to study role of different types of facemasks in preventing transmission for droplet sizes larger than 0.5 µm. It asked participants to speak inside a laser beam scatter light apparatus, which recorded droplets with a cell phone camera and a computer algorithm was used to count the droplets. It found that transmission was low for a fitted N95 mask and high for a homemade fleece mask (see Figure 4). Facemasks acted as a physical barrier and resulted in fewer droplets being transmitted, along with

causing a delay between speaking and landing of particles on a surface. It supported the evidence that facemasks reduce overall transmission via droplets. The paper is well written, and the scientific method is sound for a qualitative comparison of different masks, but I see some flaws in their method and the general approach. They propose a new method using a mobile phone camera in combination with a laser to detect aerosols/particles not being held back by different masks. The test approach in my opinion is flawed. They should have either tested the efficiency of the material of the face masks with regards to holding back particles or for the test they performed they should have also analysed how many particles escape through the side of the masks, thereby also assessing mask fit.

a. Mask material efficiency test: What they performed is a mask material efficiency test, but they fail to show how materials perform over a longer time of wearing. How does the efficiency of the mask material get affected if it, for example, gets soaked by the exhaled particles over a longer period of wearing/speaking (for example an hour of conversation)?

b. For a more comprehensive test of standard masks it would have also been required for the testers to turn their heads sideways so the particle emission from a 90 degree angle could be performed. The surgical masks should perform in this test significantly worse than the N95 mask.

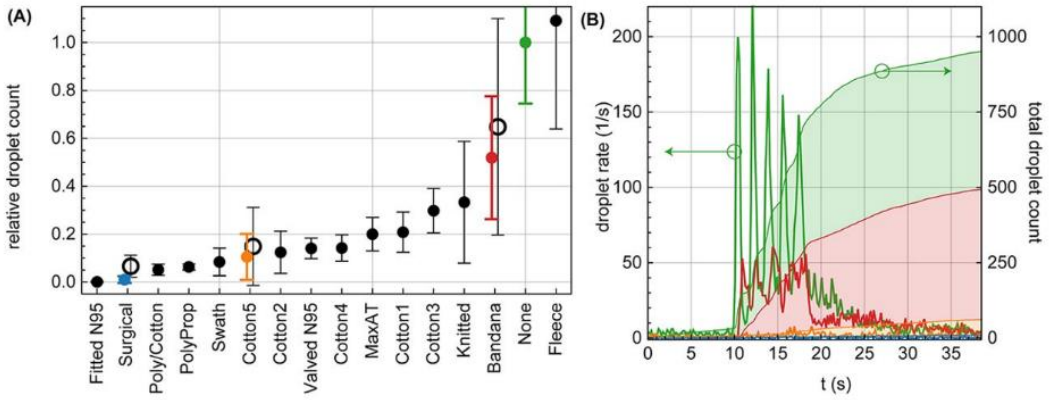

Figure 4: Droplet transmission through facemasks.

(A) Relative droplet transmission through the corresponding mask. Each solid data point represents the mean and standard deviation over 10 trials for the same mask, normalized to the control trial (no mask), and tested by one speaker. The hollow data points are the mean and standard deviations of the relative counts over four speakers. **(B)**The time evolution of the droplet count (left axis) is shown for representative examples, marked with the corresponding color in (A): No mask (Summers et al.), Bandana (Salehi et al.), cotton mask (orange), and surgical (blue – not visible on this scale). The cumulative droplet count for these cases is also shown (right axis).
Source: Fischer, E. P., Fischer, M. C., Grass, D., Henrion, I., Warren, W. S. & Westman, E. 2020. Low-cost measurement of facemask efficacy for filtering expelled droplets during speech. Science Advances, eabd3083.

As seen from figure 4, the confidence intervals are wide for knitted, bandana, fleece masks and no mask, presenting a less precise estimate of effect. It is interesting to note here that fleece masks present a higher droplet transmission rate than no mask. This is a contradiction to studies such as Bandiera et al. (2020) that state facemasks are more effective than no masks. A possible explanation, as Fischer et al. (2020) explains in his study, is that some materials can split larger droplets into smaller ones upon sneezing or coughing, increasing chances of transmission by smaller droplets (aerosol), which is less easily preventable than droplet spread, accounting for this contraindication.

As above, an important drawback of such studies is the fact that they are performed in controlled laboratory settings and their generalisability to the real-world environment is debatable. Bandiera et al. (2020) and Fischer et al. (2020) studies show that face coverings are efficient in different measures depending on the fabric. A 3-layer cotton mask mitigates transmission by 2/3rd as compared to no mask. This is evidence to believe that the results would not be very different outside of laboratory settings. Such studies on droplet transmission through fluid dynamics gave an interesting perspective to facemask efficacy. Similar studies were also conducted to assess aerosol transmission, as mentioned below.

***Aerosolised Transmission*:** Although the main route of transmission is believed to be via droplets, aerosolised transmission (i.e. droplet size less than 50 microns) can occur via very small particles of desiccated virus which remain suspended in air indefinitely rather than falling to the ground due to their small size (UNCOVER indoor transmission rapid review). Although the droplets can remain suspended in air indefinitely, this does not mean they remain infectious indefinitely; the virus has a half-life of few hours (Van Doremalen et al., 2020). Theoretically, coughing or sneezing generates both droplets and aerosols and thus there is a risk of transmission by aerosolised particles. Some studies have attempted to study such transmission by experimental means, as mentioned below.

A study by Van Doremalen et al. (2020) suggested that the virus can survive in air in aerosolized form for up to 3 hours (with a half-life of just over one hour). The study also measured persistence of the virus under different environmental conditions. It concluded that low temperatures (approximately 4°C) were more favourable for transmission than higher temperature. Experiments conducted by Chen et al. (2011) showed temperature differences between two rooms caused a two-way flow of air, hinting at

temperature differences also potentially playing a role in viral spread because of mobility of aerosols. This mobility can be due to a variety of factors such as having an open window, fans, air conditioning and heating systems and differences in temperature between two rooms.

Another study by Viola et al. (2020) investigated aerosol transmission through air flow generated while breathing and coughing by a person using different types of face coverings (see figure 5) using Background Oriented Schlieren technique, an optical technique that captures three-dimensional images of a jet of air using refractive index of particles (Goldhahn and Seume, 2007). It found that all face coverings without an outlet valve (such as FFP1 and FFP2 masks) reduce forward flow of air by 90% as compared to no mask. However, surgical masks, face shields and homemade masks cause leakage of air downwards and backwards, which can be a major health hazard. As this study is still a pre-print, it has not been peer reviewed and thus cannot be a basis for decision making by policymakers. Although the paper is well written and the literature review is very thorough, I see some limitations of the paper. First, they test breathing and coughing but not speaking. The face muscles move during speaking and the shape of the face changes, making it harder for masks to fit continuously well and to seal off. Research on face masks during speaking was thus important. Secondly, they do not test the performance of masks after wearing it for multiple hours. An important question- how long can masks be effective against aerosol transmission after coming in contact with moisture from the wearer's own air, still remains unanswered. Thirdly, there is no mention of the distribution of particle sizes, which could have a significant impact on the direction of the jet, with slightly larger particles falling downwards as compared to very minute aerosol particles. This could explain the downward jet of air- it may not be linked to aerosol particles after all. Overall, the paper presented good evidence on aerosol transmission. However, the measurement techniques in this paper in combination with Fischer et al. (2020) paper's test approach would make a more comprehensive research paper on aerosol transmission.

Figure 5: Different face coverings tested in Viola et. Al. (2020) study.
(a) surgical mask (b) handmade mask (c) FFP1 (d) FFP2 (e) respirator (f) university-made lightweight face shield (g) commercially heavy-duty face shield
Source: Viola, I., Peterson, B., Pisetta, G., Pavar, G., Akhtar, H., Menoloascina, F., Mangano, E., Dunn, K., Gabl, R. & Nila, A. 2020. Face Coverings, Aerosol Dispersion and Mitigation of Virus Transmission Risk. arXiv preprint arXiv:2005.10720.

Although epidemiological evidence from outbreaks is largely consistent with droplet transmission, there are a few reports which are suggestive of aerosolized transmission – an outbreak traced to a choir practice in Washington DC (Hamner, 2020) and a restaurant outbreak in Guangzhou, China (Lu et al., 2020), where it is thought that the air conditioning system played a role in transporting aerosolized particles around the room. Many studies showed that the ventilation system in a crowded building contributed to the dispersal of the virus over long distances (Liu et al., 2008, Li et al., 2005, Li et al., 2007), thereby potentially increasing transmission. However, ventilation systems can also help mitigate viral transmission by diluting the concentration of the virus (Jiang et al., 2009). Thus, transmission via ventilation systems plays both a positive and negative role; positive in diluting the number of viral particles in air and negative in dispersing it widely around and between buildings.

Whether face coverings can prevent against aerosolised particles is still unclear as most outbreaks are consistent with droplet transmission. Important questions about aerosols remain unanswered, for example, what is the dose needed for transmission, is there a sufficient dose of viral particles present in aerosols to cause infection, and conversely, because aerosols can be inhaled deep into the lungs, does this make them more dangerous? More research is coming up rapidly from different spheres of science such as fluid dynamics, virology etc. to add on the current evidence on aerosol transmission of COVID-19.

While the debate on facemasks was progressing, a shortage of facemasks led to the use of homemade face masks. These masks were made up of various items readily found at home- cloth, linen, undergarments and even sanitary pads. A need for a fixed set of guidelines for making effective homemade masks was felt. Following this, CDC released a step-by-step guide on how to make cloth masks (CDC guidelines, 2020). This relieved the high demand of surgical facemasks for the general public. Many small local businesses also started manufacturing cloth masks (Larsen, 2020). Although it became easy for people to have face masks, this complex debate on effectiveness of different types of facemasks is still ongoing and will continue to be discussed in detail in Chapter 2.

1.5. COVID-19 among Rohingya Refugee Populations:

COVID-19 has not affected people equally. There are huge inequalities in the impact of the disease. The worst affected people are the poorest, the ones living in overcrowded or communal settings such as refugee camps and migration centers. Those who work on a daily wage basis and have no choice but to work during the lockdown such as laborers are also affected the worst, especially those employed by unscrupulous employers who do not abide by health and safety rules and are powerless to stand up to bullying such as insisting that people come to work even when ill (Duclos and Palmer, 2020).
I decided to focus on one such specific and highly vulnerable sub-group – Rohingya refugees and asylum seekers- one of the most vulnerable populations in the world with poor living standards and overcrowded camps in Bangladesh.

Bangladesh is suffering from a high number of COVID cases. Lack of poor health infrastructure, poor adherence to preventive interventions such as social distancing, hand and respiratory hygiene, overcrowded urban areas and substandard housings are all contributing to a rise in number of cases (Islam and Yunus, 2020). Additionally, with two of the world's largest refugee camps in the world, controlling the spread of the virus seems to be an inconceivable task. Preventive interventions such as facemasks, hang hygiene and self-quarantine are not well-received initiatives at these camps. Reporting of number of cases may also be lower than the actual figure, as stigma and fear of becoming positive prevents people from getting tested and treated. Rumours such as killing of infected individuals to prevent further spread of infection are also barriers to controlling extent of the virus (Raju and Ayeb-Karlsson, 2020). It is likely that the camps are heavily affected by the pandemic, but the reporting of the

disease at these camps is inaccurate. The use of facemasks in such scenarios can make a significant difference.

Evidence to date suggests that the use of facemasks alongside other NPIs can play a role in reducing transmission of Sars-CoV-2 by reducing droplet transmission and thus can play an important role at refugee camps. This dissertation will help highlight the health inequalities and risk factors for COVID-19 transmission among Rohingya refugees, as well as the role of facemasks among these populations.

1.6. Public Health Context and Risks

Since December 2019, there has been a rapid acceleration in the number of COVID-19 cases. The number of confirmed cases as of early August 2020 have crossed 20 million as per WHO (WHOdata, 2020) , with more than 700,000 deaths. 213 countries and territories have been affected, USA being the country with highest number of cases, followed by India and Brazil (WHOcharts,2020). While many countries are still battling the virus, some countries such as Hong Kong are experiencing a second wave (Xu and Li, 2020). The pandemic has affected lives in every aspect, be it physical, mental, economic or social; and presents a threat to people of all ages and communities. It is considered one of the worst global crises of our time and the world will take a considerable amount of time to fully recover from its after-effects. Its public health implications and risks are unquestionable.

1.7. Purpose of this dissertation

With the above considered, this review summarises UNCOVER work done as part of a team working on collecting high quality evidence on prevention of COVID-19 using facemasks in both community and refugee settings, highlighting the role of facemasks in curbing the spread of the virus at Rohingya refugee camps.

1.8. Aims and Objectives

Aims

To research the role of facemasks in mitigating transmission of COVID-19 among Rohingya refugee camps.

Objectives

- Contextualise evidence on commercial and homemade facemasks for mitigating transmission of Sars-CoV-2 to the Rohingya population.
- Highlight any behavioural aspects of facemasks that make Rohingya refugees more resistant or compliant for facemask use- barriers and levers to facemask use by members of the Rohingya population.

CHAPTER TWO: BACKGROUND

Chapter one gave an overview of COVID-19, the role of facemasks in community settings as well as vulnerable populations such as the Rohingya communities; and stated the aims and objectives of this dissertation.

This chapter includes a rigorous literature review of the articles found after conducting a search for the three UNCOVER rapid reviews. It is divided into three sections, consistent with the topics of the UNCOVER rapid reviews I worked on: facemasks, homemade facemasks and Rohingya refugees. Each section will draw on the articles included in the UNCOVER rapid reviews, highlighting how they contribute to this dissertation. I will critically assess the literature, highlighting any gaps. Because extensive and comprehensive literature searches were conducted during the review process, of which I was an integral part, I have not conducted my own additional literature search on these topics. Instead, this dissertation draws on the literature identified through the rapid review process. For example, the refugee review covered search terms such as 'Rohingya refugees', 'face coverings', 'PPE' and 'health behaviors' etc. The search results therefore resulted in a large body of literature relevant to the dissertation research topic.

2.1. Facemasks effectiveness in the community

UNCOVER review 003-01 (see Appendix IV: Rapid Review: Does the use of face masks in the general population make a difference to spread of infection?) was conducted in April 2020 and published on the UNCOVER website on 7th April 2020. The research question was- 'Does the use of face masks in the general population make a difference to spread of infection?' This research question was divided into four sub-questions in this specific order- facemasks in preventing transmission in community settings, effectiveness of medical versus non-medical masks, important behavioural aspects of facemasks and lastly, the nature and spread of viral particles (i.e. viral transmission routes). This dissertation focusses on the first and third sub-questions, given their relevance to this dissertation topic. For this rapid review, three recent systematic reviews and meta-analysis were identified and comprehensively analysed. Additionally, a search was conducted on seven databases and preprint servers to identify any literature of relevance to the research question. A total of 766 records were identified by the search; 81 were retained after removing duplicates and then screened. For the first sub-question, no new studies were

retained for analysis and inclusion in the final review. For the third sub-question on behavioural aspects, 31 studies were selected for analysis and inclusion in the final review.

For the literature search, since the topic of facemasks was broad and divided into several sub-topics, the search strategy was extensive and consisted of a combination of search terms, namely 'facemasks', 'effectiveness', 'community transmission', 'behavioural aspects' etc. in a number of databases (refer to Appendix I: Databases and search strategy for the rapid review 'Does the use of face masks in the general population make a difference to spread of infection?'). Most of the studies found were epidemiological in nature which addressed the effectiveness of facemasks against influenza, Influenza like illness (Bandiera et al.), MERS (Middle-East Respiratory Syndrome) and SARS (Severe Acute Respiratory Syndrome). A large number of studies were randomized controlled trials (RCTs) that assessed use of facemasks against influenza (Aiello et al., 2010, Aiello et al., 2012, MacIntyre et al., 2016). These studies provided a quantitative assessment of facemask use, or a combination of facemask use with other preventive measures such as handwashing and sanitizing among different settings.

While many studies targeted household transmission (Cowling et al., 2009, Larson et al., 2010, MacIntyre et al., 2009, Simmerman et al., 2011), some discussed prevention of school transmission during influenza season (Azman et al., 2013, Azor-Martínez et al., 2014), generating data across all age groups. These studies relied on either absenteeism, self-diagnosis or laboratory confirmed diagnosis of influenza to confirm infection; and analysed various interventions such as facemask use, hand hygiene, cough etiquette as well as a combination of the above. Many studies focussed primarily on handwashing as a preventive measure and provided statistical evidence of handwashing with and without facemasks, providing useful insight about choice of preventive intervention, especially for policy makers (Merk et al., 2014, Ram et al., 2015, Saunders-Hastings et al., 2017). Many articles provided data on transmission of influenza among healthcare workers (Jacobs et al., 2009, Jaeger et al., 2011, Kuster et al., 2013, MacIntyre et al., 2014). They were useful in addressing which type of facemasks are relatively more effective. The studies that performed an analysis of different types of facemasks mainly focused on surgical facemasks and N95 respirators (Johnson et al., 2009, Loeb et al., 2009). Some experimental studies did not focus on the public health aspects of facemasks, but instead studied the mode of transmission of the virus as well as characteristics of the virus such as particle size (Milton et al., 2013), airborne transmission. Another interesting study stated the importance of at-home rapid tests in the prevention of influenza transmission (Cheng et al., 2011), adding to the diverse nature of collected literature.

Additionally, various studies demonstrated the prevalence of acute respiratory tract infections (RTIs) among pilgrims travelling for the annual Hajj (Al-Asmary et al., 2007, Zain Alabdeen et al., 2005, Alfelali et al., 2019, Choudhry et al., 2006, Hashim et al., 2016). These studies quantified types and number of infectious diseases prevalent during the Hajj, as well as any preventive measures taken by the travelers. An interesting qualitative study by Alqahtani et al. (2015) highlighted infection control beliefs of the pilgrims and how religious beliefs may pose a barrier to effective infection control. Another barrier noted is influenza vaccine rejection by the Hajj community (Ahmed et al., 2011). This Hajj specific literature collected presented an interesting overlap of religion and medicine which also suggested a gap in religion-specific public health norms.

The transferability of the large amount of literature collected on infection control during Hajj pilgrimage was low, since they were conducted in a non-pandemic situation and people may be much more willing to wear masks in a pandemic than otherwise. The studies based on the Hajj were also focusing on protecting the wearer instead of vice-versa. This was a problem, as policymakers had shifted their focus to the latter, making these studies less applicable for the reviews. Additionally, these studies had methodological limitations and vague questions. For example, a study by Al-Jasser et al. (2013) included questions such as 'did you wear a face covering' with three answer choices- always/sometimes/mostly. These questionnaires were also taken many months after the Hajj, providing less reliable information to researchers as they are prone to recall bias by participants. Further, the studies that were well conducted were mostly observational studies , which present a lower strength of evidence as opposed to RCTs (Murad et al., 2016). Most importantly, the studies were not about SARS-CoV-2, but were mostly on other respiratory viruses.

Given the novel nature of the Sars-CoV-2 virus, during the early stages of the pandemic, there was no alternative but to look at the evidence on other viral respiratory infectious illnesses such as flu, SARS and MERS etc. Thus, articles that focused on preventing transmission of SARS (Chen et al., 2009, Lau et al., 2004, Loeb et al., 2004, Seto et al., 2003) as well as MERS in mass gatherings and communities (Elachola et al., 2014) were added to the body of literature. Whilst necessary, this proved a disadvantage, as transferability of findings of one type of viral illness may not be very suitable for another. The viruses may have considerable differences in characteristics despite belonging to the same family. For example, although Sars-CoV-2 virus is less deadly than the viruses causing SARS and MERS, it has a much higher transmission rate and a wider clinical spectrum (Petersen et al., 2020), thus reaching a much higher

global count, further discussed in CHAPTER FIVE: DISCUSSION. The relevance of these studies to our research question remained low.

At present, there are many studies on Sars-CoV-2 as new evidence is emerging on a daily basis and research is still ongoing at a global scale. It is important to understand that reviews present a snapshot of a point in time and provide information based on already available literature. Thus, it is imperative to keep updating them.

Since the facemasks review was last updated, an important and comprehensive study has been published- as the Royal Society Delve Report by Edelstein P. and Ramakrishnan L. (2020). This report highlights asymptomatic transmission as an important driver for transmission, comments on how facemasks mitigate transmission of the virus, provides evidence on face shields as a preventive tool instead for individuals who cannot use face masks and also states facemask use should be in combination with other NPIs in closed spaces.

Overall, existing literature provided data on various aspects of facemasks, for example, a comparative analysis of different types of facemasks and various combinations of preventive interventions. However, most of the studies obtained were in very different contexts such as Hajj, influenza etc. Thus, the findings of this review need to be treated with caution.

2.2. Homemade Facemasks

UNCOVER review 004-01 (see Appendix V: Rapid Review: Are homemade facemasks effective at reducing transmission of covid-19 in community settings?) was conducted in April 2020 and published on the UNCOVER website on 19th April 2020. The research question was 'Are homemade facemasks effective at reducing transmission of covid-19 in community settings?'. A search was conducted of five databases (refer to Appendix II: Databases and search strategy for the rapid review 'Are homemade facemasks effective at reducing transmission of COVID-19 in community settings?') and preprint servers to identify any literature of relevance to the research question. A total of 549 records were identified by the search and 11 were retained for analysis and inclusion in the final review.

The literature search for this review was robust and consisted of numerous diverse search terms such as 'homemade', 'mask', 'cloth', 're-purpose', 'household', 'do it yourself' etc. The studies obtained and included in the review were varied and presented with many limitations, as discussed below.

Some studies obtained compared homemade facemasks to surgical or N95 masks. For example, a study by MacIntyre et al. (2015) was an RCT study conducted in a hospital that compared cloth masks with medical masks. It was a well conducted RCT but was measuring influenza like illness (ILI) as outcome and not COVID-19. It was also done in a hospital setting and not a community setting, thus being less applicable. On the other hand, another comparative study by Bae et al. (2020) compared commercially available cotton masks with surgical masks under carefully controlled conditions with COVID-19 patients. Although it was measuring COVID-19, it included only 4 patients as sample. This greatly reduced both variability and generalisability of the study and the results were unreliable.

Many studies were experimental studies that investigated effectiveness of homemade masks using human subjects. For example, a very informative study by Davies et al. (2013) compared cotton masks with surgical masks in the laboratory using human volunteers and assessed various aspects of mask use such as virus filtration properties, breathability, comfort and fit. It measured various parameters and on real people, making the study comprehensive and closer to real-life conditions. However, an important aspect it did not cover was mask design, an important parameter for making effective masks at home. Two more included studies conducted in laboratory settings were Dato et al. (2006) and van der Sande et al. (2008), which measured different materials used for homemade masks against medical masks. Although they were detailed and carefully controlled studies using human subjects, both had very small sample sizes, reducing generalisability. They also did not directly assess SARS-CoV-2, but other viruses.

None of the above studies talked about behavioural aspects. Contrastingly, one included study investigated behavioural aspects of facemask use versus no mask during the Hajj, a real-world setting (Choudhry et al., 2006), and stratified data by gender to remove confounding effects of sex, while also providing gender-specific behavioral data. Another similar study conducted during the Hajj provided data on behavioral aspects and measured outcome by ILI cases (Hashim et al., 2016). However, Hajj pilgrimage is a very different setting from community settings during a pandemic. These studies were

also of low quality since they were prone to recall bias, and also included imprecise or self-diagnosed measurements of disease as outcome.

Overall, the applicability of the included studies to this pandemic was questionable. The studies were low quality and mostly focused on protecting the wearer instead of the other way around. Since the focus of policymakers had shifted to the latter to develop a preventive approach to reduce the infection rate, there was, and continues to be, considerable uncertainty about the reliability of the studies included in the review.

2.3. COVID-19 Transmission and Outcome among Refugees and Migrants

This UNCOVER review is an ongoing review (refer to Appendix VI: What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review. for the review proposal and background). The research question is 'What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review'. A search was conducted of 11 white literature databases and preprint servers as well as 23 grey literature sources to identify any literature of relevance to the research question. A total of 5328 records were identified by the search and screened. 410 white literature studies and 488 grey literature studies were retained for data extraction.

The search strategy for refugee review involved an array of search terms such as 'migrants', 'refugee shelter', 'humanitarian setting', 'asylum seeker', 'respiratory viruses', 'Rohingya refugees' and so on. The complete list of search terms (last updated on August 24th, 2020) and databases are mentioned in Appendix III: Search terms for the rapid review 'What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review. '.

Most articles obtained from academic literature databases pertained to racial and ethnic minorities and described why these groups were at increased risk of COVID-19 (Control and Prevention, 2020, Khunti et al., 2020). Factor such as systemic discrimination, occupational risk, lower healthcare access and utilization, religious barriers, crowded housings and significant wealth gaps were found to be the main risk factors. While these studies highlighted risk factors, the populations and geographical locations in these studies varied greatly. Some studies described migrant populations in Asia, while others described

refugee camps in Syria or Libya. All of these populations have different challenges. For example, migrants in India and Indonesia have poor living conditions and provisions in comparison to migrants in Latin America; or small refugee camps in Greece have the ability to social distance, but not enough medical aid and resources, while large refugee camps in Jordan and Syria cannot maintain social distancing but have better humanitarian relief (Esses et al., 2017). With such diverse data, one cannot generalise any finding or apply it to a wider context. Furthermore, it is difficult to apply these findings to the Rohingya population in Bangladesh, the focus of this dissertation.

Some articles included an account of a country's response to such high-risk groups. For example, Qureshi (2020) included a summary of the UK government's response to ethnic minority groups in the country in addition to the above risk factors. Pareek et al. (2020) arranged the risk factors and outcomes into a hierarchical pyramid, as seen in figure 6. Hankivsky and Kapilashrami (2020) have emphasized in their policy brief the requirement for a gender-based focus in relation to COVID-19 is inadequate and race, ethnicity, class, migration and disability status also need to be considered. Although these are well-conducted studies, their focus is on ethnic groups in a country instead of migrants or refugees, who present with different challenges. Most ethnic groups in UK have their own accommodation as well as employment. Their challenges in this pandemic are related to occupational risks, comorbidities such as diabetes and obesity and lastly, societal stigma (England, 2020, Iacobucci, 2020). The applicability of these findings to refugees and migrants is questionable.

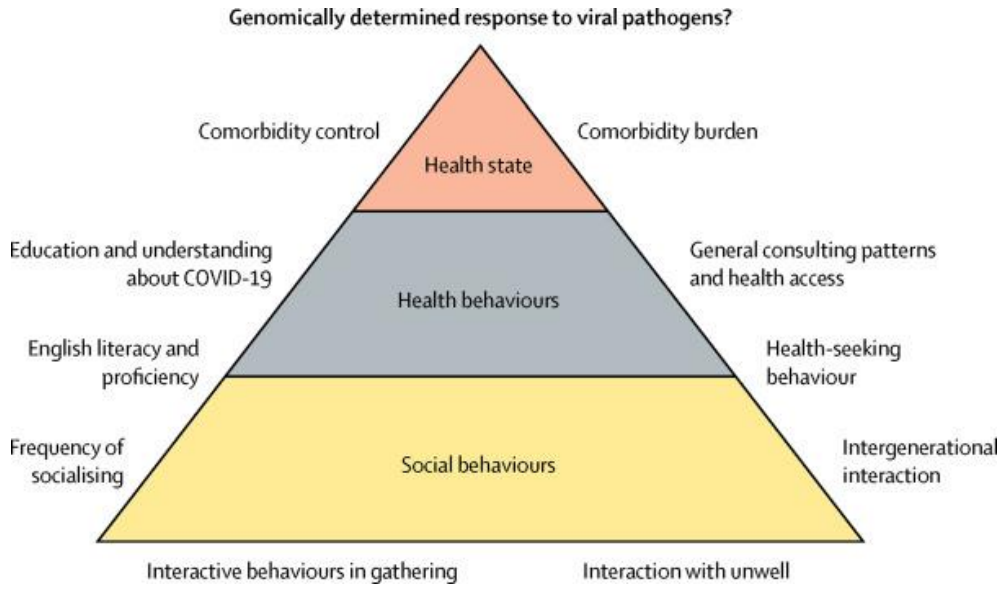

Figure 6: The potential interaction of ethnicity related factors on SARS-CoV-2 infection likelihood and COVID-19 outcomes

Source: (Pareek et al., 2020)

A small body of the literature focused on migrant populations throughout the world. Most of these articles outlined the barriers to healthcare for migrants around the globe. For example, for migrant populations from Mexico (Bojorquez et al., 2020), Africa (Bodomo et al., 2020, Bulletin, 2020) etc., most of the barriers were geographical or economic in nature. Another study by Chander et al. (2020) focused on mental health for migrant populations and argues that the mental health needs of migrants are not met, be it at detention centers or camps. These studies presented with a high risk of bias due to small sample sizes. Additionally, they did not talk about respiratory viral diseases, and thus were not pertinent. Some articles focused on behavioural aspects of migrant populations and discussed levers to handwashing to prevent COVID spread (Blum et al., 2017, Vujcic et al., 2015). Some articles discussed the impact on deprived communities during previous pandemics. For example, a quantitative study by Zhao et al. (2015) talked about ethnicity and deprived communities during the influenza pandemic. While these articles seemed more relevant to this pandemic, they failed to discuss confounding factors. Hostile environments can lead to pre-existing respiratory diseases that might not be related to the pandemic but were not mentioned separately. Additionally, there was no segregation of migrants living at camps/detention centers over a long period versus short term occupants. Long term occupants might not exhibit better compliance to social distancing or quarantine, and possibly engage in greater risk-taking behaviour, since the environment is known to them. Thus, the quality of these studies was low.

Much of the literature also focused on refugee camps throughout the world. Most of these articles were descriptive accounts of the living conditions at these camps and highlighted barriers to healthcare (Burki, 2020, Brandenberger et al., 2020, Ciccozzi et al., 2018). This dissertation focuses on the Rohingya refugees, the largest refugee population in the world, presenting a high risk of infection to a large number of people. Many articles were specific to Rohingya populations worldwide and discussed the barriers and levers to COVID-19 prevention (Islam et al., 2020, Khan et al., 2020). The most common barriers to prevention were lack of awareness, misinformation, religious barriers and health co-morbidities. However, these studies had many methodological limitations, and presented high risk of bias. The data the studies used were based on assumptions, for example, many refugees are still unregistered; the ones who are registered might not declare their health disorders due to stigma. The actual number of refugees as well as the number of refugees with co-morbidities might be much higher than assumed in these studies. Additionally, the studies presented findings specific to camp-like settings. But some dispersed groups of Rohingya refugees in Bangladesh live outside of camps, where accessibility and quality of healthcare will vary and thus the findings may not be applicable.

Some articles focused on diseases other than COVID at these camps. For example, one article focuses on diarrhea and vaccination at Rohingya camps (Summers et al., 2018). This study presented good recommendations for policy makers, but its applicability to this pandemic was low. Another study was a modelling study quantifying the impact of COVID and highlighting an urgent need for increasing healthcare relief (Truelove et al., 2020). It presented evidence on the high risk of mortality due to COVID_19 at Rohingya camps but did not mention any behavioural aspects of the population that might aid in curbing COVID-19 at these camps.

The grey literature search generated hundreds of articles across many databases and websites. Most of these were websites dedicated to providing information solely on migrant and refugee populations and were news articles. They provided information on the struggles faced by migrants and refugees at their poor lodgings. Very few studies were on behavioural aspects of PPE use and even fewer on facemask use and compliance. They were informative and made an important contribution to the scoping review, highlighting important points such as demographics, the nature of assistance needed most crucially at the camps, habits and practices of the refugees and tendency to comply with camp regulations. While studies from grey literature sources are less susceptible to publication bias, their quality of evidence can be taken as low, since they can be subject to incomplete or incorrect reporting of data (Mahood et al., 2014). Additionally, grey literature is not peer-reviewed and therefore should be treated with caution, as discussed in detail in CHAPTER FIVE: DISCUSSION.

This chapter summarised the literature available on the research topic of this dissertation. It also highlighted existing gaps in the literature and areas where more evidence is needed or needs to be updated. The next chapter will include the methods used for conducting the rapid reviews.

CHAPTER THREE: METHODS

This chapter will include the methods we used in UNCOVER to produce the rapid reviews on which this dissertation is based. It will begin with a critical discussion comparing rapid, systematic and scoping review methodologies. It will then discuss my role in each rapid review followed by the methods used by the reviews, including information on each review's inclusion and exclusion criteria, search strategy, data screening and data extraction. This will be followed by a critical analysis of the methods used in all three reviews. **Rapid Review Methodology**

As stated in chapter one, there is no agreed method for performing a rapid review and is adapted from systematic review methodology. Strengths of rapid review methodology include quick and low-cost evidence synthesis, overcoming a long-standing limitation of systematic reviews (Cook et al., 1997). A systematic review takes longer to complete for a number of reasons- more databases may be searched; additional search approaches, such as hand searching reference lists or contacting key informants to identify grey literature or unpublished data may be undertaken; two independent researchers perform every step of the process etc. In contrast, rapid reviews require less time, fewer people and resources. The number of databases searched can be reduced, and fewer people may be involved at each step. They can be very useful in emergent situations where other research methods may not be feasible due to time constraints and a modest budget- important reasons for why UNCOVER adapted rapid reviews.

However, there was a constant trade-off between methodological rigour and time. An important challenge faced while working with UNCOVER was the time-sensitive needs of policymakers and our attempt to produce high quality evidence while maintaining the reliability of the reviews, given we had to generate reviews in a turnover of days. The various steps omitted in UNCOVER rapid reviews and their impact are discussed in Table 7: Steps of systematic review omitted and their impact on the rapid reviews.

Moreover, rapid reviews can also be more susceptible to bias, as discussed below in Table 6: Types of bias in rapid reviews. In academia they are generally less preferred, and concerns can be posed about the validity of the results obtained (Haby et al., 2016). In my opinion, the pitfalls of rapid reviews present more serious concerns. They should not be considered as a reliable source of evidence if the results will

affect a large population or have major clinical implications. Rather, they should underpin other research methods.

Apart from rapid reviews, I am also working with UNCOVER at the time of writing this dissertation on a scoping review on refugees, referred to in this dissertation. A scoping review is different from a systematic and rapid review in a number of ways. First, as stated by Arksey and O'Malley (2005), while a systematic review identifies and investigates evidence to answer a well-defined question, a scoping review identifies the types of evidence to give an overview of existing literature on a broader topic where many different study designs might be appropriate. Second, scoping reviews do not require quality assessment of included studies, unlike systematic reviews. Third, scoping reviews include a wide range of research methods on areas that are complex and may not have been reviewed in detail previously, and thus require a large research team and can also lead to a less defined search strategy (Sucharew and Macaluso, 2019).

For the rapid review on refugees and migrants, it was important to first obtain currently available literature from a wide range of databases, including both white and grey literature to summarise existing evidence. Thus, a scoping review was conducted, which is still ongoing and is an elaborate account of COVID-19 among refugee populations.

3.2. Methods of UNCOVER Rapid Reviews

The method used for the rapid reviews (UNCOVER methodology) has been adapted from Cochrane Rapid Review methodology. It also follows a systematic approach to performing reviews on COVID-19 as developed by Shokraneh (2020), following most of the steps of a systematic review to provide the end result- a descriptive summary of the findings.

The methods employed for each review are mentioned below in three sub-sections, each sub-section for each UNCOVER review I was involved in.

3.2.1. Review 1

Does the use of face masks in the general population make a difference to spread of infection?

The methods used for this rapid review are demonstrated in table 2 below as well as in the review itself, mentioned in Appendix IV: Rapid Review: Does the use of face masks in the general population make a difference to spread of infection?.

Included studies:

• Studies reporting on COVID-19 and other related respiratory viruses and included data on face coverings
• Studies that report a measure of respiratory virus infection and/or its consequences (e.g. days off work, complications, hospital admission, deaths)
• How masks are used (e.g. whether people are putting them on or taking them off safely) and whether this alters their effectiveness;
• Whether mask use changes in the long term; and
• What behavioural interventions (e.g. training, communications) may affect mask use.
• Studies that look at how mask use affects other relevant behaviours – e.g.
  ○ Whether mask use (positively or negatively) affects compliance with hand hygiene, social distancing requirements, or other protective behaviours;
  ○ Whether mask use (positively or negatively) impacts on risk-taking behaviours

Excluded Studies:
• Mask use among healthcare workers or in care settings only • Publications focusing only on modelling data, nosocomial settings, animal models, and articles providing commentary but no data • Discussions, regulations, debates, commentaries • Studies based on mathematical modelling • Studies investigating transmission from non-humans • Study without: 1. Either a COVID-19 outcome measure (cases, morbidity, mortality)

2. Or a relevant risk/protective factor (e.g. comorbidities, antibodies, risk-taking behaviours, compliance with public health measures)

Databases and Search Strategy

Databases: PubMed, Medline, Embase, Scopus, CENTRAL, CINAHL and a search for pre-prints on MedRxiv.

For the full list of search terms and search strategy, refer to Appendix I: Databases and search strategy for the rapid review 'Does the use of face masks in the general population make a difference to spread of infection?'.

Key points:

1. Search started with looking for literature on prior reviews and evidence summaries on facemasks to prevent transmission of infection. 14 such prior reviews/summaries were found, but we included only three of these that were most-recent, specific to the topic and of robust quality. These reviews were screened by three reviewers, including me.
2. This was followed by a search for primary studies carried out for the main research topic by an experienced librarian across seven databases- PubMed, Medline, Embase, Scopus, CENTRAL, CINAHL and a pre-print search on MedRxiv (see table 3). A total of 766 new results were found from the database searching, reduced to 81 after removal of duplicates and pre-2020 publications

Data Screening

84 primary studies were identified from the reference lists of the relevant reviews. 8 studies were excluded because full text was unavailable, and 2 because they were not in English, by the team who retrieved the studies.

74 studies remained to be screened. Of these, 9 were prioritised by my colleague for data extraction, based on our full-text screening of the existing reviews. Data extraction was carried out by two reviewers, including myself.

Title and abstract screening was carried out by the review lead and myself for the other 65 studies, based on our inclusion criteria. 30 studies were included at this stage. Exclusions were checked by a second reviewer (me), and one further study was included for data extraction.
Data Extraction
Data extraction on these 31 studies was carried out by three reviewers, including myself. 9 further studies were excluded as a result of full-text screening, principally because they did not include any investigation of the behavioural aspects of mask use.
Risk of Bias Assessment
We used the following validated risk of bias tools to assess study quality for epidemiological studies: CASP and Joanna Briggs Institute checklists. For non-epidemiological studies, articles were assessed for rigour but without using a standardised tool. Risk of bias and evidence certainty for each article was assessed by a single reviewer- the review lead. Risk of bias ratings were limited to the most important outcomes.
Data Synthesis
Data were synthesized narratively. Because of the heterogeneity of the evidence, a meta-analysis was not appropriate. Using the GRADE system (Guyatt et al., 2008) a single reviewer- the review lead graded the certainty of the evidence.

Table 2: Methods used for the rapid review 'Does the use of face masks in the general population make a difference to spread of infection?'

3.2.2. Review 2

Are homemade facemasks effective at reducing transmission of COVID-19 in community settings?

The method used in this review is demonstrated in table 4 as well as in the review itself, mentioned in Appendix V: Rapid Review: Are homemade facemasks effective at reducing transmission of covid-19 in community settings?.

Inclusion criteria:
• studies which focus on the general population in any non-clinical setting where it is difficult to maintain social distancing • studies which focus on the effectiveness and reusability of homemade or improvised cloth facemasks compared with medical/surgical masks or with no mask at preventing the transmission of respiratory viruses • studies which report on the use of homemade or improvised cloth facemasks with or without handwashing and/or eye protection • studies which focus on the virus filtration properties of different materials used in the construction of homemade cloth masks • studies which focus on the comfort or breathability of different materials used in the construction of homemade cloth masks for preventing the transmission of respiratory viruses • studies which focus on the ability of different designs/shapes of facemasks to achieve a close fit to prevent transmission of respiratory viruses • any study design providing data on the effectiveness, virus filtration, washability, reusability or design of homemade or improvised cloth facemasks to prevent the transmission of respiratory viruses will be included
Exclusion criteria:
• do not include data on the effectiveness homemade or improvised cloth facemasks at preventing the transmission of respiratory viruses • do not include an outcome measure of respiratory illness (laboratory confirmed, clinically confirmed, self-reported, hospital admission, deaths, absence from work/school)

- report on the effectiveness of commercially manufactured masks that are not designed for clinical settings (e.g. masks purchased in DIY shops)
- are exclusively conducted in clinical settings
- studies not published in English
- studies not published in English
- studies that focus on the filtration properties of materials not commonly available in households

Databases and Search Strategy

Databases: CINAHL, Web of Science, Medline and a search for pre-prints on MedRxiv. The CINAHL and Web of Science searches were developed and performed by me.

Refer to Appendix II: Databases and search strategy for the rapid review 'Are homemade facemasks effective at reducing transmission of COVID-19 in community settings?' for list of search terms and complete search strategy.

The search adopted a four-pronged approach:

1. Reviewing primary studies from three recent systematic reviews
2. Reference screening from lists of two key papers
3. Citation tracking for the above two key papers
4. Creating and conducting a search strategy across four databases- Ovid (Medline), CINAHL, MedRxiv and Web of Science.

Data Screening

Title and Abstract Screen:

Titles and abstracts were divided, and each screened by one reviewer. A second reviewer then screened all excluded abstracts. Where there was a conflict, the abstract was included in full text screening.

Full Text Screen:

The included full text articles were each screened by one reviewer. A second reviewer then screened all excluded full texts. Conflicts were resolved by discussion.

Data Extraction
Data extraction for each article was conducted by a single reviewer and verified by the review lead. Data extraction was limited to a minimal set of required data items.
Risk of Bias Assessment
We used the following validated risk of bias tools to assess study quality for epidemiological studies: CASP and Joanna Briggs Institute checklists. For non-epidemiological studies, articles were assessed for rigour but without using a standardised tool. Risk of bias and evidence certainty for each article was assessed by a single reviewer- the review lead. Risk of bias ratings were limited to the most important outcomes.
Data Synthesis
Data were synthesized narratively. Because of the heterogeneity of the evidence, a meta-analysis was not appropriate. Using the GRADE system (Guyatt et al., 2008) a single reviewer- the review lead graded the certainty of the evidence.

Table 3: Methods used for the review 'Are homemade facemasks effective at reducing transmission of COVID-19 in community settings?'

3.2.3. Review 3

What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review.

The methods used for this scoping review are mentioned in table 5, as well as in the review proposal draft in Appendix VI: What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review.

<table>
<tr><td colspan="2">Inclusion criteria:</td></tr>
<tr><td colspan="2">We included research which relates to asylum seekers, refugees, internally displaced people, undocumented or irregular migrants, trafficked people or stateless people, which:
• Includes data or background information on COVID-19 outcomes
• Includes data or background information on COVID-19 risk factors
• Includes data on risk factors for infectious respiratory diseases
• Is of any study type (case reports, cohort studies, ecological studies etc.)
• Is a modelling study
We also included grey literature (pre-prints; publications from policy institutes; media articles) which meet these criteria.</td></tr>
<tr><td colspan="2">Exclusion criteria:</td></tr>
<tr><td colspan="2">• Does not have data or information related to asylum seekers, refugees, etc.
• Does not have data or information on COVID-19 or other infectious respiratory diseases</td></tr>
<tr><td colspan="2">Databases and Search Strategy</td></tr>
<tr><td colspan="2">General Search Terms- see Appendix III: Search terms for the rapid review ‘What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review. ’.
Databases:</td></tr>
<tr><td></td><td>• PubMed</td></tr>
</table>

White literature:	• PsycInfo • MedRxiv • Medline • Embase • CINAHL • Global Health • Global Index Medicus • Web of Science • ASSIA [Applied Social Sciences Index & Abstracts] • WHO COVID
Grey Literature:	• UNHCR • WHO: Refugee and Migrant Health • IOM – General • IOM – Migration Data Portal • ILO (Int'l Labour Organisation) • UNICEF • PICUM (Platform for International Cooperation on Undocumented Migrants) • Rights Lab (University of Nottingham – Modern Slavery) • SocialProtection.org • Migrants Rights Network (UK) • Runnymede Trust (UK) • Scottish Refugee Council • Women's Refugee Commission • InfoMigrants • Refugee Council (UK) • MedAct • ReliefWeb • New Humanitarian

	• Frontiers: Migration in the Time of COVID-19 • Mixed Migration Centre • Global Refugee-Led Network • Lancet Migration • Doctors of the World

Search Strategy:

The search strategy expanded the COVID-19 string, developed by Farhad Shokraneh (Shokraneh, 2020), to include additional respiratory terms, and combined this with a string of terms relating to refugees, which we had developed. We applied the search to discover published and pre-published papers in databases. In each case we adapted the search terms to the database, using the respective thesaurus terms to develop our subject headings. We balanced these subject searches with our free text terms. A team carried out the searching, but as far as possible the free text terms were harmonised, while allowing for variations in the focus and subject headings of the various databases. We downloaded the search results into End Note, removed the duplicates and extracted the results into an Excel file. At this point we applied a date limit and eliminated all items published prior to 2011, when the outbreak of SARS occurred. The results were then passed on for screening.

Data Screening

Title and Abstract Screening:

In accordance with the normal UNCOVER approach, all articles to be screened were divided among all reviewers. The title & abstract screening was carried out by each reviewer, with exclusions checked by a second reviewer. Any papers which were identified for inclusion by either reviewer will be carried forward. Where appropriate, the reference lists of key papers were screened.

Full text screening:

Full-text screening was carried out by each reviewer for their part of the collected literature.

Data Extraction

Data extraction of relevant data was done into a template in accordance with the usual UNCOVER process. Each reviewer performed data extraction for their part of the collected literature.
Risk of Bias Assessment
We will carry out a limited quality assessment of the papers and include a discussion of overall quality in our write-up.
Data Synthesis
Data were synthesized narratively. Because of the heterogeneity of the evidence, a meta-analysis was not appropriate. Using the GRADE system (Guyatt et al., 2008) a single reviewer- the review lead graded the certainty of the evidence.

Table 4: Methods used for the rapid review 'What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review.'

3.3. My role in UNCOVER rapid reviews

Table 5 summarises my contribution to each of the UNCOVER reviews I have been involved in as well some important learning outcomes.

Rapid Review	My Role	Learning Outcomes
Does the use of face masks in the general population make a difference to spread of infection? [6th April - 8th April 2020]	• Reviewed primary studies • Data screening • Data extraction • Quality assessment of included studies using CASP tool	• Strengthened knowledge of systematic review and rapid review methods. • Learnt to apply CASP guidelines for quality assessment. • Increased knowledge on different kinds of facemasks and their effectiveness in non-healthcare settings. • Learnt about behavioural aspects of facemask use.
Are homemade facemasks effective at reducing transmission of COVID-19 in community settings? [15th April - 19th April 2020]	• Reviewed primary studies • Performed forward citation tracking of two key papers • Performed reference screening of two key papers • Generated and applied search terms and search strategy for CINAHL and Web of Science • Title and abstract screening	• Learnt how to perform a search strategy for specific databases • Strengthened knowledge of systematic review and rapid review methods. • Learnt about effectiveness of homemade facemasks in community settings and what type of homemade

		facemask would be most effective/feasible in such settings.
What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review. [8th June 2020 – present]	• Contributed to list of search terms and search strategy • Data screening- both white and grey literature • Data extraction	• Strengthened knowledge of scoping review and systematic review methods. • Clarified difference in terminology between 'migrant', 'refugee', 'ethnic minority', 'asylum seeker' etc. • Learnt about grey literature searching, its various advantages and disadvantages. • Gained information on refugee populations around the world and their response to the pandemic, with specific focus on Rohingya refugees.

Table 5: My role in the rapid reviews and consequent learning outcomes

3.4. Analysis

3.4.1. Methodological rigour

A study by Kelly et al. (2016) rigorously analysed 66 rapid reviews from white and grey literature databases and assessed them for quality of conduct and reporting using PRISMA (Preferred Reporting

Items for Systematic Reviews and Meta-Analyses) and AMSTAR (A Measurement Tool to Assess systematic Reviews) guidelines. It concluded that most rapid reviews exhibit a number of criticisms such as incomplete reporting of data as well as poor transparency, and their compliance to these guidelines is poor. However, UNCOVER reviews avoid many of these criticisms. However, they do exhibit two of the problems identified by Kelly – namely no protocol, not piloting data extraction tool.

The rapidly spreading pandemic and the needs for policymakers to make timely decisions reduced the timeline of our reviews to few days to weeks, which did not allow us sufficient time to develop and rigorously pilot data extraction tools as well as follow a specific protocol, which can avert selective reporting and minimize bias (Higgins and Green, 2011). In addition, we did not have two individual reviewers doing each step independently and then comparing their results, as done in a systematic review. This can lead to biases and inadequate or incomplete reporting of results, a major limitation of rapid reviews. Table 6 below describes the types of biases in rapid reviews such as selection bias, publication bias etc. UNCOVER review methodology reduced chances of selection bias by conducting comprehensive searches with an experienced librarian, but was prone to the other types of biases mentioned below.

Types of bias in rapid reviews	
Selection bias	Arises when the rapid review does not identify all available evidence on a research topic. Additionally, the rapid reviews might not describe the methods used for assessing potential bias. Due to time constraints and being less resource-intensive, rapid reviews can skip hand searching, wide and detailed database searching, grey literature searching, being prone to selection bias.

Inclusion bias	It is possible for the inclusion criteria to be influenced by pre-existing studies on the subject, causing inclusion bias. For rapid reviews, since each step might have only a single reviewer, there are increased chances of inclusion bias.
Publication bias	Data from studies having a statistically significant result are more likely to get published. Due to the time constraints or lack of sufficient evidence, associated with the new pandemic, rapid reviews might not always present statistical analysis, graphical aids, and might not include any formal assessment of publication bias, and thus have a lesser chance of getting published.
Language publication bias and Citation bias	Rapid reviews in English are more likely to get published and cited than those in other languages, leading to a biased assessment of a topic. Important literature on COVID-19 in other languages such as Chinese or German etc. researched by people world-wide can be very useful during the new viral pandemic but have a lesser chance of getting published and reaching a wider audience.
Reporting bias	As most rapid reviews are not based on a formal protocol, deviations from the original research strategy developed can lead to selective presentation of data, resulting in reporting bias.

Table 6: Types of bias in rapid reviews

References used: (Butler et al., 2005, Egger and Smith, 1998, Drucker et al., 2016, Kelly et al., 2016)

3.5. Appropriateness of Method

While choosing an appropriate method for addressing the research question of this dissertation, a systematic review seemed relevant and posed a source for high quality evidence, as seen from the hierarchical evidence pyramid (Murad et al., 2016). However, due to constraints of resources, the urgency of the situation as well as lack of data on the subject due to a new virus, a rapid review was the most apt choice.

3.6. Relevance and Justification of topic

With the rapid spread of the virus to almost all parts of the world, people from innumerable populations and communities have been affected. One such population is the Rohingya refugee population. There is lack of diverse COVID-19 related data for this community in academic literature. Furthermore, there is no data on facemask compliance at such camps. This dissertation uses articles on facemasks, particularly behavioural aspects of facemasks and articles on Rohingya refugees, particularly COVID-19 related data and ascertains role of facemasks in mitigating the virus as well as degree of compliance to facemask use. At present, there are no articles on this specific topic and thus this dissertation will add new evidence to the existing body of literature.

3.7. Ethics

As no primary data collection was performed, only Level 1 ethics oversight was necessary by MPH Ethics Group at the University of Edinburgh. The Level 1 ethics exempt letter is attached in Appendix VII: Level 1 ethics exempt letter.

CHAPTER FOUR: RESULTS

After the discussion of methods in Chapter 3, this chapter presents the findings of the reviews. It will first present a brief summary of the findings of the individual rapid reviews (the reviews are also appended-refer to appendices), followed by the combined results of the reviews to address the research question.

4.1. Results of Individual Rapid Reviews

4.1.1 Review: Does the use of face masks in the general population make a difference to spread of infection?

Refer to Appendix IV: Rapid Review: Does the use of face masks in the general population make a difference to spread of infection? for this UNCOVER rapid review.

The review was conducted during the initial stages of the pandemic in a time frame of two days. It was based on data from three systematic reviews and meta-analysis. The review concluded that wearing facemasks was not significantly associated with a reduction of ILI. However, the overall quality of evidence was classified as low. Evidence on behavioural aspects of facemask use was very limited, with most studies specific to the Hajj pilgrimage. Increased frequency of mask use was associated with a higher rather than lower infection rate, suggesting an association with risk-taking behaviour, yet lack of substantial evidence and evidence directly related to covid-19 on the topic posed a significant limitation. It also stated that the Sars-CoV-2 virus can be transmitted from one person to another by both droplet and aerosols, with droplets being the main mode of transmission. Very limited evidence was found in relation to aerosols transmission.

4.1.2 Review: Are homemade facemasks effective at reducing transmission of COVID-19 in community settings?

Refer to Appendix V: Rapid Review: Are homemade facemasks effective at reducing transmission of covid-19 in community settings? for the UNCOVER rapid review.

A total of 11 studies were included in the review, with the quallity of evidence being very low and not specific to real-life conditions. The review suggests homemade masks can significantly reduce droplet transmission by limiting number of droplets reaching surfaces; but they were not found to be effective in

preventing aerosol transmission. The optimum combination of household materials for these masks included simple T-shirt or jersey material with a non-woven filter such as kitchen towel. No specific design was deemed most suitable due to lack of sufficient evidence; however, a good fit around mouth and nose was found to be crucial. Additionally, repeated washing and drying of these masks suggested reduction in effectiveness of these masks.

4.1.3 Review: What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review

Please note that as the refugees scoping review is still ongoing, the review is not complete or appended. Refer to Appendix VI: What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review. for the proposal of this UNCOVER review.

Evidence gathered till 15th August 2020 suggests experiences of refugees globally during the COVID-19 pandemic vary by geographical area. For Rohingya refugees situated in Bangladesh, no direct evidence on facemask compliance was found. Most studies claim controlling the virus will be a challenge and high levels of mortality can be expected at these camps during the pandemic due to poor health of the refugees- malnutrition, infections, concomitant diseases and poor health practices are common findings that increase chances of severe COVID-19 infection.

While many refugee groups worldwide such as those in Libya, Latin America, Tunisia and West Africa demonstrate high rates of awareness and practice caution, Rohingya refugees are likely to face significant barriers to preventive behaviour due to lack of awareness, knowledge, risk perception and assistance needs, as well as high population density, social dilemma and religious beleifs that require praying together in large gatherings. Additional barriers include lack of adequate amounts of soap and water, over burdenend health care facilities, and limited PPE. Lack of resources to make homemade facemasks is seen, but can be provided by low cost interventions, suggesting such provisions by Bangladesh government and/or refugee aid organisations would be very helpful in reducing transmission.

Behavioural aspects to facemask use such as a sense of difficulty to breathe is the main barrier. There was no data on enablers to face mask use found. One study showed increased adherence to facemask

use by refugees but compliance reduced significantly within a period of five days after implementation. However, this study was not specific to Rohingyas.

It is important to remember that this is a scoping review and thus quality assessment of the studies included is omitted, which means the conclusions are less robust and should be treated with admonition.

4.2. Overall Findings

The findings of the reviews which this dissertation is based on strongly suggest that optimum prevention of infection can be achieved by a combination of good respiratory hygiene/ cough etiquette, hand hygiene and social distancing.

Droplet and aerosol modes of transmission are largely responsible for COVID-19 infection. Droplet transmission of COVID-19 can be reduced by face masks, including homemade facemasks, and thus **are effective in mitigating droplet spread of infection**. However, whether aerosol transmission can be reduced by facemasks requires further research.

While the use of facemasks alone cannot achieve significant reduction of infection at an individual level, when implemented at community level, it can help reduce the risk of transmission, and should therefore be encouraged. Repeated wash and re-use of masks can reduce efficiency, and thus should be replaced regularly, especially if they have come in contact with moisture.

The results of these reviews suggest that the use of facemasks at Rohingya refugee camps, if available, should be made mandatory. Homemade facemasks can be an effective and affordable alternative to surgical facemasks and should be a priority for policymakers and refugee aid organisations. Awareness campaigns targetting COVID-19 risk factors, symptoms, treatment options, prevention, facemask use, compliance and safe disposal are needed that are in accordance with their cultural or religious practices. Additionally, stricter implementation of cough etiquette and hand hygiene is needed, along with a massive demand for resources at these camps.

CHAPTER FIVE: DISCUSSION

The previous chapter summarised the results of the appended rapid reviews and this dissertation. This chapter aims to critically appraise the work conducted as part of this dissertation. It will begin with a brief summary of the findings of the dissertation, its strengths and limitations, implications for policy and practice, and lastly, sum up any future research that could build on to this work.

5.1. Summary of Key Findings

This dissertation aimed to build on three separate rapid reviews conducted by the UNCOVER team, of which I played an integral part, to research the potential role of facemasks in mitigating the transmission of COVID-19 in Rohingya refugee camps in Bangladesh. The three reviews adhered to standard UNCOVER rapid review methodology, which was adapted from Cochrane methodology, to produce quick and reliable evidence on COVID-19 research areas that play a role in policymaking. This dissertation interlinked these three reviews- investigating the role of facemasks in community settings in mitigating transmission of SARS-CoV-2, the role of homemade facemasks in mitigating such transmission, and lastly, researching the transmission, outcomes and consequences of COVID-19 among refugees and migrants. It found that facemasks are effective in mitigating droplet transmission and thus should be encouraged at Rohingya refugee camps. Homemade facemasks are also effective and serve as a suitable alternative to commercially manufactured medical facemasks that are usually in short supply and should be prioritised for healthcare workers at the camps. There was no clear evidence on behavioural aspects of facemask use. Most of the studies included in the reviews presented low to moderate evidence weighting.

5.2. Strengths

UNCOVER rapid reviews were conducted to generate high quality evidence on COVID-19 that can be used by researchers, the general public as well as policymakers. The reviews themselves address important research areas that add to the existing body of evidence. The reviews include data from multiple fields of science such as fluid dynamics, virology etc., generating comprehensive and multifaceted findings. The strengths of individual rapid reviews are mentioned underneath.

5.2.1. Facemasks and Homemade facemasks review

Both facemasks reviews included in this dissertation were conducted in a period of days during the initial stages of the pandemic, generating quick evidence. They looked at RCTs, which represent the highest level of epidemiological evidence. Also, they were based on robust and comprehensive literature searches performed by an experienced librarian and used a number of databases, covering good amount of available evidence. Additionally, the facemasks reviews were updated regularly, refining results with each update and including more recent evidence. Inclusion of PRISMA guidelines was also done in an update, increasing quality of reporting and transparency. Quality assessment of epidemiological studies was done using a standard CASP Tool, minimizing bias and increasing reliability of the results.

5.2.2. Refugee review

This scoping review summarises existing evidence on COVID-19 in refugee and migrant populations. It covers a large number of white and grey literature databases, covering multiple types of evidence. The search was robust and performed by an experienced librarian. Additionally, the review follows PRISMA guidelines, increasing transparency. Most importantly, before beginning the review, the researchers clarified differences in terminology such as 'migrant', 'refugee', 'asylum seeker', 'forced migration', 'stateless person' etc. These terminologies, though insinuate similar meanings, are quite different and findings cannot be generalized to all these populations. A clear distinction and classification of these populations helped improve the screening and inclusion of relevant studies.

5.3. Limitations

Since rapid and scoping reviews omit certain stages of a systematic review, the implications of this time and resource saving measure must be assessed. Table 7 provides a detailed account of the steps omitted in UNCOVER rapid reviews and its potential impact. The main limitation of both types of reviews include increased risk of bias due to a single reviewer for most steps.

Review	Steps of Systematic Review Omitted and Other Limitations	Impact
Does the use of face masks in the general population make a difference to spread of infection?	• PICO (population, intervention, comparison and outcomes) or SPIDER (sample, phenomenon of interest, design, evaluation, research type) framework was omitted.	A search strategy is one of the most important steps in systematic reviews. If the search is not comprehensive, the review will not be a true representation of the evidence available to address a topic and will also increase risk of bias. A framework such as PICO or SPIDER helps organise and limit the search to appropriate terms and databases. As this step was omitted, the search strategy could have been weakened. To help overcome this limitation, UNCOVER searches were done by an expert librarian who performed comprehensive searches.
	• Single reviewer for data screening and data extraction.	This leads to increased risk of bias as it is possible the reviewer included less relevant studies or missed important studies, either by chance or due to person's lack of sufficient background knowledge of the research topic. The single reviewer may also have different implicit assumptions or may interpret the inclusion and exclusion criteria differently. This could lead to lack of reproducibility and to bias. The data extraction tool was used by a single reviewer and was not tested to make sure all

		researchers were interpreting it the same way. This may have resulted in incorrect reporting of evidence.
	• Single reviewer for quality assessment. Did not use standardised tool for non-epidemiological studies quality assessment.	Increased chances of introducing bias. It is possible the single reviewer may have rejected high quality studies or kept in low quality studies and either of these may have skewed the results. Lack of a standardised tool also increased chances of bias.
Are homemade facemasks effective at reducing transmission of COVID-19 in community settings?	• PICO (population, intervention, comparison and outcomes) or SPIDER (sample, phenomenon of interest, design, evaluation, research type) framework	As mentioned above, lack of such a framework reduced accuracy of the search strategy.
	• PRISMA guidelines omitted	PRISMA guideline improves quality of reporting of reviews and aids the critical appraisal of a paper. Absence of PRISMA framework reduced the quality of reporting of the review by decreasing transparency.
	• Single reviewer for data screening and extraction	As mentioned above, this can lead to increased risk of bias as it is possible the reviewer included less relevant studies or missed out on some important studies, either

		by chance or due to lack of sufficient background knowledge and experience on the research topic. This could lead to incomplete evidence of available data.
	• Single reviewer for quality assessment • No standardised tool for non-epidemiological studies quality assessment and risk of bias	Increased chances of introducing bias. It is possible a single reviewer may have rejected high quality studies or retained low quality studies. Either of which may have skewed the results. Lack of a standardised tool also increased chances of bias, especially due to a single reviewer performing this step.
	• No grey literature screened	Grey literature is a useful way to obtain information on small populations and very specific and less popular research areas. It can also be more recent than published literature. In this review, since facemasks are not a very narrow and less popular topic, grey literature screening is unlikely to have added greatly to the body of evidence. While looking for recent studies on facemasks, we searched for pre-prints on MedRxiv. Additionally, since this review was intended for policymakers, screening scholarly literature was an apt choice since grey literature sources are not peer-reviewed or critiqued and are more prone to bias or inaccurate reporting.

What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review.	• Quality of studies not determined	Quality assessment is integral to evaluating the methodological quality of the reviews. It also assesses the overall strength of available evidence addressing a research topic, especially for policy making and evidence-based practice. If a study is poorly conducted (as judged by the quality assessment), it can lead to inaccurate results, reduced applicability and most importantly, waste of time and resources. There are a number of tools used for assessing the quality of studies, the most common ones being GRADE system (Goldet and Howick, 2013), Cochrane quality assessment tool (Higgins and Green, 2011), CASP Tool etc. that offer a standardised quality assessment of studies. Omitting this step greatly reduces the reliability of the study.
	• PICO (population, intervention, comparison and outcomes) or SPIDER (sample, phenomenon of interest, design, evaluation, research type) framework omitted	As mentioned above, lack of such a framework reduced accuracy of the search strategy.

	• Single reviewer for data screening and extraction	As mentioned above, having a single reviewer can increase risk of bias and can lead to incomplete evidence presented of available data.

Table 7: Steps of systematic review omitted and their impact on the rapid reviews
References used: Moher et al. (2009), Methley et al. (2014), Seo and Kim (2012), Munn et al. (2018)

5.3.1. Facemasks rapid review:

The time constraint of two days for this review means we may have not included all of the available evidence . Despite our comprehensive searches, we only looked at the best RCT studies for evidence on facemasks, which found no evidence for the effectiveness of facemasks in community settings. Had we considered the para-epidemiological aspects of the topic, for example, a fluid mechanics' or a virologist's perspective, we may have had a different result. Fluid mechanistic studies (references) found facemasks to be highly effective in preventing droplet transmission- a stark contrast to the findings of the review. Including such studies could therefore have improved the review and altered its conclusion.

Further, the RCT studies included investigated other viral respiratory illnesses rather than COVID-19. The applicability of these studies to the current pandemic is arguably low. For example, people with COVID become infectious few days before symptom onset (Phan et al., 2020, Rothe et al., 2020), as opposed to SARS and MERS where people become infectious after symptom onset, contributing to transmission (Hui et al., 2014). This can make measures such as quarantine (separating healthy people from other healthy or potentially infected people) and temperature screening less effective for COVID-19 (Wilder-Smith et al., 2020). In addition, the clinical spectrum for COVID was much broader than SARS and MERS. Initially, symptoms of COVID-19 were associated with pneumonia. However, as new cases emerged, more symptoms were discovered that were milder than pneumonia. This contrasts with SARS and MERS, where pneumonia was the main symptom and infected people progressed to respiratory failure much more rapidly (Hui et al., 2014). Hospitalization of the patients was therefore important, as opposed to COVID patients with mild symptoms, who can look after themselves at

home. With such differences, most NPIs may not have a similar impact for all three diseases, which could also explain why the RCTs included in the rapid review found low effectiveness of facemasks for other viral illnesses but in reality, facemasks can work well against droplet transmission of COVID-19.

Finally, most of the primary studies included in these rapid reviews were of low quality. Many were also pre-prints, thus neither peer-reviewed nor critically appraised. Only English language studies were included, resulting in reporting of incomplete evidence, while also increasing chances of English language publication bias (refer to Table 6). Many included studies were also conducted in a very different context from community settings, for example, the Hajj pilgrimage, which is significantly different from the life of people during the pandemic. With crowded housings and large communal areas, the pilgrimage can be a challenge for following basic preventive interventions such as social distancing, hand sanitising and self-imposed quarantine. It is also not possible for participants of the Hajj to acquire and dispose of PPE easily. Yet again, the transferability of the findings of the review to the current pandemic was low. Thus, it was difficult to give a well-evidenced account of the findings of the facemasks rapid review and we ended up giving caveats wherever needed.

5.3.2. Homemade Facemasks rapid review:

Similarly to the previous face mask review, this too was conducted in a very brief period of time- about 4 days. Despite a robust search strategy which included numerous databases, evidence on homemade facemasks was limited, with most studies having a low-quality assessment. Some of these studies were conducted in laboratories and no study evaluated effectiveness of these masks in real-life conditions (Davies et al., 2013, van der Sande et al., 2008, Dato et al., 2006). While it is a strength that these studies used a human participant instead of a manikin as manikins cannot fully mimic all human movements, the controlled laboratory settings may not fully resemble real-world behaviour. This may limit the study findings' transferability to community settings where the wearers might engage in long conversations at different angles.

In addition, there was not sufficient evidence assessing mask design. Masks should have least possible leakage jets and thus mask design is a key component while making homemade facemasks. This aspect is therefore as yet unanswered.

Lastly, most studies had a very limited sample size- reducing variability and transferability and increasing risk of bias (Dechartres et al., 2013). Although most people would have the same type of droplet projection from the mouth while coughing or beathing, speaking projections can vary due to changes in facial muscles. This can even vary between males and females, with females having softer facial muscle tones and thus flatter projections (Schwartz et al., 1980). These changes need to be taken into consideration while designing a mask.

5.3.3. Refugees review:

This scoping review incorporated grey literature. This needs to be done with caution as biased, unverified and inaccurate data can be included. Many of these studies also do not provide background information on author(s), reducing quality of reporting. Such studies also have less longevity as compared to white literature, which can be found on databases for much longer (Mahood et al., 2014).

5.4. Context in Wider Literature

The findings of this dissertation align with, and are supported by, recent publications by Royal Society DELVE report (Edelstein and Ramakrishnan, 2020), World Health Organisation (WHO) (World Health, 2020) and the British Medical Association (BMA-facemasks report, 2020). All of these recent publications concluded that commercial and homemade facemasks are effective in decreasing transmission of the virus where physical distancing is not possible. These reports also stress the importance of asymptomatic transmission of COVID-19 being prevalent in the community. Almost all health organisations such as CDC, WHO etc. are now recommending facemask use. This demonstrates a shift in evidence and thinking due to emerging evidence in just a few months.

Studies conducted prior to 2020 pertain to other respiratory diseases such as influenza or ILI and the guidelines are for these diseases are very different. Most of the health organisations claim very low effectiveness of facemasks in reducing viral spread of influenza and their use is not encouraged, as seen from Figure 8. Such findings also influenced early COVID-19 research, including UNCOVER research, which accounts for the initial findings of the facemasks review on ILI. The underlying motivations for facemask use took a shift from protecting the wearer to protecting those around the wearer, causing a subsequent change in findings.

Setting	Persons not at increased risk of severe illness from influenza (Non-high risk persons)	Persons at increased risk of severe illness from influenza (High-Risk Persons) [3]
Community		
No 2009 H1N1 in community	Facemask/respirator not recommended	Facemask/respirator not recommended
2009 H1N1 in community: not crowded setting	Facemask/respirator not recommended	Facemask/respirator not recommended
2009 H1N1 in community: crowded setting	Facemask/respirator not recommended	Avoid setting. If unavoidable, consider facemask or respirator [4] [5]
Home		
Caregiver to person with influenza-like illness	Facemask/respirator not recommended	Avoid being caregiver. If unavoidable, use facemask or respirator [4] [5]
Other household members in home	Facemask/respirator not recommended	Facemask/respirator not recommended
Occupational (non-health care)		
No 2009 H1N1 in community	Facemask/respirator not recommended	Facemask/respirator not recommended
2009 H1N1 in community	Facemask/respirator not recommended but could be considered under certain circumstances [4] [5]	Facemask/respirator not recommended but could be considered under certain circumstances [4] [5]
Occupational (health care) [6]		
Caring [7] for persons with known, probable or suspected 2009 H1N1 or influenza-like illness	Respirator	Consider temporary reassignment. Respirator

Figure 7: Interim Recommendations for Facemask and Respirator Use for Home, Community, and Occupational Settings for Non-Ill Persons to Prevent Infection with 2009 H1N1

Source: https://www.cdc.gov/h1n1flu/masks.html

Homemade facemasks are highly effective in reducing COVID-19 spread and their use in refugee camps is therefore likely to be a suitable alternative to commercial facemasks. There is abundant grey literature supporting these findings. Many refugee aid organisations are providing refugee women with the resources to sew cloth masks that can be used at the camps (UN women, 2020, MOAS, 2020). There is still limited academic literature on this topic and further research should be conducted to fully assess the outcomes and benefits of this intervention in Rohingya camps.

5.5. Implications for Further Research

While the findings of this study are applicable to Rohingya refugee populations, they can also be applied to other refugee and migrant communities with similar circumstances. It would be helpful to know the feasibility and outcome of facemasks interventions at different settings.

Behavioural aspects of facemask use is under-researched and there is only very limited evidence available. Numerous research ideas are recommended on the basis of the findings of this dissertation, such as qualitative studies assessing facemask compliance among refugee groups. What are the possible barriers and levers to facemask use among these groups? Would refugee persons who are more aware about the disease be more compliant to facemask use? Might wearing facemasks induce risk-taking behaviour at these camps? Quantitative studies can also provide evidence on behavioural aspects- surveys investigating how many refugees in the target camp adhered to respiratory hygiene measures, how soon might it be before adherence started to reduce and why? Care should be taken to include an appropriate sample size and also mitigate risk of bias. The methods employed should also be sensitive to the cultural and religious practices of the refugee camps.

This dissertation provides evidence based on UNCOVER reviews which have a number of limitations such as inclusion of low-quality studies, single reviewers etc. Future research should employ methods to mitigate these limitations.

5.6. Implications for Policy and Practice

The most important intervention needed at Rohingya camps is education to increase awareness. Awareness campaigns are urgently needed to inform Rohingya refugees about COVID-19 symptoms, preventive measures and treatment options. Misinformation, if any, needs to be addressed. Facemask use, compliance and safe disposal/reuseability should be the focus of these campaigns.

Policymakers should consider increasing the provision of homemade facemasks and make it mandatory in camps. Resources to manufacture simple cloth masks by individuals belonging to a refugee population can make a considerable difference in mitigating spread of transmission and also generate income by providing a small payment to the refugees per cloth mask made- providing both economic and healthcare benefit to these groups.

CHAPTER SIX: CONCLUSION

There is a severe risk of COVID-19 associated mortality at Rohingya refugee camps in Bangladesh, with a rising prevalence of infection. The main risk factors include lack of awareness about COVID-19, poor living conditions, underlying diseases and comorbidities, severe lack of healthcare provisions and skilled health workers and scarce resources such as PPE, soap and water.

The most suitable NPIs for mitigating transmission of infection at the camps include respiratory hygiene and hand hygiene measures. Social distancing and voluntary quarantine are not possible due to lack of sufficient housing provisions. Separating high-risk groups such as elderly or immunocompromised people from others is possible and should be considered by policymakers.

Facemasks, if available, can significantly reduce transmission of infection and should be made mandatory. Homemade facemasks are a very suitable alternative to commercial facemasks and should be the made mandatory at a large scale. Low cost interventions targetting provision of materials for making homemade facemasks should be a priority for policymakers and organisations.

There is some evidence of association between facemask use and increased risk-taking behaviour. There is some evidence of breathing difficulty being the main barrier to facemask use. However, significant evidence was not available to confirm these findings. There is no data on enablers to facemask use. Significant gaps in litrature have been identified and further research can substantially improve quality of findings to provide conclusive evidence that can benefit both policymakers and commmunities.

REFLECTIVE REPORT

Dissertation Outline

My dissertation explores the potential role of facemasks in mitigating COVID-19 transmission among Rohingya refugee populations in Bangladesh. It interlinks three rapid reviews I was involved in with UNCOVER, Usher Institute's academic body of professors, experts and students that generate rapid evidence reviews on key public health topics on COVID-19 that can be useful by the general public as well as policymakers. The three individual rapid reviews researched the following topics: the effectiveness of facemasks in mitigating transmission of COVID-19 in community settings, the effectiveness of homemade facemasks in mitigating spread of infection; and lastly, transmission, outcomes and consequences of COVID-19 among refugees and migrants. I used the data obtained from these reviews to address my research question.

Choice of Topic and Study Design

Since the beginning of my MPH program, I had my mind set on a very specific research question for my dissertation. I have a background in clinical dental sciences and during my practice I realised that most of my patients were from rural India and presented with more severe dental problems than urban populations. Thus, I wanted to research the barriers and levers to oral healthcare among rural populations of India using qualitative research methods. However, the sudden and rapidly advancing pandemic took over the globe, causing sudden closure of borders between countries and preventing me from returning to India to work on my dissertation. I suddenly found myself without a research question or any alternate ideas. It was a period of anxiousness and worry. Fortunately, I found the opportunity to work with UNCOVER on COVID-19 rapid reviews, with an option to convert them into a dissertation. I worked on a number of reviews and found a new interest- researching vulnerable populations and how they are more affected by the pandemic due to existing health inequalities. One particular question that caught my eye was the availability and effectiveness of facemasks at these camps since they live in poor living conditions where other NPIs such as quarantine and social distancing are not possible. I decided to use all the resources I had obtained through UNCOVER to generate evidence to answer this question, which became my dissertation.

Initially I did not narrow down my research question on facemasks to one refugee population. But this was causing some difficulties in my research. The experience of different refugee populations depends on their geographical area- while some refugee camps have better access to resources and medical aid, others do not. This was making my dissertation difficult to research and structure as I had very diverse data and results, enough to be converted into separate projects. I asked for advice from my supervisors, who suggested that I should narrow my research question to one population. Consequently, out of all the globally spread out Refugee populations, I decided to focus on Rohingya refugees in Bangladesh since they are closer to home and I knew and understood their cultural and religious beliefs quite well. I thus found myself with a specific and appropriate research question that I felt interested in, which encouraged me to work diligently. It was an important lesson, since it made me realise I work with greater interest and motivation on topics I feel passionately about.

My involvement and Contribution

My involvement in the UNCOVER rapid reviews differed with each review. In the face masks review, I was involved in data screening, data extraction and quality assessment using CASP framework. In the homemade facemasks review I was involved with creating and performing the search strategy for CINAHL and Web of Science databases, forward citation tracking and reference screening for two key papers. For the refugees rapid review, which is an ongoing review, I was involved in developing search terms, data screening and data extraction.

Possible Bias

Because my dissertation utilized UNCOVER rapid reviews conducted a few months prior to the dissertation period, I already had the results of the facemasks rapid reviews ready for my reference. Thus, while working on my dissertation, I had to take great care not to let the pre-existing review results influence my research. UNCOVER reviews concluded a low to moderate effectiveness of facemasks in community settings and I had to keep reminding myself not to be more biased towards including more data that are consistent with these findings and dismiss any articles that are contradictory. I also found myself sympathetic towards refugee populations and I had to be aware and acknowledge my feelings throughout dissertation work. I had to avoid introducing bias into my work that would lead the results in favour of these populations instead of presenting the actual evidence. In my opinion, I was successful in

avoiding such bias in both situations mentioned above, thanks to my supervisors who kept reminding me to have a neutral perspective. The courses on qualitative research methods also deserve credit here for introducing me to the concept of reflexivity, which played a big part in my dissertation. Being aware of my pre-existing thoughts and emotions on the topic made me more cautious while working on the dissertation, improving the quality of my work.

Challenges and personal growth

The dissertation phase was filled with numerous challenges of different natures. The COVID-19 pandemic impacted on countless lives and I was no exception. The very first challenge I faced was my inability to continue with the original research plan of qualitative research in rural India, as mentioned above. That period of disappointment was difficult, even more so because I had great passion for my original topic, and I had received very positive feedback from my professors throughout the year regarding its execution. Thus, finding a new topic that I felt as strongly about seemed impossible at the time. After a period of uncertainty, finding the opportunity to work with UNCOVER was a blessing and helped me overcome this challenge. It also taught me an important lesson- life does not always go as planned and it is good practice to be open to sudden changes while acknowledging the disappointment about things not going to plan. It also taught me to have a backup plan for important projects, as I should have had for my dissertation much earlier on.

Another challenge I faced was the lack of comprehensive guidance and examples of rapid review dissertations, since this was the first time such a dissertation was being conducted. Although it was very interesting and exciting to do something new, it also left me with no textbook example to follow. This led to many gaps in my work in regard to structure and content. I am thankful to my supervisors for handling my many questions and issues with my content with great patience and guiding me throughout the process, helping me overcome this challenge.

The UNCOVER rapid review on refugees and migrants that I am involved in and have used for my dissertation is still ongoing. My dissertation and the rapid review were both progressing at a very different pace and I constantly found myself without sufficient information to proceed to the next stage- another important challenge. For example, while I was working on the background chapter for my dissertation, it was still the initial stages of the rapid review and I did not have enough information about the review's inclusion and exclusion criteria as well as my role in the review. Thus, I faced a major

challenge trying to write refugee rapid review related parts in my dissertation, causing a significant delay in my work. I overcame this difficulty by doing certain steps myself, for example, conducting a quick search on PubMed and Ovid to browse over the available literature, which helped me structure my background chapter. This gave me confidence over my literature search skills.

Another important challenge I faced was the lack of sufficient data on my research question. COVID-19 is a new disease and I constantly found insufficient academic literature on COVID-19 in Rohingya populations, suggesting how vulnerable populations are not given enough attention in scientific research when we have a new disease affecting the globe. I had no option left but to work with what I have, much like we did as a team at the start of the facemask research where we had to use indirect evidence. I had to leave some questions partially answered due to lack of sufficient evidence to fully support them, while including admonitions wherever necessary. Additionally, UNCOVER gave me the opportunity to work with experts from various disciplines of science such as virologists, fluid mechanics experts etc. While this was a great advantage, I found myself unable to completely comprehend certain concepts that were out of my area of expertise. For example, a fluid dynamic study by Viola et al. (2020) I used for my dissertation to study aerosol transmission of the virus involved concepts such as Background Oriented Schlieren technique, was a completely new area for me. Thus, it was difficult for me to fully understand and critique the paper. I was lucky to be able to take advice from the fluid mechanics expert working with UNCOVER, who helped me understand certain concepts and guided me on how to analyze results for such studies. This taught me to not be afraid and reach out for help even if I am not acquainted with that person directly, since it can improve the quality of my work substantially.

Another challenge, and possibly the biggest one I faced, is directly related to the pandemic. With the rapid rise of COVID-19 cases in my home country, my family residence became a containment zone due to a very sharp rise of cases within that residential area, greatly affecting my parents' lives. I felt a strong sense of grief, anxiety and helplessness being in a different continent and unable to go home due to border closures. This anxiety caused me to work very slowly and I often found myself staring at the computer screen for hours without getting much work done. Yet, due to my introverted nature and in an attempt to be brave, I did not open up to anyone about this issue. The stress caused due to these personal reasons, in addition to the stress caused while trying to juggle daily life in lockdown, volunteer work as well as dissertation work soon became overwhelming and I finally broke down and asked for help. The support I received from the MPH team and my supervisors was wonderful. Opening up and talking to staff and other students was remedial. I soon found myself doing significantly more work than my previous attempts. I learnt another important lesson here- opening up and asking for help in uneasy

and distressing situations can make a remarkable difference to one's mental health and I should have done this sooner.

Learning Outcomes

I had a pre-conception about rapid and systematic reviews being very tedious and complex, which initially made me very skeptical about choosing these study methods for my dissertation. Working very closely under the guidance of UNCOVER review leads substantially helped build my rapid and systematic review skills. I also conducted searches for specific databases such as CINAHL and Web of Science, citation tracking and reference screening, which I had not previously done before, adding to my learning of the subject. I can safely say that at present, I have a much better understanding of the rationale, methods and applications of these study designs.

Since we had to work in a team for conducting the rapid reviews, I also experienced handling sensitive situations, for example, talking about the Islamic religious beliefs and practices of Rohingya refugees with the team without making any opinionated or insensitive statements, or having a difference in opinion about whether to include or exclude a particular study (which happened quite a few times, and was not always smooth) etc. It was an important learning experience. Initially I felt obligated to agree with the general opinion of the team even if mine was contrasting. With great many attempts to try and bring my argument forward, I finally learnt to state my point firmly while having a polite demeanor. It felt like a great personal triumph!

Future directions

Having researched a question which has not been answered before, I am eager to take it forward and delve deeper into research. While my work focusses on Rohingya refugee camps, I also see a gap in literature for other smaller refugee populations worldwide where this research could also be useful. I see many wonderful opportunities from where I am currently at and I am motivated to undertake a PhD or work with a refugee aid organisation. At present, I will try to refine my results as much as possible and wait to see if my work can be used as a starting point for future research.

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Appendix I: Databases and search strategy for the rapid review 'Does the use of face masks in the general population make a difference to spread of infection?'

MedRxiv and BioRxiv

for abstract or title "respiratory influenza flu covid-19 covid19 coronavirus coronaviruses SARS MERS" (match any words) and full text or abstract or title "facemask facemasks respirator respirators" (match whole any)

Scopus

TITLE-ABS-KEY ((facemask? OR "facemasks?" OR mask? OR goggle? OR faceshield? OR respirator OR respirators) AND (influenza OR flu OR sars OR tuberculosis OR mers OR coronav* OR "cov" OR respiratory syndrome OR wuhan OR "ncov")) AND LOAD-DATE > 20200131 AND (LIMIT-TO (SUBJAREA , "MEDI") OR LIMIT-TO (SUBJAREA , "NURS") OR LIMIT-TO (SUBJAREA , "IMMU"))

Embase and Medline via Ovid

1. ((facemask? or "face-masks?" or mask? or goggle? or face-shield? or respirator or respirators).ti. or (facemask? or "face-masks?" or mask? or goggle? or face-shield? or respirator or respirators).ab. or (facemask? or "face-masks?" or mask? or goggle? or face-shield? or respirator or respirators).kw.) and ((influenza or flu or sars or tuberculosis or mers or coronav* or "cov" or respiratory-syndrome or "ncov" or wuhan).kw. or (influenza or flu or sars or tuberculosis or mers or coronav* or "cov" or respiratory-syndrome or "ncov" or wuhan).ti. or (influenza or flu or sars or tuberculosis or mers or coronav* or "cov" or respiratory-syndrome or "ncov" or wuhan).ab.) (2381)
2. ("202006" or "202007" or "202008" or "202009" or 20201*).em. (550416)
3. 1 and 2 (44)
4. (202002* or 202003* or 202004*).ed. (178569)
5. 1 and 4 (13)
6. 3 or 5 (57)

PubMed

("Influenza, Human"[Mesh] OR "Influenzavirus A"[Mesh] OR "Influenzavirus B"[Mesh] OR "Influenzavirus C"[Mesh] OR Influenza[tiab] OR "Respiratory Tract Diseases"[Mesh] OR "Bacterial Infections/transmission"[Mesh] OR Influenzas[tiab] OR "Influenza-like"[tiab] OR ILI[tiab] OR Flu[tiab] OR Flus[tiab] OR "Common Cold"[Mesh:NoExp] OR "common cold"[tiab] OR colds[tiab] OR coryza[tiab] OR

coronavirus[Mesh] OR "sars virus"[Mesh] OR coronavirus[tiab] OR Coronaviruses[tiab] OR "coronavirus infections"[Mesh] OR "severe acute respiratory syndrome"[Mesh] OR "severe acute respiratory syndrome"[tiab] OR "severe acute respiratory syndromes"[tiab] OR sars[tiab] OR "respiratory syncytial viruses"[Mesh] OR "respiratory syncytial virus, human"[Mesh] OR "Respiratory Syncytial Virus Infections"[Mesh] OR "respiratory syncytial virus"[tiab] OR "respiratory syncytial viruses"[tiab] OR rsv[tiab] OR parainfluenza[tiab] OR ((Transmission[tiab]) AND (Coughing[tiab] OR Sneezing[tiab])) OR ((respiratory[tiab] AND Tract[tiab]) AND (infection[tiab] OR Infections[tiab] OR illness[tiab])))

AND

("Hand Hygiene"[Mesh] OR handwashing[tiab] OR hand-washing[tiab] OR ((Hand[tiab] OR Alcohol[tiab]) AND (wash[tiab] OR Washing[tiab] OR Cleansing[tiab] OR Rinses[tiab] OR hygiene[tiab] OR rub[tiab] OR Rubbing[tiab] OR sanitiser[tiab] OR sanitizer[tiab] OR cleanser[tiab] OR disinfected[tiab] OR Disinfectant[tiab] OR Disinfect[tiab] OR antiseptic[tiab] OR virucid[tiab])) OR "gloves, protective"[Mesh] OR Glove[tiab] OR Gloves[tiab] OR Masks[Mesh] OR "respiratory protective devices"[Mesh] OR facemask[tiab] OR Facemasks[tiab] OR mask[tiab] OR Masks[tiab] OR respirator[tiab] OR respirators[tiab] OR "Protective Clothing"[Mesh:NoExp] OR "Protective Devices"[Mesh] OR "patient isolation"[tiab] OR ((school[tiab] OR Schools[tiab]) AND (Closure[tiab] OR Closures[tiab] OR Closed[tiab])) OR Quarantine[Mesh] OR quarantine[tiab] OR “Hygiene intervention”[tiab] OR "Mouthwashes"[Mesh] OR gargling[tiab] OR “nasal tissues”[tiab])

AND

("Communicable Disease Control"[Mesh] OR "Disease Outbreaks"[Mesh] OR "Disease Transmission, Infectious"[Mesh] OR "Infection Control"[Mesh] OR Transmission[sh] OR “Prevention and control”[sh] OR "Communicable Disease Control"[tiab] OR “Secondary transmission”[tiab] OR ((Reduced[tiab] OR Reduce[tiab] OR Reduction[tiab] OR Reducing[tiab] OR Lower[tiab]) AND (Incidence[tiab] OR Occurrence[tiab] OR Transmission[tiab] OR Secondary[tiab])))

AND

(Randomized controlled trial[pt] OR controlled clinical trial[pt] OR randomized[tiab] OR randomised[tiab] OR placebo[tiab] OR "drug therapy"[sh] OR randomly[tiab] OR trial[tiab] OR groups[tiab])

NOT

(Animals[Mesh] not (Animals[Mesh] and Humans[Mesh]))

NOT

(“Case Reports”[pt] OR Editorial[pt] OR Letter[pt] OR Meta-Analysis[pt] OR “Observational Study”[pt] OR “Systematic Review”[pt] OR “Case Report”[ti] OR “Case series”[ti] OR Meta- Analysis[ti] OR “Meta-Analysis”[ti] OR “Systematic Review”[ti])

Cochrane CENTRAL

([mh "Influenza, Human"] OR [mh "Influenzavirus A"] OR [mh "Influenzavirus B"] OR [mh "Influenzavirus C"] OR Influenza:ti,ab OR [mh "Respiratory Tract Diseases"] OR Influenzas:ti,ab OR "Influenza-like":ti,ab

OR ILI:ti,ab OR Flu:ti,ab OR Flus:ti,ab OR [mh "Common Cold"] OR "common cold":ti,ab OR colds:ti,ab OR coryza:ti,ab OR [mh coronavirus] OR [mh "sars virus"] OR coronavirus:ti,ab OR Coronaviruses:ti,ab OR [mh "coronavirus infections"] OR [mh "severe acute respiratory syndrome"] OR "severe acute respiratory syndrome":ti,ab OR "severe acute respiratory syndromes":ti,ab OR sars:ti,ab OR [mh "respiratory syncytial viruses"] OR [mh "respiratory syncytial virus, human"] OR [mh "Respiratory Syncytial Virus Infections"] OR "respiratory syncytial virus":ti,ab OR "respiratory syncytial viruses":ti,ab OR rsv:ti,ab OR parainfluenza:ti,ab OR ((Transmission) AND (Coughing OR Sneezing)) OR ((respiratory:ti,ab AND Tract) AND (infection:ti,ab OR Infections:ti,ab OR illness:ti,ab)))

AND

([mh "Hand Hygiene"] OR handwashing:ti,ab OR “hand-washing”:ti,ab OR ((Hand:ti,ab OR Alcohol:ti,ab) AND (wash:ti,ab OR Washing:ti,ab OR Cleansing:ti,ab OR Rinses:ti,ab OR hygiene:ti,ab OR rub:ti,ab OR Rubbing:ti,ab OR sanitiser:ti,ab OR sanitizer:ti,ab OR cleanser:ti,ab OR disinfected:ti,ab OR Disinfectant:ti,ab OR Disinfect:ti,ab OR antiseptic:ti,ab OR virucid:ti,ab)) OR [mh "gloves, protective"] OR Glove:ti,ab OR Gloves:ti,ab OR [mh Masks] OR [mh "respiratory protective devices"] OR facemask:ti,ab OR Facemasks:ti,ab OR mask:ti,ab OR Masks:ti,ab OR respirator:ti,ab OR respirators:ti,ab OR [mh ^"Protective Clothing"] OR [mh "Protective Devices"] OR "patient isolation":ti,ab OR ((school:ti,ab OR Schools:ti,ab) AND (Closure:ti,ab OR Closures:ti,ab OR Closed:ti,ab)) OR [mh Quarantine] OR quarantine:ti,ab OR "Hygiene intervention":ti,ab OR [mh Mouthwashes] OR gargling:ti,ab OR "nasal tissues":ti,ab)

AND

([mh "Communicable Disease Control"] OR [mh "Disease Outbreaks"] OR [mh "Disease Transmission, Infectious"] OR [mh "Infection Control"] OR "Communicable Disease Control":ti,ab OR "Secondary transmission":ti,ab OR ((Reduced:ti,ab OR Reduce:ti,ab OR Reduction:ti,ab OR Reducing:ti,ab OR Lower:ti,ab) AND (Incidence:ti,ab OR Occurrence:ti,ab OR Transmission:ti,ab OR Secondary:ti,ab)))

CINAHL

((MH "Influenza, Human+") OR (MH "Orthomyxoviridae+") OR TI Influenza OR AB Influenza OR (MH "Respiratory Tract Diseases+") OR TI Influenzas OR AB Influenzas OR TI Influenza-like OR AB Influenza-like OR TI ILI OR AB ILI OR TI Flu OR AB Flu OR TI Flus OR AB Flus OR (MH "Common Cold+") OR TI "common cold" OR AB "common cold" OR TI colds OR AB colds OR TI coryza OR AB coryza OR (MH "coronavirus+") OR (MH "sars virus+") OR TI coronavirus OR AB coronavirus OR TI Coronaviruses OR AB Coronaviruses OR (MH "coronavirus infections+") OR (MH "severe acute respiratory syndrome+") OR TI "severe acute respiratory syndrome" OR AB "severe acute respiratory syndrome" OR TI "severe acute respiratory syndromes" OR AB "severe acute respiratory syndromes" OR TI sars OR AB sars OR (MH "respiratory syncytial viruses+") OR TI "respiratory syncytial virus" OR AB "respiratory syncytial virus" OR TI "respiratory syncytial viruses" OR AB "respiratory syncytial viruses" OR TI rsv OR AB rsv OR TI parainfluenza OR AB parainfluenza OR ((Transmission) AND (Coughing OR Sneezing)) OR ((TI respiratory

OR AB respiratory AND Tract) AND (TI infection OR AB infection OR TI Infections OR AB Infections OR TI illness OR AB illness)))

AND

((MH "Handwashing+") OR TI handwashing OR AB handwashing OR TI hand-washing OR AB handwashing OR ((TI Hand OR AB Hand OR TI Alcohol OR AB Alcohol) AND (TI wash OR AB wash OR TI Washing OR AB Washing OR TI Cleansing OR AB Cleansing OR TI Rinses OR AB Rinses OR TI hygiene OR AB hygiene OR TI rub OR AB rub OR TI Rubbing OR AB Rubbing OR TI sanitiser OR AB sanitiser OR TI sanitizer OR AB sanitizer OR TI cleanser OR AB cleanser OR TI disinfected OR AB disinfected OR TI Disinfectant OR AB Disinfectant OR TI Disinfect OR AB Disinfect OR TI antiseptic OR AB antiseptic OR TI virucid OR AB virucid)) OR (MH "gloves+") OR TI Glove OR AB Glove OR Gloves OR (MH "Masks+") OR (MH "respiratory protective devices+") OR TI facemask OR AB facemask OR TI Facemasks OR AB Facemasks OR TI mask OR AB mask OR TI Masks OR AB Masks OR TI respirator OR AB respirator OR TI respirators OR AB respirators OR (MH "Protective Clothing") OR (MH "Protective Devices+") OR TI "patient isolation" OR AB "patient isolation" OR ((TI school OR AB school OR TI Schools OR AB Schools) AND (TI Closure OR AB Closure OR TI Closures OR AB Closures OR TI Closed OR AB Closed)) OR (MH "Quarantine+") OR TI quarantine OR AB quarantine OR TI "Hygiene intervention" OR AB "Hygiene intervention" OR (MH "Mouthwashes+") OR TI gargling OR AB gargling OR TI "nasal tissues" OR AB "nasal tissues")

AND

((MH "Infection Control+") OR (MH "Disease Outbreaks+") OR (MH "Infection Control+") OR TI "Communicable Disease Control" OR AB "Communicable Disease Control" OR TI "Secondary transmission" OR AB "Secondary transmission" OR ((TI Reduced OR AB Reduced OR TI Reduce OR AB Reduce OR TI Reduction OR AB Reduction OR TI Reducing OR AB Reducing OR TI Lower OR AB Lower) AND (TI Incidence OR AB Incidence OR TI Occurrence OR AB Occurrence OR TI Transmission OR AB Transmission OR TI Secondary OR AB Secondary)))

AND

((MH "Clinical Trials+") OR (MH "Quantitative Studies") OR TI placebo* OR AB placebo* OR (MH "Placebos") OR (MH "Random Assignment") OR TI random* OR AB random* OR TI ((singl* or doubl* or tripl* or trebl*) W1 (blind* or mask*)) OR AB ((singl* or doubl* or tripl* or trebl*) W1 (blind* or mask*)) OR TI clinic* trial* OR AB clinic* trial* OR PT clinical trial)

Appendix II: Databases and search strategy for the rapid review 'Are homemade facemasks effective at reducing transmission of COVID-19 in community settings?'

CINAHL - 206 Results

"(facemask* OR "face mask*" OR mask* OR veil*) AND (self-made OR "self made" OR "home made" OR homemade OR improvise* OR at-home OR re-purpose* OR "re purpose*") AND ("virus*" OR "viral" OR respiratory OR infection* OR outbreak* OR transmission* OR influenza OR "coronavirus*" OR COVID* OR "COVID-19" OR "severe acute respiratory syndrome" OR SARS* OR MERS*) Language: English AND Apply equivalent subjects on 2020-04-17 01:21 PM".

MedRxiv - 70 results

for abstract or title "facemask facemasks mask masks covering veil" (match any words) and full text or abstract or title "household home-made improvised self-made" (match whole any)

Web of Science – 142 Results

(self-made OR "self made" OR "home made" OR homemade OR improvise* OR at-home OR re-purpose* OR "re purpose*") AND (facemask* OR "face mask*" OR mask* OR veil*) AND ("virus*" OR "viral" OR viroid* OR respiratory OR infection* OR outbreak* OR transmission* OR influenza OR "coronavirus*" OR COVID* OR "COVID-19" OR "severe acute respiratory syndrome" OR SARS* OR MERS*)

Medline OVID - 33 results

Search source: Developed by expert searchers at Ovid in April 2020, available from: https://tools.ovid.com/coronavirus/

1. disease outbreaks/ or epidemics/ or pandemics/ or disease transmission, infectious/ or exp equipment contamination/ or equipment reuse/ or exp hygiene/ or exp Infection Control/ or exp coronavirus/

2. ((disease$ adj2 outbreak$) or epidemic$ or pandemic$ or pandemie* or influenza or SARS or MERS or flu or tuberculosis or zika or ebola or covid19 or "covid-19" or "SARS-CoV-2" or "2019-nCov" or coronavirus* or corona-virus* or nCov or SARS-CoV* or SARSCov2 or ncov*).mp.

3. middle east respiratory syndrome coronavirus/ or sars virus/ or exp Tuberculosis/ or influenza, Human/ or exp respiratory tract infections/

4. or/1-3

5. ((cloth$ or DIY or "do it yourself" or t-shirt$ or homemade or home-made or bandana$ or scarf$ or neckscarf$ or kerchief$ or napkin$ or bracup$ or bra-cup$ or 3D or "3-D" or cotton$ or muslin$ or gauze$ or "cheese cloth" or towel$ or fabric$ or tight$ woven or tight$ weav$) adj2 (facemask$ or face-mask$ or mask$)).mp.

6. (((home adj1 made) or homemaker$ or household$ or "house hold$") adj1 mask$).mp.

7. ("16752475" or "26980847" or "25903751" or "18612429" or "32203710" or "23968983" or "25903751" or "19702582" or "20584862").ui.

8. or/5-7

9. (((cloth$ or DIY or "do it yourself" or t-shirt$ or homemade or home-made or bandana$ or scarf$ or neckscarf$ or kerchief$ or napkin$ or bracup$ or bra-cup$ or 3D or "3-D" or cotton$ or muslin$ or gauze$ or "cheese cloth" or towel$ or fabric$ or tight$ woven or tight$ weav$) adj (facemask$1 or face-mask$1 or mask$1)) and (develop$ adj1 countr$)).mp.

10. ("16752475" or "26980847" or "25903751" or "18612429" or "32203710" or "23968983" or "25903751" or "19702582" or "20584862").ui.

11. "20390479".ui.

12. (4 and 8) or 7 or 9

13. 12 not 11

Appendix III: Search terms for the rapid review 'What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review. '

(as at 11.06.2020)

COVID-19	Refugees and Migrants
• COVID-19 search string(s) • Respiratory virus search string(s)	Refugee Asylum seeker Displaced person (or people) IDP Migrant (immigrant, emigrant) Migration Transient Stateless Sanctuary Traffick* (trafficking, trafficked) Smuggl* (smuggling, smuggled) Slavery (modern slavery) Forced labour Domestic servitude Undocumented migrant (irregular, illegal) Guest worker (foreign worker) Clandestine
	Persecution (fear of persecution) Conflict War Violence Torture Displacement Country of origin Transit Flee
	Humanitarian setting Camp (refugee camp) Detention centre Immigration detention Incarceration Deportation Shelter Precarious Insecurity Hostile environment Reunification (family reunification)
	Border (border crossing) Language (barrier) Nationality Citizenship Foreign

Appendix IV: Rapid Review: Does the use of face masks in the general population make a difference to spread of infection?

UNCOVER
Usher Network for COVID-19 Evidence Reviews

Review: Does the use of face masks in the general population make a difference to spread of infection?

Date:7 April 2020 Version: 003−01

THE UNIVERSITY of EDINBURGH | usher institute

Review Question: Does the use of face masks in the general population make a difference to spread of infection?

Date of review: 7 April 2020
Answer:

- Based on the evidence from three recent systematic reviews and meta−analyses [including our re−analysis focusing on community trials] wearing face masks in the community was not significantly associated with a reduction in episodes of influenza−like illness [ILI]; the overall assessment of the quality was classified as low.
- Jefferson 2020 [re−analysed]: 7 RCTs in the general population with ILI outcome [OR (95% CI) 0.92 (0.87, 1.07)]
- Xiao 2020: 10 RCTs in non−healthcare settings with pandemic influenza outcomes
- [OR (95% CI) 0.97 (0.79, 1.18]
- Brainard 2020: various study designs with respiratory illness outcome; OR (95% CI): 0.94 (0.75, 1.19)
- SARS−CoV−2 is transmissible by contact and droplets [aerodynamic diameter >5µm]. SARS− CoV−2 can be detectable and viable in aerosols [aerodynamic diameter Š5µm], suggesting possible transmission routes by aerosols. However, there is little current evidence demonstrating actual aerosol transmission episodes by SARS−CoV−2.
- The quality of the evidence on face mask effectiveness is moderate to low. See table 1. Many of the cohort and cross−sectional studies rely on self−reported symptoms not confirmed clinically or using lab tests. There is very little information on duration or frequency of use or correct usage of masks.
- Whilst some of the RCTs specify the type of mask used, many of the studies do not define the type of mask or the materials masks are made from. This makes it difficult to evaluate the evidence.
- Mask−wearing alone, in the absence of other preventive measures, is unlikely to be effective, yet most studies do not take this into account. Many studies did not gather information on general hygiene and other relevant health behaviours (e.g. hand sanitizer, handwashing). Many of the studies do not make a distinction between indoor and outdoor settings.
- Much of the evidence is not generalizable to a UK community setting. For example, 8 of the 24 studies focus on face mask use during the annual hajj pilgrimage in Saudi Arabia − a very specific context in very different climatic conditions. The influence of cultural and socio− behavioural factors (e.g. fear, stigma, altruism) on levels of compliance during a pandemic may differ meaningfully from other circumstances.
- There is little evidence on the behavioural aspects of facemask use. The most−studied aspect relates to frequency ƒ consistency of use, with more consistent use linked to a greater reported protective effect (although this must be taken in the context of our overall findings which failed to find a clear protective effect of facemasks). One study found that facemasks contribute to an increased sense of isolation.
- Public health awareness campaigns [Aiello−2010], specific education [Barasheed−2016] and provision of free facemasks [Alabdeen−2005] all appeared to incentivize greater uptake of facemasks. There were little data on how long people can be expected to comply with requirements to wear a facemask. One review reported that “in one study, rates of self− reported adherence were found to decline over a

5−day period" [PHE−2014].

Conclusion:

This review found mixed and low-quality evidence on the use of face masks to prevent community transmission of respiratory illness, with much of the evidence generated in very different contexts from the UK. Key issues are the need for better quality research in community settings, which focuses not only on evaluating different types of mask but also on evaluating adherence (duration and frequency of mask use, correct procedure for putting on and removing masks) and the use of masks in conjunction with hand hygiene.

Note: This review was conducted very quickly, and as such has the following weaknesses: full text screening, extracted data and quality assessment were not checked by a second reviewer, thus introducing a risk of bias. We will continue to update and refine this review going forward.

Reviewers note that the WHO Expert Panel reported on 6ƒ4ƒ2020 that "the wide use of masks by healthy people in the community setting is not supported by current evidence and carries uncertainties and critical risks".

Background and Aims

Current UK advice advises that "respiratory etiquette when coughing or sneezing" and social distancing of at least 2m apart should give sufficient protection against transmission from viruses carried in droplets which evaporate or fall to the ground within that distance. However, recent data has suggested that exhalation, coughing and sneezing can carry liquid droplets ƒ aerosols over larger distances and has led to renewed interest in the role of facemasks to limit transmission risk. If there were a general recommendation to wear face masks indoor when symptomatic, or outdoors in public is there evidence to suggest that this may help slow the spread of coronavirus? Could wearing a mask be as effective as social distancing? The WHO Expert Panel on this topic reported on 6ƒ4ƒ2020 that "the wide use of masks by healthy people in the community setting is not supported by current evidence and carries uncertainties and critical risks". This is in contrast to US CDC who recommended the US public wear cloth coverings in pharmacies, groceries and other public places where social distancing is hard to maintain.

Background policy relevance

- Can the use of masks prevent transmission of SARS−COV−2?
- Do masks reduce the virus shedding in respiratory droplets andƒ or aerosols?
- Is there a difference between different types of masks (eg surgical or home−made masks)?
- Are there behavioural aspects of face mask wearing by the general population that relate to compliance or risk taking behaviour that are relevant?

Methods:

We adapted rapid review methods outlined by the Cochrane Collaboration. We sought publications in four main inter−connected areas:

- sub−review 1: what is the effectiveness of face masks in preventing respiratory transmission in the community?

- sub−review 2: what is the relative effectiveness of medical masks versus non−medical masks or equivalent barriers?
- sub−review 3: what important behavioural aspects of wearing masks in terms of compliance with advice and impact on risk taking behaviour can be identified?
- sub−review 4: what is known about the nature and spread of respiratory airway particles?

Literature Search: We excluded publications focusing only on health care settings, modelling data, animal models, and articles providing commentary but no data. We focused on studies reporting on COVID−19 but included data from other related respiratory viruses, where appropriate. We became aware that a number of recent existing reviews on related relevant topics. Since there is currently no register of existing reviews, we compiled this from websites of partners taking part in the WHO Evidence Collaborative and identified ~170 COVID−19 evidence reviews, including some on use of face masks. We searched the literature for prior reviews and evidence summaries on facemasks to prevent transmission of infection. We appraised the 14 prior review summaries found, and for this update rapid review selected the three most recent, on−topic, and robust quality [Jefferson 2020, Brainard 2020, Xiao 2020] for updating and re−analysis. We sought publications with data on face masks of any study design and of published or pre−published status by updating the literature searches of three systematic reviews. The search was limited to publications from the date onward that each of the systematic review had stopped their search. We searched the databases used in the prior reviews (PubMed, Medline, Embase, Scopus, CENTRAL, CINAHL) and augmented the methods by including a search for pre−prints on MedRxiv. The searches were carried out by one reviewer (MD). From the updated search results set, we excluded publications published before 2020, from nosocomial settings, modelling data, animal models, providing commentary but no data. All component studies of the three systematic reviews were included in this update. There were no language limitations as part of the search, but due to time and resource constraints, non−English publications were not included in analysis.

Sub-review 1: What is the effectiveness of face masks in preventing respiratory transmission in the community?

Background

Community face mask use was part of successful control policies in China, South Korea and Vietnam, but it is not possible to disentangle their separate contribution to reducing transmission. This rapid review was carried out to establish whether there is evidence for the use of face masks in the general population to reduce the spread of infection with SARS−COV−2.

Methods

We adapted rapid review methods outlined by the Cochrane Collaboration. We searched the literature for prior reviews and evidence summaries on facemasks to prevent transmission of infection. We appraised the 14 prior review summaries found, and for this update rapid review selected the three most recent, on−topic, and robust quality [Jefferson 2020, Brainard 2020, Xiao 2020] for updating and re−analysis. We sought publications with data on face masks of any study design and of published or pre−published status by updating the literature searches of three systematic reviews. The search was limited to publications from the date onward that each of the systematic review had stopped their search. We searched the databases used in the prior reviews (PubMed, Medline, Embase, Scopus, CENTRAL, CINAHL) and augmented the

methods by including a search for pre−prints on MedRxiv. The searches were carried out by one reviewer (MD). From the updated search results set, we excluded publications published before 2020, from nosocomial settings, modelling data, animal models, providing commentary but no data. All component studies of the three systematic reviews were included in this update.

Screening was shared between three reviewers (MG, XL, WX). Each new title, abstract and full text was screened by one reviewer (MG). References of previous systematic reviews were searched by two reviewers (XL, WX). No new studies meeting the inclusion criteria were identified.

Results

- A total of 766 new results was found from the database searching, reduced to 81 after removal of duplicates and pre−2020 publications. We excluded 72 records by screening titles and abstracts and a further 9 at the full text screen quality assessment phase, leaving 0 new articles for inclusion in the final review. The key findings from this rapid review were:
- Of the three high quality recent reviews we scrutinized in detail, two included only RCTs [Jefferson 2020, Xiao 2020], whereas Brainard 2020 included population studies too. We ran updated literature searches for these reviews to identify new studies. No new studies meeting inclusion criteria were identified.
- All component studies of the three systematic reviews were included for analysis in this update.
- Jefferson 2020 included 9 RCTs (7 in the general population and 2 in health care workers) and reported that there was no reduction of Influenza−like illness (Bandiera et al.) for masks compared to no masks [Random effects OR (95% CI): 0.93 (0.83, 1.05)].
- We re−ran a random effects meta−analysis restricting to the 7 RCTs conducted in the general population from Jefferson 2020 and also found no significant reduction of ILI [OR (95% CI): 0.92 (0.87, 1.07)]. Risk of bias analysis using the Cochrane tool done by Jefferson et al indicated that there was high or unknown risk of bias in relation to performance, detection and reporting bias.
- Xiao 2020 evaluated environmental and personal protective measures for pandemic influenza in non−healthcare settings. They run a fixed effect meta−analysis of 10 RCTs of community use of face masks (with or without hand hygiene measures) and they reported a no significant reduction of ILI [Fixed effect OR (95% CI): 0.92 (0.75, 1.12)]. We repeated the analysis using random effects meta−analysis and the result was similar [Random effects OR (95%CI): 0.97 (0.79, 1.18)]. The study quality of the included studies was evaluated using GRADE by Xiao et al and the overall assessment of the quality was classified as low.
- Brainard 2020 included all study designs on facemasks and similar barriers to prevent respiratory illness. Based on random effects meta−analyses on RCTs, they concluded that wearing face masks can be very slightly protective against primary infection from casual community contact, but this was not significant, and the evidence was classified as low certainty−evidence using the Cochrane risk assessment [Random effects OR (95% CI): 0.94 (0.75, 1.19)]. Similar were the findings for the prevention of household infections when both infected and uninfected members wear face masks.

Conclusion
Based on the evidence from three recent systematic reviews and meta−analyses wearing face masks in the community is not significantly associated with a reduction in ILI and the overall assessment of the quality was classified as low.

Lead reviewers [with contact details of lead]
Prof Evropi Theodoratou, e.theodoratou@ed.ac.uk
Marshall Dozier, Margaret Guyan, Dr Xue Li, Wei Xu

Sub-review 2: what is the relative effectiveness of medical masks versus non-medical masks or equivalent barriers?

Background
This review evaluates the evidence on the effectiveness of facemasks for preventing respiratory infection in community settings.

Method
We adapted rapid review methods outlined by the Cochrane Collaboration. We sought published or pre−published observational or intervention studies, investigating face masks or respirators to prevent the transmission of respiratory viruses in community settings. Facemasks could be surgical, medical, N95 respirators, homemade, improvised or repurposed (e.g. DIY masks) made of any material. Included studies had to report a measure of respiratory virus infection and/or its consequences (e.g. days off work, complications, hospital admission, deaths). We excluded case series, case reports, review articles, guidelines, discussions, regulations, debates, and commentaries. We also excluded publications which investigated the prevention of transmission to and from clinically trained persons in clinical settings, studies based on mathematical modelling, and studies investigating transmission from non−humans

We searched the literature for prior reviews and evidence summaries on facemasks to prevent transmission of infection. We appraised the 14 prior review summaries found, and for this update rapid review selected the three most recent, on−topic, and robust quality [Jefferson 2020, Brainard 2020, Xiao 2020] for updating and re−analysis. We sought publications with data on face masks of any study design and of published or pre−published status by updating the literature searches of three systematic reviews. The search was limited to publications from the date onward that each of the systematic review had stopped their search. We searched the databases used in the prior reviews (PubMed, Medline, Embase, Scopus, CENTRAL, CINAHL) and augmented the methods by including a search for pre−prints on MedRxiv. The searches were carried out by one reviewer
(MD). From the updated search results set, we excluded publications published before 2020, from nosocomial settings, modelling data, animal models, providing commentary but no data. All component studies of the three systematic reviews were included in this update.

Title and abstract screening was done by three people, each person screening a third of the studies. A second person checked all rejected studies. Where the second reviewer disagreed with the decision of the first reviewer, the paper was retained for full text screening. Full text screening was again split between the three reviewers. Data extraction and quality appraisal were conducted by a different reviewer from the reviewer who conducted the screening. We used the following quality assessment checklists: CASP checklist for randomised controlled trials, cohort and case −control studies and Joanna Briggs checklists for case series and cross−sectional studies.

Results

We identified a total of 182 studies (107 were primary studies from the 3 key systematic reviews and 78 were studies identified in our update search. We rejected 125 through screening titles and abstracts and a further 32 when reviewing full texts. Reasons for rejection at full text screen were: not meeting inclusion and exclusion criteria (n=18), not primary studies (n=6), full text not available (n=8). We retained 25 studies for detailed analysis and quality appraisal. Key findings were that:

- The quality of the evidence on face mask effectiveness is moderate to low. See table 1.
- Many of the cohort and cross−sectional studies rely on self−reportedsymptoms not confirmed clinically or using lab tests.
- There is very little information on duration or frequency of use or correct usage of masks.
- Whilst some of the RCTs specify the type of mask used, many of the studies do not define the type of mask or the materials masks are made from. This makes it difficult to evaluate the evidence.
- Mask−wearing alone, in the absence of other preventive measures, is unlikely to be effective, yet most studies do not take this into account. Many studies did not gather information on general hygiene and other relevant health behaviours (e.g. hand sanitiser, hand−washing)
- Many of the studies do not make a distinction between indoor and outdoor settings.
- Much of the evidence is not generalizable to a UK community setting. For example, 8 of the 24 studies focus on face mask use during the annual hajj pilgrimage in Saudia Arabia − a very specific context in very different climatic conditions. Only one lack of transferability between different populations.
- Of the seven studies of moderate quality (table 3) − i.e. the strongest evidence found − three reported no evidence of effectiveness of face masks, whilst 4 reported some evidence of effectiveness. However a key consideration is the difference between evidence of effectiveness in a controlled study and the evidence of effectiveness in real life situations, where compliance may not be optimum.

Table 1: Summary of study designs and evidence quality (GRADE criteria)

Study ID	Study design	Quality assessment
Aiello−2010	RCT	Moderate
Aiello−2012	cRCT	Moderate
Alfelali−2019	cRCT	Moderate

MacIntyre−2009	cRCT	Moderate
MacIntyre−2016	cRCT	Moderate
Simmerman−2011	RCT	Moderate
Suess−2012	cRCT	Moderate
Barasheed−2014	cRCT	Low
Cowling−2009	cRCT	Low
Al−Jasser−2013	Cohort	Low
Balaban−2012	Cohort	Low
Choudhry−2006	Cohort	Low
Gautret−2011	Cohort	Low
Gautret−2015	Cohort	Very low
Larson−2010	Cohort	Very low
Wu−2004	Case−control	Low
Emamian−2013	Case−control	Very low
Zhang−2013b	Case−control	Very low
Kim−2011	Cross−sectional	Low
Uchida−2017	Cross−sectional	Low
Deris−2010	Cross−sectional	Very low
Hashim−2016	Cross−sectional	Very low
Wu−2016	Cross−sectional	Very low
Ma−2020	Experiment	Difficult to evaluate

Conclusions

This review found mixed and low quality evidence on the use of face masks to prevent community transmission of respiratory illness, with much of the evidence generated in very different contexts from the UK. Key issues are the need for better quality research in community settings, which focuses not only on evaluating different types of mask but also on evaluating adherence (duration and frequency of mask use, correct procedure for putting on and removing masks). This review was conducted very quickly, and as such has the following weaknesses: full text screening, extracted data and quality assessment were not checked by a second reviewer, thus introducing a risk of bias; We will continue to update and refine this review goingforward.

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Sub-review 3 - what evidence is there for the role of behavioural factors on the effectiveness of face mask use in the community?

Background

We looked at behavioural factors that are linked directly to facemask use: Is the facemask put on and taken off correctly? How often do people wear facemasks? Does this change over time? Do

the population comply with advice on their use?

Methods

For the full review, we adapted rapid review methods outlined by the Cochrane Collaboration. We searched the literature for prior reviews and evidence summaries on facemasks to prevent transmission and appraised the 14 prior reviews and summaries found.

These reviews were screened by three reviewers (EMS, MP, AN) for relevance to our sub−question (behavioural aspects of facemask use) and 11 were identified that met our inclusion criteria. The primary studies within these reviews were then taken forward for title & abstract, and subsequent full−text, screening.

Screening Criteria: We included studies that considered:

- How masks are used (e.g. whether people are putting them on or taking them off safely) and whether this alters their effectiveness;
- How mask use affects other relevant protective or risk−taking behaviours;
- Whether mask use changes in the long term; and
- What behavioural interventions (e.g. training, communications) may affect mask use.
- We excluded studies that considered:
- Mask use among healthcare workers or in care settings only.

Screening and Data Extraction

- 84 primary studies were identified from the reference lists of the relevant reviews. 8 studies were excluded because full−text was unavailable, and 2 because they were not in English, by the team who retrieved the studies (RMQ, LG and YB).
- 74 studies remained to be screened. Of these, 9 were prioritised by MP for data extraction, based on our full−text screening of the existing reviews. Data extraction was carried out by two reviewers (MP and AN).
- Title and abstract screening was carried out by one reviewer (EMS) for the other 65 studies, based on our inclusion criteria. 30 studies were included at this stage. Exclusions were checked by a second reviewer (MP), and one further study was
- included for data extraction.
- Data extraction on these 31 studies was carried out by three reviewers (EMS, AN and MP). 9 further studies were excluded as a result of full−text screening, principally because they did not include any investigation of the behavioural aspects of mask use.

Quality assessment:

We carried out a quality assessment of the remaining 22 reviews based on templates adapted from the CASP checklists for critical appraisal.

Results

The key findings from this rapid review were:

- Behavioural aspects of mask use have not been a primary focus of any study on the effectivenessof facemasks. A small number of studies compare the effectivenessof occasional vs regular facemask use, but these terms are not clearly defined and the studies depend on self−reporting ofcompliance.

- The limited evidence base suggests that regularƒconsistent use of masks may be more protective than irregular use (but within the context of a wider literature which is inconclusive about the general protective effect of masks). However, the difference between 'consistent' and 'irregular' use is not clearly defined in existing studies, and is therefore of limited use in developing guidance.
- One review found that adherence to facemask use tended to drop off after five days. Another found that adherence depended on health beliefs and perception of risk.
- Reported concerns that people may wear masks 'incorrectly', and therefore ineffectively, in the community are a feature of the literature, but there do not appear to be any studieswhich assess the extent to which this actually happens, nor how it impacts on effectiveness.
- One study found that people who wore facemasks appeared to have increased compliance with hand hygiene practices. Of concern, however, the same study found an increased rate of respiratory infection among non−vaccinated people who wore facemasks. The evidence is not strong enough to allow us to conclude that facemask use encourages either protective or risk− taking behaviours, but these findings certainly suggest that a degree of caution should be applied.

- A small number of studies found that behavioural incentives − including specific training, public health awareness campaigns, and provision of free face masks − encouraged uptake of masks.
- One study addressed the barriers to use of facemasks and found that masks contributed to a sense of isolation from others (as well as discomfort and difficulty breathing). This study was not carried out in the context of a pandemic, with mass distancing and 'lockdown', but the possible mental health implications of this finding may require some consideration in this context.
- Most of the studies looking at the use of masks in community settings relate to very specific contexts: schools, university halls of residence, and, most frequently, the Hajj. The Hajj in particular is a unique, time−limited event. Care should be taken when generalizing from these studies to the community in general.

Conclusions

- There is little evidence on the behavioural aspects of facemask use, and most studies relate to unique, defined contexts (predominantly the Hajj). The aspect most frequently studied relates to frequency ƒ consistency of use, and it is suggested that more consistent use is linked with a more protective effect (although this must be taken in the context of overall findings about the [limited] protective effect of facemasks).
- One study found that facemasks contribute to an increased sense of isolation, while another found higher rates of respiratory infection among some participants who wore a facemask, which may hint at a link between facemask use and risk−taking behaviours. Neither of these findings is supported by substantial or robust evidence, but both might merit further research in order to inform a full appraisal of the costs vs benefits of facemask use in community settings.

Sub-review 4: what is the mode of transmission of SARS-CoV-2 and other common respiratory pathogens?

Background

This rapid review was conducted to address the question of whether an understanding of SARS−CoV− 2 transmission routes can help inform decisions regarding community use of face masks.

Methods

Two working strands were conducted in parallel to address the question.

- Strand 1 searched for original studies and reviews that reported the mode of transmission of coronaviruses, including SARS−CoV−2, MERS−CoV, SARS−CoV−1, and seasonal coronaviruses (i.e. NL63, 229E, OC43 and HKU1).
- Strand 2 searched for existing reviews that reported the mode of transmission of common human respiratory pathogens.

Selection criteria are in the Appendix. As studies applied different approaches to infer mode of transmission, we grouped the approaches into three levels based on the strength of the evidence:

- Level 1. Pathogen being detectable (in aerosols, droplets or surfaces).
- Level 2. Pathogen being detectable and viable.
- Level 3. Actual transmission events being confirmed. All studies were extracted to an extraction template attached in Appendix.2.

Results

A total of 25 studies were included and their findings were summarised in Table 1. Key findings include:

- All respiratory pathogens included in the review can be transmitted by directfindirect contact and droplets.
- Measles, influenza virus and adenovirus are known to be transmissible by aerosols.
- SARS−CoV−2 can be detected and is viable in aerosols but with no direct evidence of transmission via aerosols.

Conclusions

- SARS−CoV−2 is transmissible by contact and droplets.
- SARS−CoV−2 can be detectable and viable in aerosols, suggesting possible transmission routes by aerosols. However, little evidence is available so far demonstrating actual aerosol transmission episode by SARS−CoV−2.

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Table 2. Summary of findings on mode of transmission of common human respiratory pathogens

Pathogen	Contact[1]	ref	Droplets	ref	Aerosols					
					Detectable	ref	Viable	ref	Transmission events[2]	ref
Measles	yes	Kutter, 2019; Shiu, 2019	mixed	Kutter, 2019; Shiu, 2019	not known		not known		yes	Kutter, 2019; Shiu, 2019
Parainfluenza virus	yes	Kutter, 2019	yes	Kutter, 2019	not known		not known		not known	
Human metapneumovirus	yes	Kutter, 2019; Shiu, 2019 Nam, 2019;	yes	Kutter, 2019 Nam, 2019;	not known		not known		not known	
Respiratory syncytial virus	yes	Shiu, 2019; Kutter, 2019 Public Health England–2014, 2014;	yes	Shiu 2019; Kutter, 2019 Shiu, 2019; Moghadami, 2017; Kutter, 2019; Otter 2016;	not known Cowling, 2010; maclntyre,		not known		not known	
Influenza virus	yes	SAunders, 2017; Otter, 2016; Kutter, 2019; Moghadami, 2017	yes	Saunders, 2017; Public Health England–2014, 2014; maclntyre, 2015; Leung 2020; Cowling 2010	yes	Leung, 2020	yes	2015, Public Health England-2014, 2014	mixed	Shiu, 2019
Human rhinovirus	yes	Kutter, 2019	yes	Leung, 2020; Kutter 2019		Leung, 2020; Kutter, 2019	not known		yes	Kutter, 2019
Coronavirus , seasonal	not known	—	yes	Leung, 2020	yes yes	Leung, 2020	not known		not known	
Adenovirus	yes	Kutter, 2019	yes	Kutter, 2019	not known		not known		yes	Kutter,2019
SARS−CoV−1	yes	Shiu,2019;Kutter 2019;Adhikari 2020; Hugonnet 2004; Otter 2016	yes	Shiu,2019;Kutter 2019; Hugonnet 2004; Otter 2016	not known		yes	Huggonet 2004; Shiu, 2019; Kutter 2019; Doremala,2020	not known	
MERS−CoV	yes	Shapiro 2016;	Yes	Raoult2020;Kilerby	yes	Shapiro 2016	not known		not known	
SARS-CoV-2	**yes**	Di Wu,2020; Peng 2020;Hui 2020;	**yes**	Di Wu 2020; Wang 2020; Raoult2020; Liu 2020;Peng 2020;Hui 2020;	**yes**	Liu 2020;	**yes**	van	**not known**	

SARS = Severe acute respiratory syndrome; MERS = Middle East respiratory syndrome; ref = reference

[1] Transmission by contact includes direct contact (person to person) and indirect contact via a contaminated object.

[2] Transmission event is defined by the transmission of a pathogen via a specific route (e.g. aerosols), causing human infection

The UNCOVER network is committed to responding quickly and impartially to requests from policymakers for evidence reviews. This document has therefore been produced in a short timescale and has not been externally peer−reviewed.

RR- face mask review keywords and key references

Sub-review 1 What is the effectiveness of face masks in preventing respiratory transmission in the community?

Keywords

Masks, Respiratory Protective Devices, Personal Protective Equipment, Primary Prevention.

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Sub-review 2: what is the relative effectiveness of medical masks versus non-medical masks or equivalent barriers?

Keywords
COVID−19; coronavirus; SARS−CoV−2; transmission; face masks; community

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Sub-review 3 - what evidence is there for the role of behavioural factors on the effectiveness of face mask use in the community?

Sub-review 4: what is the mode of transmission of SARS-CoV-2 and other common respiratory pathogens?

Inclusion criteria

- Reviews and commentaries that reported evidence−based findings of the mode of transmission of coronaviruses (including SARS−CoV−1, SARS−CoV−2, MERS−CoV and seasonal CoVs) and other respiratory pathogens among general human population; OR
- Any published original studies that reported findings of the mode of transmission of coronaviruses

Exclusion criteria

- Animal−based models

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Appendix V: Rapid Review: Are homemade facemasks effective at reducing transmission of covid-19 in community settings?

Review: Are homemade facemasks effective at reducing transmission of covid-19 in community settings?

Date: 19 April 2020 Version: 004-01

THE UNIVERSITY of EDINBURGH | usher institute

Title: Are homemade facemasks effective at reducing transmission of covid-19 in community settings?

Date of review: 19 April 2020.

Background and Aims

As governments around the world turn their attention to strategies for coming out of the lockdown, one approach being explored is the use of facemasks to reduce person-to-person transmission in community settings as levels of self-isolation are reduced.

The CDC recommendation that people should wear facemasks in public settings where other social distancing measures are difficult to maintain (e.g. when visiting supermarkets) is based on the fact that a significant proportion of individuals with, and able to transmit, coronavirus are asymptomatic or pre-symptomatic. Thus it is based on the precautionary principle that facemasks *may* reduce transmission of covid-19 in community settings. There is no clear RCT evidence that this is the case.

Any move to recommend widespread use of facemasks by the general public risks disrupting the already fragile supply of medical and surgical facemasks to frontline healthcare workers, whose needs must be prioritised. This has led CDC to recommend that the general public use homemade, cloth facemasks. They have launched a website with detailed instructions of how homemade facemasks can be easily made at home using commonly available materials.

The purpose of this review is to assess the evidence of effectiveness of homemade or improvised facemasks. Specifically, it will address the following questions:

- Do homemade or improvised facemasks prevent the transmission of respiratory viruses?
- What materials work (what are the virus filtration properties of different materials)?
- What design(s) of mask work (in terms of fit and comfort)?
- Can these masks be safely washed and reused?

This study will not look at behavioural aspects of facemask use, beyond issues related to fit and comfort. Those issues are explored elsewhere.

For a useful background website describing the different types of commercially available masks and respirators and their standards, see: Sampol C (2020) Surgical Masks, Respirators, Barrier Masks: Which Masks Actually Protect Against Coronavirus?

Methods

Inclusion and Exclusion Criteria:

This study will include:

- studies which focus on the general population in any non-clinical setting where it is difficult to maintain social distancing
- studies in clinical settings will be included only if they compare cloth with surgical masks
- studies which focus on the effectiveness and reusability of homemade or improvised cloth facemasks compared with medical/surgical masks or with no mask at preventing the transmission of respiratory viruses;
- studies which report on the use of homemade or improvised cloth facemasks with or without handwashing and/or eye protection;
- studies which focus on the virus filtration properties of different materials used in the construction of homemade cloth masks;
- studies which focus on the comfort or breathability of different materials used in the construction of homemade cloth masks for preventing the transmission of respiratory viruses;
- studies which focus on the ability of different designs/shapes of facemasks to achieve a close fit to prevent transmission of respiratory viruses;
- any study design providing data on the effectiveness, virus filtration, reusability or design of homemade or improvised cloth facemasks to prevent the transmission of respiratory viruses will be included.

This review will exclude articles that:

- do not include data on the effectiveness homemade or improvised cloth facemasks at preventing the transmission of respiratory viruses (or proxy);
- do not include an outcome measure of or equivalent to respiratory illness (laboratory confirmed, clinically confirmed, self-reported, hospital admission, deaths, absence from work/school, or penetration of material by virus-sized or droplet-sized particles);
- report on the effectiveness of commercially manufactured masks that are not designed for clinical settings (e.g. masks purchased in DIY shops);
- are exclusively conducted in clinical settings (except where evaluating cloth vs other materials);
- studies not published in English;
- studies that focus on filtration properties of materials without reference to homemade cloth facemasks;
- studies that focus on the filtration properties of materials not commonly available in households.

Literature search:

The literature search was designed and executed with the involvement of an Information Specialist (MD). We adopted a four-pronged approach:

- We reviewed the primary studies from three recent systematic reviews (Jefferson et al (2020), Brainard et al (2020), Xiao et al (2020));
- We screened the reference lists of two key papers (Davies et al (2013; Ma et al (2020));
- We performed forward citation tracking for the above two papers
- We repeated a search strategy by created by Ovid (WoltersKluwer 2020) on Medline
- We created a new search strategy for CINAHL (see below
- We created a new search strategy for MedRxiv (see below)
- We created a new search strategy for Web of Science (see below)

CINAHL – searched 17th April 2020 by NA - 206 Results

"(facemask* OR "face mask*" OR mask* OR veil*) AND (self-made OR "self-made" OR "home made" OR homemade OR improvise* OR at-home OR re-purpose* OR "re purpose*") AND ("virus*" OR "viral" OR respiratory OR infection* OR outbreak* OR transmission* OR influenza OR "coronavirus*" OR COVID* OR "COVID-19" OR "severe acute respiratory syndrome" OR SARS* OR MERS*) Language: English AND Apply equivalent subjects on 2020-04-17 01:21 PM".

medRxiv – searched 17 April 2020 by MD - 70 results
for abstract or title "facemask facemasks mask masks covering veil" (match any words) and full text or abstract or title "household home-made improvised self-made" (match whole any)

Web of Science – searched 17 April 2020 by NA - 142 Results

(self-made OR "self made" OR "home made" OR homemade OR improvise* OR at-home OR re- purpose* OR "re purpose*") AND (facemask* OR "face mask*" OR mask* OR veil*) AND ("virus*" OR "viral" OR viroid* OR respiratory OR infection* OR outbreak* OR transmission* OR influenza OR "coronavirus*" OR COVID* OR "COVID-19" OR "severe acute respiratory syndrome" OR SARS* OR MERS*)

Medline searched 17 April 2020 run by MD - 33 results

Search source: Developed by expert searchers at Ovid in April 2020, available from: https://tools.ovid.com/coronavirus/

1. disease outbreaks/ or epidemics/ or pandemics/ or disease transmission, infectious/ or exp equipment contamination/ or equipment reuse/ or exp hygiene/ or exp Infection Control/ or exp coronavirus/
2. ((disease$ adj2 outbreak$) or epidemic$ or pandemic$ or pandemie* or influenza or SARS or MERS or flu or tuberculosis or zika or ebola or covid19 or "covid-19" or "SARS-CoV-2" or "2019-nCov" or coronavirus* or corona-virus* or nCov or SARS-CoV* or SARSCov2 or ncov*).mp.
3. middle east respiratory syndrome coronavirus/ or sars virus/ or exp Tuberculosis/ or influenza, Human/ or exp respiratory tract infections/
4. or/1-3
5. ((cloth$ or DIY or "do it yourself" or t-shirt$ or homemade or home-made or bandana$ or scarf$ or neckscarf$ or kerchief$ or napkin$ or bracup$ or bra-cup$ or 3D or "3-D" or cotton$ or muslin$ or gauze$ or "cheese cloth" or towel$ or fabric$ or tight$ woven or tight$ weav$) adj2 (facemask$ or face-mask$ or mask$)).mp.
6. (((home adj1 made) or homemaker$ or household$ or "house hold$") adj1 mask$).mp.
7. ("16752475" or "26980847" or "25903751" or "18612429" or "32203710" or "23968983" or "25903751" or "19702582" or "20584862").ui.
8. or/5-7
9. (((cloth$ or DIY or "do it yourself" or t-shirt$ or homemade or home-made or bandana$ or scarf$ or neckscarf$ or kerchief$ or napkin$ or bracup$ or bra-cup$ or 3D or "3-D" or cotton$ or muslin$ or gauze$ or "cheese cloth" or towel$ or fabric$ or tight$ woven or tight$ weav$) adj (facemask$1 or face-mask$1 or mask$1)) and (develop$ adj1 countr$)).mp.
10. ("16752475" or "26980847" or "25903751" or "18612429" or "32203710" or "23968983" or "25903751" or "19702582" or "20584862").ui.
11. "20390479".ui.
12. (4 and 8) or 7 or 9
13. 12 not 11

Title and Abstract Screen: Titles and abstracts were each screened by one reviewer (RM, AN, MD). A second reviewer then screened all excluded abstracts. Where there was a conflict, the abstract was included in full text screening.

Full Text Screen: The included full text articles were each screened by one reviewer (RM, MD). A second reviewer then screened all excluded full texts (RM, MD). Conflicts were resolved by discussion.

Data Extraction: Data extraction for each article was conducted by a single reviewer (RM). Data extraction was limited to a minimal set of required data items.

Risk of Bias Assessment: We used the following validated risk of bias tools to assess study quality for epidemiological studies: CASP and Joanna Briggs Institute checklists.

For non-epidemiological studies, articles were assessed for rigour but without using a standardised tool. Risk of bias and evidence certainty for each article was assessed by a single reviewer (RM). Risk of bias ratings were limited to the most important outcomes.

Data Synthesis: Data were synthesized narratively. Because of the heterogeneity of the evidence, a meta-analysis was not appropriate. Using the GRADE system (Guyatt et al, 2008) a single reviewer (RM) graded the certainty of the evidence.

Results

After removal of duplicates, a total of 549 results was found from the database searching. We excluded 461 records by screening titles and abstracts and a further 77 at the full text screen stage, leaving 11 articles for inclusion in the final review. Reasons for exclusion were: article did not contain relevant data, article was not about facemasks/homemade facemasks, article was in Chinese, could not find article. See PRISMA diagram below for full details.

The key findings from this rapid review:

Evidence:

- The quality of the evidence available was **very low**.
- Homemade masks are **not effective at filtering respiratory aerosols**. Van der Sande et al (2008) compared the effectiveness of different masks at filtering respiratory aerosols from the outside to the inside of the mask. FFP respirators, which provide a minimum of 94% filtration, were found to be 25 times more effective than surgical masks, which were in turn about twice as protective as homemade masks.
- Homemade masks **may have potential to reduce transmission through droplets**. By reducing the number of droplets reaching surfaces, homemade masks may play a role in reducing the risk of transmitting or acquiring COVID-19 through reducing environmental (surface) contamination.
- Suitable household materials for making homemade masks must combine filtration properties with breathability. There is a trade-off between filtration and breathability. T- shirt or jersey material combined with a non-woven filter, such as kitchen paper, have been proposed as the optimum materials; however evidence is limited. Much of the evidence about suitable materials focuses only on filtration properties tested in laboratories and not on comfort and breathability tested in human subjects.
- Although there is a proliferation of mask designs available online, no studies have systematically evaluated or compared different designs for filtration, closeness of fit and comfort.
- If a mask does not fit well around the nose and mouth it will be of no benefit. Suggestions for improving the fit of homemade masks include the use of pipe-

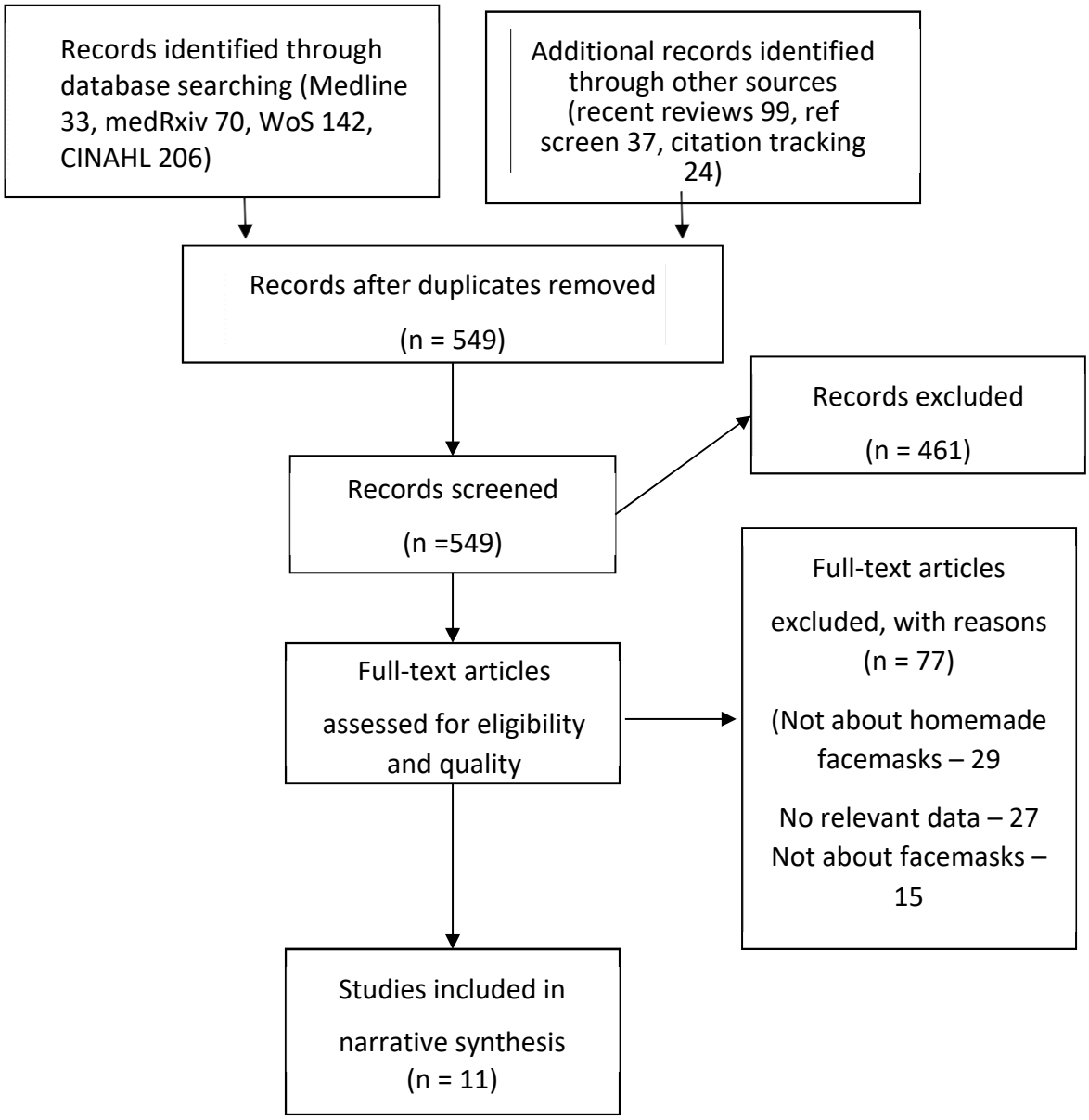
cleaners to ensure a close fit across the bridge of the nose and cheeks.

- Evidence on the effect of repeatedly washing and homemade masks drying masks suggests that this may reduce mask filtration effectiveness by distorting porousness. This is important because people may be more likely to cut up a less effective old T-shirt than a brand new T-shirt when fashioning a mask at home.

Policy implications:

- Although at the individual level, homemade facemasks may only have a marginal protective effect, when multiplied up to the population level, they may contribute to reducing transmission. However, we found no research evidence quantifying this.
- On the other hand, encouraging the use of facemasks in the general population may have negative consequences such as putting pressure on already fragile supply chains of surgical masks required by healthcare and other frontline health care workers. Again, we found no evidence quantifying the likely impacts.
- Another potentially serious consequence is that facemasks may give people a false sense of security and encourage behaviour that puts people at increased risk of infection. The lower protective capabilities of a homemade mask should be emphasized to the public so that unnecessary risks are not taken.
- Masks should be changed regularly: a mask that has become damp from use will be less effective than a fresh mask.
- It is vital to emphasise that any mask will have minimal effect unless used in conjunction with other preventative measures, such as good respiratory etiquette and regular hand hygiene.

Prisma flow diagram of publications screening and appraisal



Summary of results

A total of 549 unique articles were identified through the search strategies. After screening all titles and abstracts, 88 articles remained. After full text screening, eleven articles met the inclusion criteria and are included in this review:

- Bae et al (2020) Effectiveness of Surgical and Cotton Masks in Blocking SARS-CoV-2: A Controlled Comparison in 4 Patients
- Choudhry et al (2006) Hajj-associated acute respiratory infection among hajjis from Riyadh.
- Dato et al (2006) Simple respiratory mask
- Davies et al (2013) Testing the efficacy of homemade masks: would they protect in an influenza pandemic?
- Hashim et al (2016) The prevalence and preventive measures of the respiratory illness among Malaysian pilgrims in 2013 Hajj season
- Ma et al (2020) Potential utilities of mask-wearing and instant hand hygiene for fighting SARS-CoV-2
- MacIntyre et al (2015) A cluster randomised trial of cloth masks compared with medical masks in healthcare workers
- Neupane et al (2019) Optical microscopic study of surface morphology and filtering efficiency of face masks
- Rengasamy et al (2010) Simple respiratory protection--evaluation of the filtration performance of cloth masks and common fabric materials against 20-1000 nm size particles.
- Rodriguez-Palacios et al (2020) Textile Masks and Surface Covers - A 'Universal Droplet Reduction Model' Against Respiratory Pandemics
- van der Sande et al (2008) Professional and home-made face masks reduce exposure to respiratory infections among the general population

The overall quality of the evidence is **very low**. There are no studies evaluating homemade facemasks in real life conditions. We found three studies evaluating the effectiveness of homemade masks under laboratory conditions using human subjects (Davies et al, 2013; van der Sande et al, 2008; Dato et al, 2006); however only one of these (Dato et al, 2006) specified mask design. We found five studies evaluating commonly available household materials for their effectiveness at virus filtration; however only one of these (Davies et al, 2013) also tested the breathability of the materials and their overall suitability for use in a homemade mask. We found only one study which investigated the impact of repeated laundering on the effectiveness of cloth masks (Neupane et al, 2019).

Sub-question 1: Do homemade or improvised facemasks prevent the transmission of respiratory viruses? Answer:

- Homemade masks may reduce the number of microorganisms expelled when coughing or sneezing but not as effectively as surgical masks. Surgical masks are more effective than homemade masks at filtering aerosolised virus particles, but even surgical masks are only marginally effective.
- Homemade masks may have potential to reduce transmission through droplets. By

reducing the number of droplets reaching surfaces, homemade masks may play a role in reducing the risk of transmitting or acquiring COVID-19 through reducing environmental (surface) contamination.

- Although at the individual level, homemade facemasks may only have a marginal protective effect, when multiplied up to the population level, they may contribute to reducing transmission.
- On the other hand, encouraging the use of facemasks in the general population may have negative consequences such as putting pressure on already fragile supply chains of surgical masks required by healthcare and other frontline health care workers.
- Another potentially serious consequence is that facemasks may give people a false sense of security and encourage behaviour that puts people at increased risk of infection. The lower protective capabilities of a homemade mask should be emphasized to the public so that unnecessary risks are not taken.
- It is also important to emphasise that any mask will have minimal effect unless used in conjunction with other preventative measures, such as good respiratory etiquette and regular hand hygiene.

Sub-question 2: What materials work (what are the virus filtration properties of different materials)? Answer:

Suitable household materials for making homemade masks must combine filtration properties with breathability. There is a trade-off between filtration and breathability. A double layer of T-shirt material or pillowcase, combined with a non-woven filter, such as kitchen paper, have been proposed as the optimum materials; however evidence is limited. Much of the evidence about suitable materials focuses only on filtration properties and not on comfort and breathability. Mask comfort and breathability are essential, as people will not wear uncomfortable masks or masks which make it harder to breathe.

Sub-question 3: What design(s) of mask work (in terms of fit and comfort)? Answer:

Although there is a proliferation of mask designs available online, no studies have systematically evaluated or compared different designs for filtration, closeness of fit and comfort.
If a mask does not fit well around the nose and mouth it will be of no benefit.
Suggestions for improving the fit of homemade masks include the use of pipe-cleaners to ensure a close fit across the bridge of the nose and cheeks.

Sub-question 4: Can homemade masks be safely washed and reused? Answer:

Evidence on the effect of repeatedly washing and homemade masks drying masks suggests that this may reduce mask filtration effectiveness by distorting porousness. This is important because people may be more likely to cut up a less effective old T-shirt than a brand new T-shirt when fashioning a mask at home.

Detailed results by study sub-question and type of study

The results of this review are organised and presented by reporting evidence relating to each of the four sub-questions, broken down by study type. This is summarised in table 1.

Table 1: Summary of the types of evidence available to address each sub-question

Sub-question	**Types and numbers of studies (n.b. the same study may contribute to more than one of the sub-questions)**
Do homemade or improvised facemasks prevent the transmission of respiratory viruses?	Studies testing homemade masks under laboratory conditions using human subjects (n = 3)
What materials work (what are the virus filtration properties of different materials)?	• Laboratory experiments investigating the filtration properties of commonly-available household materials, not using human subjects (n = 5) • Studies comparing cloth masks with surgical masks in healthcare settings (n = 2)
What design(s) of mask work (in terms of fit and comfort)?	• Studies evaluating homemade mask designs (n = 3) • Studies evaluating improvised (as opposed to homemade) masks (n = 2)
Can homemade masks be safely washed and reused?	Laboratory experiment (n = 1)

Studies testing homemade masks under laboratory conditions using human subjects

Three studies (Davies et al, 2013; van der Sande et al, 2008, Dato et al, 2006) tested homemade masks under laboratory conditions using human subjects. All three specified the material used to make the mask but only one (Dato et al, 2006) specified the precise mask design. All three used commercial fit tests to test the effectiveness of the masks at preventing the transmission of particles. None tested the mask under real world conditions. Results are summarised in table 2.

Davies et al (2013) tested a range of household materials under controlled experimental conditions for their virus filtration properties and breathability and compared the results with surgical masks. They concluded that a double layer of cotton T-shirt material achieved the optimum combination of filtration and breathability. They then tested this mask for fit and comfort using human volunteers. There is a good lay summary of this study.

Van der Sande (2008) tested the fit and virus filtration of a homemade mask made from teatowel material under laboratory conditions, using human subjects. They tested the performance of the mask for both short (minutes) and long term (three hours) periods. They tested for both outward and inward transmission. They did not clearly specify mask design and they did not test the mask under real world conditions. The study is available here.

Dato et al (2006) used a commercial fit test to evaluate several prototype homemade mask designs. The researchers report a detailed specification for the best performing design (see figure 2). They fit tested two different sizes of this design, made from a 100% cotton, preshrunk, heavyweight T-shirt. This mask had 8 layers of fabric across the mouth and nose. This was compared wit an N95 mask.

Table 2: Summary of the evidence on the effectiveness of homemade masks from studies testing homemade masks under laboratory conditions using human subjects

Study	Description of mask	Comparator	Key Findings	Strengths and Limitations
Davies et al, 2013	Mask made from 2 layers of cotton T-shirt material. Volunteers made masks at home using sewing machine to a specification provided by the researchers (not published)	Surgical mask	• Homemade masks reduce the number of microorganisms expelled when coughing but not as effectively as surgical masks, particularly at low particle sizes. The authors conclude that an improvised face mask should be viewed as the last possible alternative if a supply of commercial face masks is not available. • The lower protective capabilities of a homemade mask should be emphasized to the public so that unnecessary risks are not taken. • Any mask will have minimal effect unless used in conjunction with other preventative measures, such as good respiratory etiquette and regular hand hygiene. • If a mask does not fit well around the nose and mouth it will be of no benefit. • Mask comfort is essential, as people will not wear uncomfortable masks. • Masks should be changed regularly: a mask that has become damp from use will be less effective than a fresh mask.	**Strengths of this study**: it looked at all aspects of mask effectiveness: virus filtration properties of different materials, breathability of different materials, design capable of being made at home by volunteers, fit of the mask and comfort of the mask. It used objective measures to assess parameters. It tested masks on real people, doing breathing exercises to simulate real life conditions. It used a virus smaller than corona virus to test the materials. **Limitations of this study**: the authors did not make the mask design available for evaluation. Washability and performance of the mask after being worn for longer periods are not assessed.

Van der Sande et al, 2008	Homemade mask made from teatowel material. Design not provided	Surgical and FFP2 (European equivalent of N95) masks	• Although masks provided protection against transmission for both children and adults, homemade masks provided much less protection than surgical or FFP2 masks and this difference was strongly statistically significant. • Findings were similar for both short term and long term use. • Surgical masks provided about twice as much protection as home made masks, the difference a bit more marked among adults. • FFP2 masks provided adults with about 50 times as much protection as home made masks, and 25 times as much protection as surgical masks. • The increase in protection for children was less marked, about 10 times as much protection by FFP2 versus home-made masks and 6 times as much protection as surgical masks. • The homemade mask provided only marginal outward protection (i.e protection of the external environment from particles generated by the mask • user). Interestingly, this study found that inward protection (i.e. protection of the mask user) was considerably higher than outward protection for all mask types.	**Strengths of this study**: This study was performed under carefully controlled conditions using standard protocols and human subjects. **Limitations**: There was a small number of participants. Because it was conducted under experimental conditions, it may not reflect behavioural and other parameters in the real world. Mask design was not specified.

Dato et al, 2006	Two different sizes of homemade mask made from a 100% cotton, preshrunk, heavyweight T- shirt. This mask had 8 layers of fabric across the mouth and nose. See figure 2 for specificati on.	N95	• The smaller mask achieved a fit factor of 67 (compared with 100 for an N95 respirator). The larger mask achieved fit factors between 13 and 17.	**Strengths of this study**: It provided a detailed design specification and specification of materials. It evaluated more than one size of mask. It used validated, objective methods to assess fit. **Limitations**: it did not assess breathability. It did not directly measure respiratory virus. It was a very small study (3 subjects).

Laboratory experiments investigating the filtration properties of commonly available household materials, not using human subjects

Five studies tested commonly available household materials for their virus filtration properties under controlled laboratory conditions (Davies et al, 2013; Ma et al, 2020; Rengasamy et al, 2010; Rodrigues-Palacios et al, 2020; Neupane et al, 2019). Results are summarised in table 3.

Davies et al (2013) compared the virus filtration properties and breathability of a range of common household materials (cotton t-shirt, scarf, teatowel, pillowcase, antimicrobial pillowcase, vacuum cleaner bag, cotton mix, linen, silk) with surgical masks. This was the only laboratory study that assessed breathability as well as virus filtration. They did this by measuring the pressure drop across the different materials when air was blown at them.

Ma et al (2020) tested the virus filtration properties of a homemade mask made of 1 layer of polyester and 4 layers of kitchen paper under laboratory conditions, using aerosolised low pathogenic avian influenza A virus. They compared the results with a medical mask and an N95 mask.

Rengasamy et al (2010) assessed the filtration performance of a range of household materials (T- shirts, towels, scarves, and cloth masks) by subjecting them to dispersed aerosols of nano-size particles the size of viruses (20-1000 nm). This was repeated at different velocities to simulate breathing and coughing. They compared the results with an N95 mask.

Rodriguez-Palacios et al (2020) assessed household textiles (T-shirt material, pillowcase, woven cotton cloth, sport jersey material) to quantify their potential to prevent transmission via droplet, as opposed to aerosol. They compared the fabrics with no barrier, a medical mask and surgical cloth material.

Neupane et al (2019) evaluated the effectiveness of commercially produced cloth masks at filtering particulate matter (PM - i.e. much bigger particle size than viruses). Although this study is not about homemade, masks is included because it evaluates relevant materials (cloth masks). Although it is about the filtration of PM rather than viruses, it is included because if cloth masks are shown to be ineffective at filtering much larger particles, they will certainly be ineffective for virus filtration.

Table 3: Summary of the evidence on suitable materials for homemade masks (sub-question 2) from laboratory experiments investigating the filtration properties of commonly-available household materials, not using human subjects

Study	Materials tested	Comparator	Key Findings	Strengths and Limitations
Davies et al, 2013	cotton t-shirt, scarf, teatowel, pillowcase, antimicrobial pillowcase, vacuum cleaner bag, cotton mix, linen, silk	Surgical mask	• All the materials tested showed some capability to filter microbial aerosols of similar particle size to SARS-CoV-2. • Filtration efficiency for MS2 (particle size 5 x smaller than corona virus) was: surgical mask 90%, vacuum cleaner bag 86%, teatowel 72%, cottonmix 70%, antimicrobial pillow case 69%, linen 62%, pillowcase 57%, silk 54%, cotton t-shirt 51% and scarf 49%. • Doubling the layers increased the filtration efficiency slightly for the t-shirt and pillow case and significantly for the teatowel. • Although the vacuum cleaner bag had the best virus filtration properties, its thickness, stiffness and poor breathability make it unsuitable for a face mask. • Similarly, although the double layered tea towel had a high filtration efficiency it had poor breathability. • The authors concluded that a double layer of T-shirt material was the optimum choice for a homemade mask because it combined filtration, breathability, comfort and fit. The slightly stretchy quality of a double layer of T-shirt material compared to the other materials tested was considered likely to provide a better fit.	See above.

Ma et al, 2020	homemade mask made of 1 layer of polyester and 4 layers of kitchen paper	Medical mask, N95 mask	• The homemade mask made from 1 layer of polyester and 4 layers of kitchen paper prevented 95% of virus penetration, compared with over 99.9% for the N95 mask and 97% for the medical mask. • The authors stress the importance of incorporating kitchen paper in the mask. • They suggest it may be effective in blocking the virus because of its multiple layers, nonwoven structure, and virus-absorbing properties. • They also suggest that effectiveness will likely be reduced if fewer layers of kitchen paper are used and that other types of homemade masks, especially those made of cloth alone, may be unable to block the virus and thus confer no protection against the virus. • An advantage of this style of mask is that the kitchen paper can be changed frequently. • The authors conclude that whilst homemade masks have limited potential to prevent transmission at the individual level, when multiplied up to the population level they have the potential for significant impact, particularly if used in conjunction with hand hygiene.	**Strengths of this study**: it used objective measures to assess virus filtration properties of different materials under carefully controlled conditions, using avian influenza virus in the experiment. It repeated measurements to bolster robustness of results. **Limitations**: it did not assess how the masks might work in the real world (breathability, comfort, closeness of fit) and did not address mask design (shape).

Rengasamy et al, 2010	T-shirts, towels, scarves, and cloth masks	N95 mask	• The penetration levels of all the fabric materials tested were much higher than the penetrations for the N95 mask (in other words, virus easily penetrated all the fabric materials). • The different household materials had 40 – 90% instantaneous penetration compared with 0.12 % for the N95 mask. • The authors concluded that common fabric materials may provide only marginal protection against nanoparticles including those in the size ranges of virus-containing particles in exhaled breath.	**Strengths of this study**: It was performed under controlled experimental conditions using standard protocols. **Limitations**: The study only tested a few types of fabric and only measured penetration – it did not assess face seal leakage, which is a critical component of respiratory protection. It also did not assess the effect of laundering the materials (none of the materials had been worn or laundered), which could affect filtration performance.

Rodrigues-Palacios et al, 2020	t-shirt material, pillow case, woven cotton cloth, sport jersey material	no barrier, a medical mask and surgical cloth material	• All textiles reduced the number of droplets reaching surfaces, restricting their dispersion to <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 <10cm. • T-shirt and sport jersey material were the most effective. • The authors conclude that homemade masks made from household materials could have potential to reduce environmental contamination and the risk of transmitting or acquiring infectious respiratory pathogens, including COVID-19.	**Strengths of this study**: It evaluated different fabrics under controlled laboratory conditions. **Limitations**: This study investigates droplet spread only – it does not evaluate aerosol transmission. It is a laboratory study, which does not evaluate real life use of homemade masks.
Neupane et al, 2019	20 different types of cloth facemasks purchased from markets in Kathmandu, Nepal	7 different brands of surgical mask	• Filtering efficiency of cloth masks for ambient PM 10 was poorer than in surgical masks because of the presence of larger sized pores. • Stretching the CM surface alters the pore size and potentially decreases the filtering efficiency. • The authors conclude that cloth masks are not effective, and that effectiveness deteriorates if the mask is stretched.	**Strengths of this study**: It was conducted under controlled experimental conditions. **Limitations**: This study is about particulate matter (i.e. much bigger particle sizes than viruses). However, demonstrating the limitations of cloth face masks even with bigger particle size underlines the limitations for virus filtering.

Studies comparing cloth masks with surgical masks in healthcare settings

Two studies evaluated the effectiveness of manufactured cloth masks compared to surgical masks in hospital settings. Although these studies are not about homemade masks and are relevant to a clinical, as opposed to community setting, they are included because they focus on relevant materials (cloth) and provide a direct comparison with surgical masks. Results are summarised in table 4.

Bae et al (2020) evaluated the effectiveness of surgical and cotton masks in filtering SARS–CoV-2 in a hospital-based study involving 4 covid-19 patients. They compared (manufactured) reusable cotton masks with surgical masks.

MacIntyre et al (2015) conducted a cluster randomised controlled trial to compare the efficacy of cloth masks (locally manufactured, two layer) with surgical masks in 1607 healthcare workers in 14 secondary/tertiary hospitals in Hanoi, Vietnam.

Table 4: Summary of the evidence on suitable materials for homemade masks (sub-question 2) from studies comparing cloth masks with surgical masks in healthcare settings

Study	Description of mask	Comparator	Key Findings	Strengths and Limitations
Bae et al, 2020	Commercially produced cotton mask	Surgical mask	• Neither surgical nor cotton masks effectively filtered SARS–CoV-2 during coughs by infected patients. • This study found greater contamination on the outer than the inner mask surfaces. This observation supports the importance of hand hygiene after touching the outer surface of masks. • The authors conclude that both surgical and cotton masks are ineffective in preventing the dissemination of SARS–CoV-2 from the coughs of patients with COVID-19 to the environment and external mask surface.	**Strengths of this study**: It was conducted under controlled conditions with COVID-19 patients. **Limitations**: It was a very small study (4 patients), data were incomplete and it is not about homemade masks.
MacIntyre et al, 2015	Cloth masks	Medical masks	• The rates of all infection outcomes were highest in the cloth mask arm, with the rate of influenza-like illness statistically significantly higher in the cloth mask arm (relative risk (RR)=13.00, 95% CI 1.69 to 100.07) compared with the medical mask arm. • Rates of laboratory confirmed respiratory virus infection were also higher in the cloth mask arm than in the medical mask arm, but the difference was not significant.	**Strengths of this study**: This was a large, well-conducted cluster RCT. **Limitations**: Researchers did not objectively measure compliance with hand hygiene. This is not directly relevant to the current question because it is not about homemade masks and it was conducted in a hospital, not a community setting.

Studies evaluating mask designs

Despite a plethora of homemade mask designs proliferating on the internet in recent weeks, unfortunately there are no studies which systematically evaluate and compare different homemade mask designs. The US Centers for Disease Control and Prevention website provides patterns for creating masks, categorised into those that require sewing and those that do not; however there is no evidence that these designs have been tested. Most of the designs described are modelled on surgical masks but other designs are also proposed – for example, the design tested by Dato et al (2006) – see figure 2.

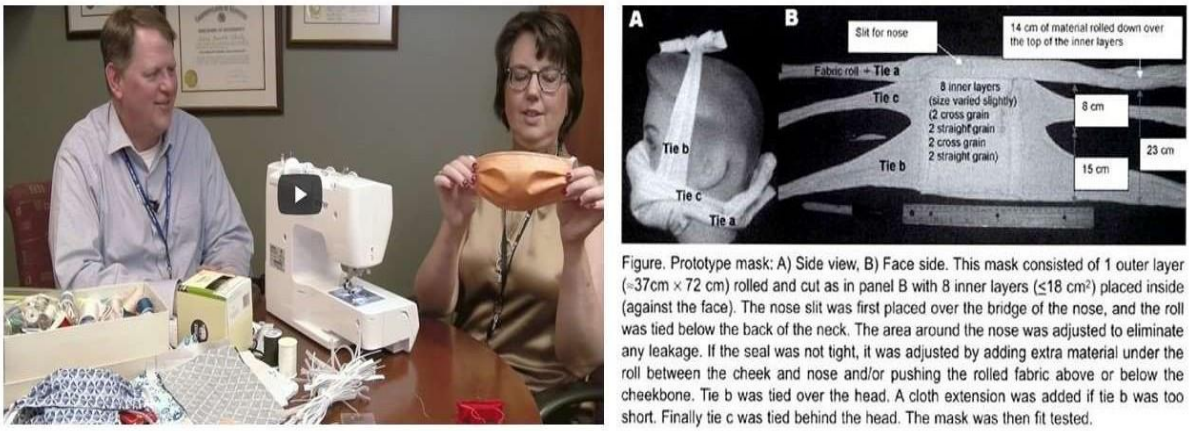


Figure 2: Two alternative homemade mask designs. The one on the left is based on surgical mask design and requires sewing (source: Deaconess. *https://www.deaconess.com/How-to-make-a-face-Mask). The one on the right does not require sewing (source: Dato et al, 2006).*

Key dimensions in mask design, apart from the filtration properties of the materials used, which we explored in the previous section, are:

- How well the mask fits – it is essential to have a good seal between the mask and the face to prevent leakage and contamination, otherwise the mask will be ineffective;
- How easy it is to breathe when wearing the mask – as described above, the mask with the most effective filtration properties will not be the optimum design if it is difficult for users to breathe whilst wearing it;
- How comfortable the mask is – people will not wear masks that are uncomfortable.

We found three studies which evaluated at least one of these parameters. Two of these are described above (Davies et al, 2013 and van der Sande et al, 2008). The third is a study by Dato et al (2006)

Davies et al assessed how well their T-shirt material masks fit using a commercial fit test system. The fit factor of a mask is defined as the ratio of the concentration of microscopic particles outside the respirator with the concentration of particles that have leaked into the respirator. Volunteers were instructed to fit their surgical and homemade face masks with no help or guidance from the operator. The fit test was then conducted with volunteers

performing a series of exercises. Davies et al also investigated mask comfort by asking volunteers to rate this.
Van der Sande et al (2008) conducted a similar fit test, evaluating their homemade mask made out of teatowel material for both short term (minutes) and long term (3 hours) use.

Dato et al (2006) also used a commercial fit test to evaluate several prototype homemade mask designs. The researchers report a detailed specification for the best performing design (see figure 2). They fit tested two different sizes of this design, made from a 100% cotton, preshrunk, heavyweight T-shirt. This mask had 8 layers of fabric across the mouth and nose. This was compared with an N95 mask.

Table 5: Summary of the evidence on mask design (sub-question 3) from studies evaluating mask fit, breathability and comfort

Study	Description of mask	Comparator	Key Findings	Strengths and Limitations
Davies et al, 2013	Mask made from 2 layers of cotton T-shirt material. Volunteers made masks at home using sewing machine to a specification provided by the researchers (not published)	Surgical mask	• The homemade mask performed significantly poorer on the fit test compared with the surgical mask. • 20/21 participants reported that their t-shirt face mask was comfortable; however, each participant kept their mask on for only a short time (15 min), and with long-term wear, comfort might decrease.	See above.
Van der Sande et al, 2008	Homemade mask made from teatowel material. Design not provided	Surgical and FFP2 (European equivalent of N95) masks	• Although masks provided protection against transmission for both children and adults, homemade masks provided much less protection than surgical or FFP2 masks and this difference was strongly statistically significant. • Findings were similar for both short term and long-term use. • Surgical masks provided about twice as much protection as homemade masks, the difference a bit more marked among adults. • FFP2 masks provided adults with about 50 times as much protection as homemade masks, and 25 times as much protection as surgical masks.	See above

			• The increase in protection for children was less marked, about 10 times as much protection by FFP2 versus home-made masks and 6 times as much protection as surgical masks.	
Dato et al, 2006	Two different sizes of homemade mask made from a 100% cotton, preshrunk, heavyweight T-shirt. This mask had 8 layers of fabric across the mouth and nose. See figure 2 for specification	N95	• The smaller mask achieved a fit factor of 67 (compared with 100 for an N95 respirator). The larger mask achieved fit factors between 13 and 17. • Breathability: The authors did not objectively assess breathability, but the filter section of the mask was 8 layers of fabric thick. They wore the mask for an hour and their subjective assessment was that ease of breathing was similar to that for a standard N95 mask. However they caution that people with respiratory compromise of any type should not use this mask.	See above.

Studies evaluating improvised (as opposed to homemade) masks

We found two studies in this category, both of which investigated the association between respiratory illness and using a face cover (hijab/niqab) by female pilgrims attending the Hajj in Saudi Arabia. Both studies were of low quality for the purposes of this review because they did not collect detailed information on the consistency or duration of veil or mask use. Also, both studies were set in a very specific context (the Hajj) which is not generalizable to other contexts.

Choudhry et al (2006) conducted a prospective cohort study to estimate the incidence of acute respiratory infections (ARI) among pilgrims travelling from the capital of Saudi Arabia, Riyadh city to the Hajj. ARI were defined in terms of self-reported symptoms. The study asked about to use of a facemask among male hajjis and a facemask or a face cover (hijab/niqab) by female hajjis.

Hashim et al (2016) conducted a cross-sectional study to assess factors associated with respiratory illness during the Hajj among 468 Malaysian adult hajj pilgrims. Participants were asked if they used a wet towel, dry towel, veil, surgical mask or N95 mask to protect against respiratory illness. The outcome measure was self-defined influenza-like illness based on symptoms.

Table 6: Summary of the evidence on improvised, as opposed to homemade masks (sub-question 3)

Study	Description of mask	Comparator	Key Findings	Strengths and Limitations
Choudhry et al, 2006	facemask (male hajjis), facemask or face cover (hijab/niqab) (female hajjis)	No mask	• Whereas for men there was a statistically significant protective effect from wearing a face mask, there was no evidence of a significant decrease in the incidence of ARI among women related to using a facemask or face cover. • This difference from males may be explained by other customs, for example, women do not cover their face when alone in their tents with other females, and therefore have the same high risk of disease transmission in a closed environment with exposure to droplet infection. • Men, however, were using the facemask as a personal hygiene measure, independent of the place where they were.	**Strengths of this study**: It evaluates facemask/face covering behaviour in real-world settings. **Limitations**: The outcome measure (self-reported symptoms) is subjective. The measurement of facemask/face covering is imprecise ("most of the time, sometimes, never").

Hashim et al, 2016	wet towel, dry towel, veil	Surgical or N95 masks	• The study found no difference in influenza-like illness for those wearing improvised masks or veils compared with surgical or N95 masks.	**Strengths of this study**: It assessed facemask use among real life conditions. **Limitations**: The outcome measure (self-reported symptoms) is subjective. The measurement of facemask/face covering is imprecise – there is no measure of frequency or duration of use.

Studies which evaluated whether homemade masks can be safely washed and reused

We found one study which evaluated this question. It is described above (Neupane et al, 2019). The researchers evaluated the impact on filtration efficiency of repeatedly laundering cloth facemasks.

Table 7: Summary of the evidence on whether cloth masks can be safely washed and reused (sub- question 4)

Study	Materials tested	Test	Key Findings	Strengths and Limitations
Neupane et al, 2019	20 different types of cloth facemasks purchased from markets in Kathmandu, Nepal	To measure the mask efficiency after washing and drying cycles, mask was soaked for 1 h in an aqueous solution of powder detergent. The mask was rinsed multiple times with water so as to get rid of the detergent. The mask was then laid on a flat surface to make sure no stretching of the cloth fibers, and the mask was air dried. Filtering efficiency was measured after each washing and drying cycle.	• Repeatedly washing and drying the mask results in deterioration of the filtering efficiency. • The authors conclude that effectiveness of cloth masks deteriorates with repeated washing and drying.	See above

Discussion

This rapid evidence review found

that: Evidence:

- The quality of the evidence available was **very low**.
- Homemade masks are **not effective at filtering respiratory aerosols**. Van der Sande et al (2008) compared the effectiveness of different masks at filtering respiratory aerosols from the outside to the inside of the mask. FFP respirators, which provide a minimum of 94% filtration, were found to be 25 times more effective than surgical masks, which were in turn about twice as protective as homemade masks.

- Homemade masks **may have potential to reduce transmission through droplets**. By reducing the number of droplets reaching surfaces, homemade masks may play a role in reducing the risk of transmitting or acquiring COVID-19 through reducing environmental (surface) contamination.
- Suitable household materials for making homemade masks must combine filtration properties with breathability. There is a trade-off between filtration and breathability. T- shirt or jersey material combined with a non-woven filter, such as kitchen paper, have been proposed as the optimum materials; however evidence is limited. Much of the evidence about suitable materials focuses only on filtration properties tested in laboratories and not on comfort and breathability tested in human subjects.
- Although there is a proliferation of mask designs available online, no studies have systematically evaluated or compared different designs for filtration, closeness of fit and comfort.
- If a mask does not fit well around the nose and mouth it will be of no benefit. Suggestions for improving the fit of homemade masks include the use of pipe-cleaners to ensure a close fit across the bridge of the nose and cheeks.
- Evidence on the effect of repeatedly washing and homemade masks drying masks suggests that this may reduce mask filtration effectiveness by distorting porousness. This is important because people may be more likely to cut up a less effective old T-shirt than a brand new T-shirt when fashioning a mask at home.

Policy implications:

- Although at the individual level, homemade facemasks may only have a marginal protective effect, when multiplied up to the population level, they may contribute to reducing transmission. However, we found no research evidence quantifying this.
- On the other hand, encouraging the use of facemasks in the general population may have negative consequences such as putting pressure on already fragile supply chains of surgical masks required by healthcare and other frontline health care workers. Again, we found no evidence quantifying the likely impacts.
- Another potentially serious consequence is that facemasks may give people a false sense of security and encourage behaviour that puts people at increased risk of infection. The lower protective capabilities of a homemade mask should be emphasized to the public so that unnecessary risks are not taken.
- Masks should be changed regularly: a mask that has become damp from use will be less effective than a fresh mask.
- It is vital to emphasise that any mask will have minimal effect unless used in conjunction with other preventative measures, such as good respiratory etiquette and regular hand hygiene.

This study has a number of strengths: because it was completed very rapidly, in less than one week, it includes the most up-to-date evidence. It is based on a robust literature search, which interrogated several research databases, including unpublished articles. It

also has several limitations: the quality of the primary evidence is very low. The review process is itself subject to bias because several of the steps (data extraction and quality assessment) were undertaken by a single reviewer (RM). In the light of this, the results of the review should be treated with caution.

Keywords: facemasks, homemade, respiratory viruses, covid-19

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Appendix VI: What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review. PROPOSAL v.4

1. Methods

We will use the Joanna Briggs Institute methods manual for scoping reviews (link), which is informed by the work of Arksey & O'Malley and others. We will use the PRISMA statement on scoping reviews (link) to shape our write-up.

2. Suggested Review Question

What is known about COVID-19 transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants? A Scoping Review.

3. Topic Introduction and Overview

Over the last six months, as the COVID-19 pandemic has spread across the world, more than 6.5 million people have become ill and nearly 400,000 people have died (WHO, 2020).
We have conducted research looking at racial and ethnic disparities in COVID-19 outcomes in the UK and globally (UNCOVER, 2020), contributing to a growing body of research which demonstrates that people from ethnic and racial minorities are generally exposed to more risk, and experience more harm, as a result of COVID-19.
This has highlighted a particular need to look at the experiences of refugees, asylum seekers, and other migrants who may not have full access to citizenship rights in the country in which they live.
This scoping review aims to summarise what is currently known about COVID-19 transmission and outcomes among refugees, asylum seekers and undocumented migrants, and to identify gaps in the current research.

3a. Key Terms

The Glossary for the First World Congress on Migration, Ethnicity, Race and Health (Johnson et al, 2019) defines a number of key terms relevant to this review, including: **asylum seeker**, **forced migration**, **irregular** or **undocumented migrant**, **refugee**, **stateless person** and **trafficked person**. Where we use these terms, we will do so consistently with their definitions in the Glossary.
For the avoidance of doubt, we will consider the experiences of **internally displaced people or IDPs** (that is, people who are forced to flee to another part of the country, rather than across an international border) alongside those of **asylum seekers** and **refugees**.
In considering the experiences of **undocumented migrants**, we will consider all people who lack the legal authorisation to reside in the country where they are living (Johnson et al,

2019). This includes people who have entered the country through informal channels, or who have been trafficked (including people who may now be working in conditions of modern slavery). We will also consider the experiences of **stateless people** here – although many people are made stateless in countries in which they have always lived, the lack of citizenship rights arising from statelessness means that these people are likely to be marginalised in many of the same ways as are undocumented migrants.

In respect of **COVID-19**, this scoping review aims to look at what is known about transmission, outcomes and consequences among refugees, asylum seekers and undocumented migrants. In terms of **transmission**, we will explore risk factors which can affect the transmission of COVID-19 or other respiratory viruses (such as living conditions, ability to comply with public health measures, etc).
By way of **outcomes**, we will look primarily for information about COVID-19 prevalence, severity and mortality among refugees, asylum-seekers and undocumented migrants. In terms of **consequences**, we will examine the wider impact of COVID-19 (for example, its impact on international mobility, access to employment, creation or reinforcement of stigma and so on).

3b. Geographical Focus

We have not limited our review to a specific geographical area. However, we recognise that the experience of refugees and migrants may vary significantly from country to country. We will be careful to highlight where the research indicates that there are particular country-specific experiences of refugees, asylum seekers and undocumented migrants – whether these relate to migrants' country of origin, or of transit or destination.

3c. Organising our Findings

To organise the findings of our scoping review, we propose to use a framework adapted from Dahlgren and Whitehead's model of the determinants of health (Figure 1; see Dahlgren & Whitehead, 2006):

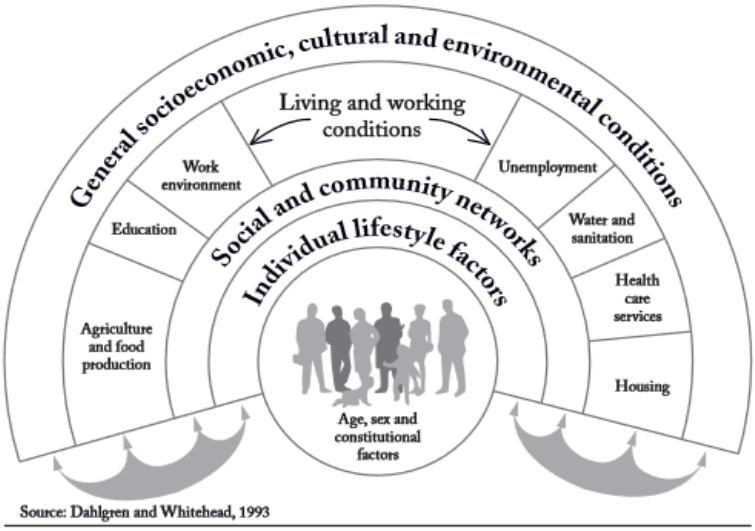

Figure 1. Social Determinants of Health (in Dahlgren & Whitehead, 2006)

We propose to expand the Dahlgren & Whitehead model by adding certain sub-categories within each level. The 'new' sub-categories seek to draw out issues which may be

specific to the complex experience of refugees and migrants, to ensure that these are fully examined. These sub-categories are marked with an asterisk and discussed further below.

Level	Category
Individual factors	**Demographics**
	Health status
Social and community factors	**Access to family and community support networks**
	Social and cultural inclusion*
	Language barriers*
	Trust*
	Gendered dynamics*
Living and working conditions	**Accommodation status**
	Access to healthcare
	Access to health information*
	Access to clean water and sanitation facilities
	Employment status
	Financial status*
	Education status
	Access to food
Socioeconomic, cultural, and environmental conditions	**Country-level policy (including approaches to immigration enforcement)***
	Legal status*
	International mobility / border closures*
	Stigma, discrimination and racism*

(Table 1. Organising our findings)

Individual factors: We will summarise what is known about the demographics and health status (including both physical and psychological health) of refugee, asylum-seeker, and undocumented migrant populations. This may allow the identification of risk factors associated with age, disability, or pre-existing health conditions.

Social and community factors: We have expanded this part of the model to look at four different dimensions of social and community networks: access to support networks (including family); social and cultural inclusion of refugees, asylum seekers and undocumented migrants; language barriers faced by refugees, asylum seekers and undocumented migrants in the place where they live; and issues of trust.
We anticipate that these factors will affect refugees and migrants more than the majority population in the places they live, and may have a direct impact on their ability or willingness to understand, and comply with, the kind of public health measures that are needed to prevent the transmission of diseases like COVID-19.
We have also included gendered dynamics under this heading, including the possible relationship between COVID-19 and gender-based violence affecting refugees and migrants (Pertek et al, 2020)

Living and working conditions: We have included the category “access to health information” in addition to “access to healthcare services”, as many of the non-pharmaceutical interventions designed to prevent the spread of COVID-19 rely on individuals understanding and taking measures to protect their own health and the health of others.

Similarly, we have included “income status” as distinct from “employment status”, in order to ensure that we fully investigate any issues arising from poverty, inequality or lack of access to resources; and any issues relating to remittances in the context of COVID-19.

Socioeconomic, cultural, and environmental factors: We have included four categories under this heading: country-level policies (including approaches to immigration enforcement); legal status; international mobility and border closures; and stigma, discrimination, and racism. COVID-19 has led to border closures and restrictions around the world on an unprecedented scale. Refugees and migrants are, by definition, among those most directly affected by this. In many places, this has also fed into a political environment where stigma, discrimination and racism against migrants and refugees has become more prevalent; and where (often already harsh) national policy approaches have further hardened. In the context of country-level policies, we will specifically look at approaches to immigration enforcement, such as the ‘hostile environment’ in the UK (Medact et al, 2020) which have a direct impact on migrants’ willingness or ability to access health services.
We will consider how these political factors and cultural attitudes affect refugees and undocumented migrants. We will also consider the impact of migrants’ legal status and how it affects their vulnerability in the face of COVID-19; including the challenge of (in)visibility in national and international statistics for people who migrate through unofficial channels.

4. Inclusion and Exclusion Criteria

We will **include** research which relates to asylum seekers, refugees, internally displaced people, undocumented or irregular migrants, trafficked people, or stateless people, which:

- Includes data or background information on COVID-19 outcomes
- Includes data or background information on COVID-19 risk factors
- Includes data on risk factors for infectious respiratory diseases
- Is of any study type (case reports, cohort studies, ecological studies etc)
- Is a modelling study

We will **include** grey literature (pre-prints; publications from policy institutes; media articles) which meet these criteria.

We will **exclude** research which:

- Does not have data or information related to asylum seekers, refugees, etc
- Does not have data or information on COVID-19 or other infectious respiratory diseases

5. Search Strategy

5a. General Search Terms

Our proposed search terms are set out in the review appendix (and will be updated as we refine our search).

5b. Databases

- PubMed
- medRxiv (Butler et al.)
- Global Health
- Global Index Medicus

- Web of Science (gwenetta)
- ASSIA [Applied Social Sciences Index & Abstracts] (gwenetta)

- CINAHL (Butler et al.)
- PsycInfo(emilie)
- Embase (emilie)
- Medline (emilie)
- WHO database

5c. Sources of Grey Literature

We will search a limited list of grey literature sources. The proposed sources are:

Source	Link
UNHCR	https://www.unhcr.org/uk/data.html
WHO: Refugee and Migrant Health	https://www.who.int/migrants/en/
IOM – General	https://www.iom.int/
IOM – Migration Data Portal	https://gmdac.iom.int/global-migration-data-portal
ILO (Int'l Labour Organisation)	https://www.ilo.org/global/lang--en/index.htm
UNICEF	https://www.unicef.org/
PICUM (Platform for International Cooperation on Undocumented Migrants)	https://picum.org/
Rights Lab (University of Nottingham – Modern Slavery)	https://www.nottingham.ac.uk/research/beacons-of-excellence/rights-lab/covid-19/index.aspx
SocialProtection.org	https://www.socialprotection.org/
Migrants Rights Network (UK)	https://migrantsrights.org.uk/
Runnymede Trust (UK)	https://www.runnymedetrust.org/
Scottish Refugee Council	https://www.scottishrefugeecouncil.org.uk/covid-19/
Women's Refugee Commission	https://www.womensrefugeecommission.org/covid-19/
InfoMigrants	https://www.infomigrants.net/en/about
Refugee Council (UK)	https://www.refugeecouncil.org.uk/
MedAct	https://www.medact.org/
ReliefWeb	https://reliefweb.int/
New Humanitarian	https://www.thenewhumanitarian.org/
Frontiers: Migration in the Time of COVID-19	https://www.frontiersin.org/research-topics/13787/migration-in-the-time-of-covid-19-comparative-law-and-policy-responses#overview
Mixed Migration Centre	http://www.mixedmigration.org/
Global Refugee-Led Network	https://www.globalrefugeelednetwork.org/
Lancet Migration	https://www.migrationandhealth.org/migration-covid19-briefs
Doctors of the World	https://www.doctorsoftheworld.org.uk/

6. Screening, Data Extraction and Write-Up

In accordance with the normal UNCOVER approach, we will carry out title & abstract screening with a single reviewer, with exclusions checked by a second reviewer. Any papers which are identified for inclusion by either reviewer will be carried forward. Where appropriate, we may also screen the reference lists of key papers.
We will carry out full-text screening and extract relevant data into a template in accordance with the usual UNCOVER process. Data extraction will be carried out by a single reviewer. We will carry out a limited quality assessment of the papers and include a discussion of overall quality in our write-up.

As with previous reviews, we will write up our findings on a thematic basis, using the approach set out in Table 1 above to organise our findings. As this is a scoping review, we will seek to summarise what is currently known and also to identify the gaps in the existing literature. We will approach representatives of migrants' and refugees' organisations who may be willing to be involved in this research, and consult with them to share and refine our findings.

7. References

Dahlgren G & Whitehead M (2006) European Strategies for Tackling Social Inequities in Health: Levelling Up Part 2. Copenhagen: WHO Europe. [Online] Available at: http://www.euro.who.int/__data/assets/pdf_file/0018/103824/E89384.pdf

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Pertek J, Phillimore J, McKnight P et al (2020) Forced Migration, SGBV and COVID-19: Understanding the impact of COVID-19 on forced migrant survivors of SGBV. [Online] Available at: https://www.birmingham.ac.uk/Documents/college-social-sciences/social-policy/iris/2020/sgbv-covid-19.pdf

UNCOVER (2020) Summary: What is the evidence on ethnic variation on COVID-19 incidence and outcomes? Version 013-02. [Online] Available at: https://www.ed.ac.uk/files/atoms/files/uncover_summary_013-02_ethnicity_and_covid-19.pdf

WHO (2020) Coronavirus disease (Carfì et al.) Situation Report – 138, 06 June 2020. [Online] Available at: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200606-covid-19-sitrep-138.pdf?sfvrsn=c8abfb17_4

8. Version Control

Version	Notes
1	Completed by EM 07.06.20 and shared with GC and MD for comment.
2	Revised following meeting with GC and MD on 10.06.20. (EM)

3	Revised following input from NV on 11.06.20 (EM)
4	Addition of further databases, consultation stage on 13.06 (EM with GC, NV, MD)

Review Appendix: **Draft Search Terms as at 11.06.2020**

COVID-19	**Refugees and Migrants**
• COVID-19 search string(s) • Respiratory virus search string(s)	Refugee Asylum seeker (Pubmed: search as free text) Displaced person (or people) (Pubmed: search as free text) IDP Migrant (immigrant, emigrant) Migration Transient Stateless Sanctuary Traffick* (trafficking, trafficked) Smuggl* (smuggling, smuggled) Slavery (modern slavery) Forced labour Domestic servitude Undocumented migrant (irregular, illegal) Guest worker (foreign worker) Clandestine
	Persecution (fear of persecution) Conflict War Violence Torture Displacement Country of origin Transit Flee
	Humanitarian setting Camp (refugee camp) Detention centre Immigration detention Incarceration Deportation Shelter Precarious Insecurity Hostile environment Reunification (family reunification)
	Border (border crossing) Language (barrier) Nationality Citizenship Foreign

Appendix VII: Level 1 ethics exempt letter

THE UNIVERSITY of EDINBURGH | usher institute

MPH ETHICS GROUP
Tel: +44 (0)131 651 1832
email: mph.ethics@ed.ac.uk

23 April 2020

[redacted]

Dear [redacted]

Re: Effectiveness of different types of facemasks against viral infections Application No MPH049

This letter is to confirm that the Ethics Self-Audit (Overview) section of the MPH Ethics Form, completed by you with respect to the above study, demonstrates that the proposed research poses no reasonably foreseeable ethical risks.

Within our research governance process, this means that the research proposed does not require formal ethics review – i.e. it can be considered to be 'exempt'.

You may forward this letter to any collaborating data owner who requires reassurance as to ethical oversight of the research proposed, together with the form completed.

Please be aware that this outcome is in respect of the above research, as described in the application submitted to the MPH Ethics group. If there is in the future *a change* to the study design/protocol/methods, you should check whether the previous self-audit 'exempt' outcome applies, and if not, contact MPH Ethics group immediately explaining that you now need to submit an application for ethics approval.

Best wishes with your research.

Yours sincerely

Helen Walker

Helen Walker
MPH Ethics Group Administrator

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