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Evidence Reviews

Review: What is the evidence on ethnic variations in COVID-19 incidence and outcomes?

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Title: What is the evidence on ethnic variations in COVID-19 incidence and outcomes?

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Background and Aims

The effects of COVID-19 on the health of racial and ethnic minority groups is still emerging; however, current data from around the world indicate that racial and ethnic minority groups may be disproportionately affected. This rapid review assesses the latest available data on incidence, severity and mortality from the UK and around the world and seeks to answer the following questions:

- **Sub-question 1:** What is the evidence for differences in COVID-19 incidence and outcomes (hospitalisation, ICU admission, death)? Is the emerging evidence from the UK in line with that from other countries?
- **Sub-question 2:** Health differences between racial and ethnic groups are multifactorial, with deep structural inequalities driving disadvantage in economic and social conditions. Are differences in living and working conditions among ethnic groups associated with differences in COVID-19 incidence and outcomes?
- **Sub-question 3:** Are differential rates of relevant comorbid conditions associated with differences in COVID-19 outcomes?

A note on terminology: We are using internationally recognized terminology and definitions for race and ethnicity outlined by Johnson and others (2019).

Methods

There are two parts to this paper: an analysis of data collected by the UK Intensive Care National Audit & Research Centre (INARC) and a rapid review of the literature on ethnicity and COVID-19.

Methods: Analysis of ICU data (ICNARC): We analysed data in relation to the different ethnic groups (white, all ethnic minorities and more specifically for Asian and Black ethnic minorities) and various indicators as reported by the ICNARC report on COVID-19 in [critical care published on 24 April 2020](#) (INARC, 2020). We applied Pearson's chi-squared test (χ^2) to evaluate whether observed differences between the different ethnic groups in relation to the type of respiratory support, type of renal support and death after ICU admission occurred by chance. We also tested whether differences in the observed ethnic distributions for COVID-19 ICU admissions and ICU admission for non-COVID-19 viral pneumonia (occurred in 2017-2019) are due to chance. Finally we compared the ethnic distributions of

ICU admissions with the ethnic distributions of the underlying general population (ONS, 2018) Analyses were conducted using Stata 12.

Methods: Literature review: As a starting point, we looked for prior reviews. MD scrutinised COVID-19 resource collections (e.g. Cochrane – see appendix for full list) and searched Google for prior reviews on the impact of the pandemic on ethnic groups. Eight grey literature and journal publications were identified and reference lists were screened for inclusion in this review. We contacted experts in the field to find out about ongoing or completed reviews.

PubMed and medRxiv were searched on 26 and 28 April 2020 with entry date limits from late 2019. Full search histories are provided in the appendix.

The initial search on 26 April was a scoping search using a limited set of terms; through collaborative identification of key concepts relevant to the populations of interest a highly sensitive search was created for PubMed, and a slightly more sensitive search was created for medRxiv within search functionality limitations.

The results from the search on 26 April (123 total) were all screened. The results of the more sensitive search on 28 April (841 before deduplication) were too numerous to screen in a rapid review timescale, so we prioritised for the first version of the rapid review those publications with BAME terms (Black, Asian, minority, ethnic) in titles or abstracts (31 new results). The remaining 751 results unique to the more sensitive search will be screened and incorporated into the next update of this rapid review.

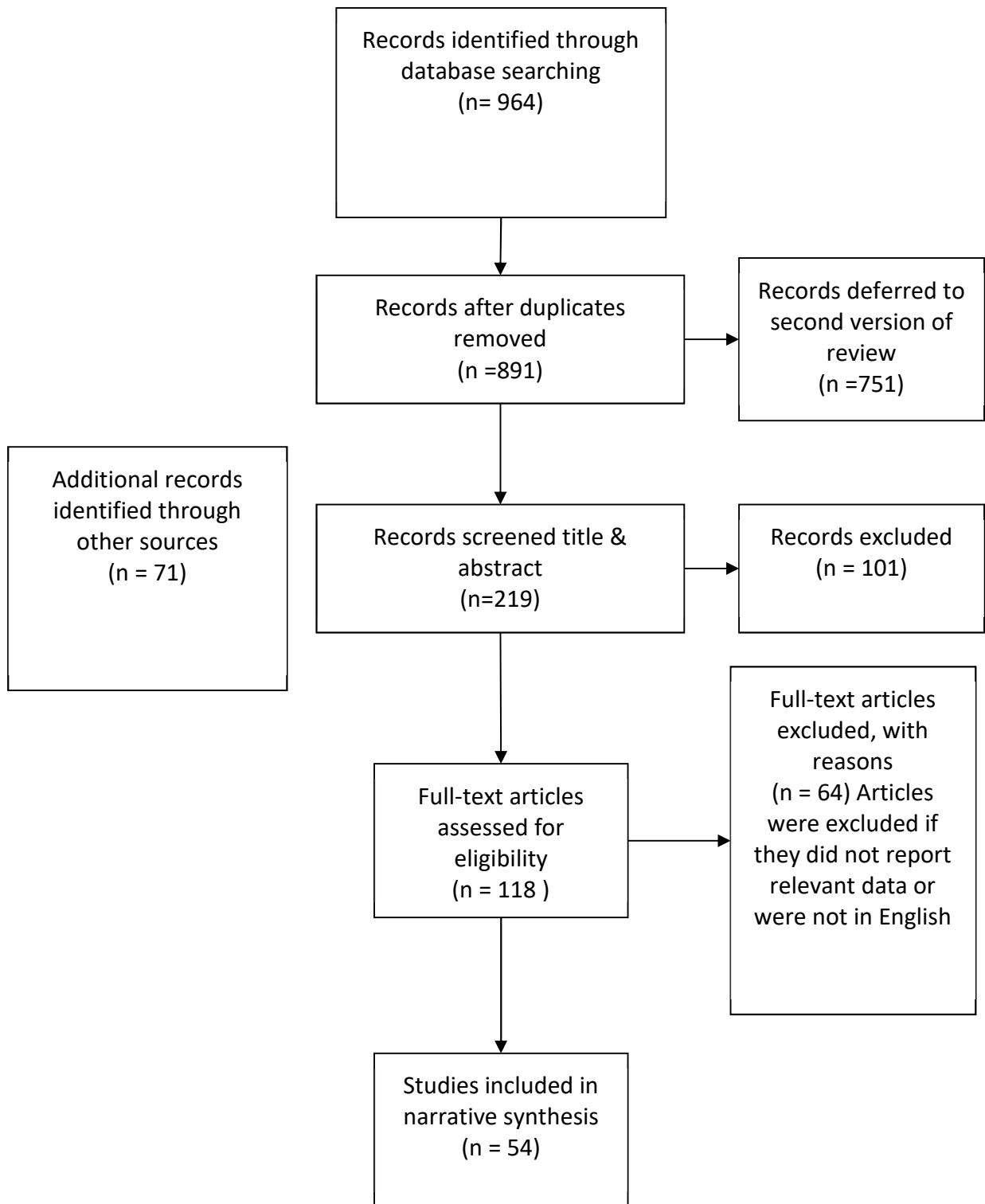
The titles and abstracts of all identified articles were screened by one reviewer (GC, DK, LG, EM, RM). Rejections were reviewed by a second reviewer (GC, DK, LG, EM, RM) and any discrepancies were retained for full text screening. Full texts were screened by one reviewer (GC, DK, LG, EM, RM). Rejections were reviewed by a second reviewer (GC, DK, LG, EM, RM) and any disagreements were resolved through discussion. Because of time pressure and the heterogeneity of the literature, quality assessment was conducted simultaneously with data extraction and without using standardised tools. Data were summarised thematically and reported narratively.

Results

Literature search: A total of 891 unique articles were identified by the literature search; however because of time pressure, a second, more focused search was conducted to reduce the number of articles requiring screening. Additional relevant articles were identified through searching the reference lists of key articles. The titles and abstracts of 219 articles were screened and 101 were rejected at this stage. A further 64 were removed at full text screen, leaving 54 to be analysed. Results are summarised in the following sections.

Evidence quality: Using the GRADE criteria, we rated the overall quality of the evidence from the literature review as **very low**.

Prisma flow diagram of publications screening and appraisal



Results: Sub-question 1: What is the evidence for ethnic differences in COVID-19 incidence and outcomes (hospitalisation, ICU admission, death)? Is the emerging evidence from the UK in line with that from other countries? Results below are split into two parts.

- Firstly, we present the results of an analysis of UK ICU data, comparing ethnic groups for a range of ICU outcomes.
- Secondly, we present the results of a rapid review of the literature on this topic.

Results of analysis of ICU data (ICNARC): Results of the ICNARC data are presented in Tables 1-5. When compared to ICU patients with white ethnicity, ethnic minorities, have a higher proportion than expected for needing advanced respiratory support ($p=1.02e-09$), for needing any renal support ($p=2.68e-09$) and for dying after admitting to ICU with COVID-19 ($p=0.0001$). Also ethnic minorities have a higher proportion than expected by chance to be admitted to ICU when compared to ICU admissions of non-COVID-19 viral pneumonia from 2017-2019 ($p=3.82e-183$) and to the underlying general population ($p=1.37e-87$). Similar were the findings when we restricted the analysis to patients of Asian or Black ethnicity. This analysis is descriptive and it was not adjusted for potential confounding factors including age, sex, obesity and other comorbidities (that could explain these findings), due to no access to individual level data. ICNARC have also not undertaken multivariable analyses of risk factors for critical care outcomes for ICU patients with confirmed COVID-19 due to any bias of reporting from early data. They highlight in their report that such analysis is underway and we will update our findings with any new results that become available.

Table 1 Ethnicity of patients critically ill with confirmed COVID-19 that received advanced respiratory support (n=2423) versus those that received only basic respiratory support (n=1007)

Ethnicity	Advanced Respiratory Support	Only basic respiratory support	Pearson's chi square p-value¹
	N (%)	N (%)	
White	1589 (65.6%)	768 (76.3%)	
All ethnic minorities	834 (34.4%)	239 (23.8%)	1.02e-09
<i>Asian</i>	<i>374 (15.4%)</i>	<i>116 (11.5%)</i>	<i>0.0001</i>
<i>Black</i>	<i>281 (11.6%)</i>	<i>70 (7.0%)</i>	<i>2.39e-06</i>

¹ P-values represent the following comparisons: All ethnic minorities versus white, Asian versus White, Black versus White

Table 2 Ethnicity of patients critically ill with confirmed COVID-19 that received any renal support (n=795) versus those that did not receive any renal support (n=2766)

Ethnicity	Patients receiving any renal support	Patients not receiving any renal support	Pearson's chi square p-value ¹
	N (%)	N (%)	
White	477 (60%)	1969 (71.2%)	
All ethnic minorities	318 (40%)	797 (28.8%)	2.68e-09
<i>Asian</i>	<i>132 (16.6%)</i>	<i>378 (13.7%)</i>	<i>0.001</i>
<i>Black</i>	<i>131 (16.5%)</i>	<i>233 (8.4%)</i>	<i>1.67e-12</i>

¹ P-values represent the following comparisons: All ethnic minorities versus white, Asian versus White, Black versus White

Table 3 Ethnicity of patients critically ill with confirmed COVID-19 that were discharged alive (n=1820) versus those that died (n=1863)

Ethnicity	Discharged alive	Died	Pearson's chi square p-value ¹
	N (%)	N (%)	
White	1306 (71.8%)	1227 (65.9%)	
All ethnic minorities	514 (28.2%)	636 (34.1%)	0.0001
<i>Asian</i>	<i>218 (12.0%)</i>	<i>299 (16.0%)</i>	<i>0.0001</i>
<i>Black</i>	<i>165 (9.1%)</i>	<i>208 (11.2%)</i>	<i>0.009</i>

¹ P-values represent the following comparisons: All ethnic minorities versus white, Asian versus White, Black versus White

Table 4 Ethnicity of patients critically ill with confirmed COVID-19 (n=5993) compared to a historic cohort of patients critically ill with viral pneumonia (non-COVID-19) during the years 2017-19 (n=5600).

Ethnicity	Critically ill with COVID-19	Critically ill with non-COVID-19 viral pneumonia 2017-2019	Pearson's chi square p-value ¹
	N (%)	N (%)	
White	3938 (65.7%)	4951 (88.4%)	
All ethnic minorities	2055 (34.3%)	649 (11.6%)	3.82e-183
<i>Asian</i>	<i>925 (15.4%)</i>	<i>325 (5.8%)</i>	<i>5.93e-86</i>
<i>Black</i>	<i>639 (10.6%)</i>	<i>155 (2.8%)</i>	<i>6.59e-85</i>

¹ P-values represent the following comparisons: All ethnic minorities versus white, Asian versus White, Black versus White

Table 5 Ethnicity of patients critically ill with confirmed COVID-19 (n=5993) compared to the English/ Wales/ N.Ireland population ethnicity.

Ethnicity	Critically ill with COVID-19	English/Wales/ N. Ireland population ¹	Pearson's chi square p-value ²
	N (%)	N (%)	
White	3938 (65.7%)	46707655 (76.6%)	
All ethnic minorities	2055 (34.3%)	14289796 (23.4%)	1.37e-87
<i>Asian</i>	925 (15.4%)	7437014(12.2%)	1.17e-26
<i>Black</i>	639 (10.6%)	3968540 (6.5%)	1.46e-53

¹ Estimates based on INCNARC reported percentages and current population estimates obtained by [ONS 2018 estimates](#).

²P-values represent the following comparisons: All ethnic minorities versus white, Asian versus White, Black versus White

Results of rapid literature review for sub-question 1: We found seven relevant studies, two from the UK and five from the USA. The overall quality of the evidence is graded as **very low**. The two UK studies are of most relevance to the UK population.

Niedzwiedz et al (2020) conducted a [cohort study on the relative risk of covid-19 infection by ethnic group](#), linking UK Biobank data with SARS-CoV-2 test results held by Public Health England. UK Biobank recruited 40 – 70 year olds in 2006 – 2010 from the general population. In this study, they present data for 1474 UK Biobank participants who tested positive for SARS-CoV-2 between 16 March and 13 April 2020. The study found that (self-defined) black, south Asian and white Irish people were more likely to have confirmed infection (RR 4.01 (95%CI 2.92-5.12); RR 2.11 (95%CI 1.43-3.10); and RR 1.60 (95% CI 1.08-2.38) respectively) and were more likely to be hospitalised compared to white British people. The study also found that area-based measures of socioeconomic deprivation and having no qualifications were consistently associated with a higher risk of confirmed infection (RR 1.91 (95%CI 1.53-2.38); and RR 2.26 (95%CI 1.76-2.90) respectively). However, even after controlling for this, some minority ethnic groups have a higher risk of confirmed SARS-CoV-2 infection. Strengths of this study are that it is a very large, well-conducted cohort study of long standing. Limitations are that data on self-defined ethnicity and socio-economic variables were collected some years ago and may no longer be valid. Another limitation is that the study population may not reflect the broader UK population.

de Noronha (2020) analysed [actual vs expected hospital deaths](#) during the pandemic period to 21 April 2020. Data on actual hospital deaths by ethnic group were compared with expected hospital deaths, which were estimated using census 2011 data on ethnicity. The study found that for all ethnic groups other than white British and white Irish, the number of deaths exceeded what would be expected for that age group. The mixed and Indian ethnic groups were more than twice as likely to die; Pakistani, Bangladeshi and black Caribbean nearly three times as likely, black African more than four times as likely and other black and other ethnic group nearly eight times as likely. A strength of this analysis is that it is based on actual hospital deaths. A limitation is that expected deaths are based on 2011 census data, which may be out of date. The article provides very little information on

methodology, around 9% of actual deaths had no ethnicity recorded and the results do not report confidence intervals or p-values.

The following five studies were conducted in USA, so are not directly applicable to the UK context.

Three (Guha et al, 2020; Li et al, 2020 and Maroko et al, 2020) are ecological studies, which are prone to confounding and which cannot be used to draw inferences at the individual level. Guha et al (2020) found that the [proportion of African American residents in a zip code area was significantly associated with increased likelihood of cases of COVID-19](#), although a sensitivity analysis suggested that this might be explained by population density. Li et al (2020) found that [counties with a higher proportion of African American residents had higher COVID-19 incidence and mortality rates and that this was not driven by socio-economic factors \(p = 0.008\)](#). Maroko et al (2020) found that cold spots (areas in New York City and Chicago with low rates of people testing positive for SARS-CoV-2) had significantly higher proportions of non-Hispanic white residents and more workers in managerial occupations. [Hotspots had higher percentages of people of colour and foreign-born people](#). However this study did not adjust for potential confounders.

The other two US articles (Badawi et al, 2020 and Garg et al, 2020) report on hospital-based studies conducted in March 2020. Both can only provide a snapshot from an early point in what is a highly dynamic and fast-moving pandemic. Badawi et al (2020) conducted a [descriptive study of ICU patients across New York City](#), comparing the patient population immediately before the pandemic (2019) with the patient population during the pandemic (between March 23 and April 6, 2020). Data are from 186 ICU beds from 14 ICUs and 9 hospitals using a tele-ICU monitoring system, representing 10,714 patients in 2019 and 465 patients during the pandemic period. They found that the proportion of patients with Hispanic ethnicity doubled (7.8% to 16.6%; $p < 0.01$). The proportion of African American patients increased from 16.6 % to 20.6 % but the difference was non-significant. Garg et al (2020) report [age-stratified hospitalisation rates and clinical data for laboratory-confirmed COVID-19 cases admitted](#) from 1 – 30 March 2020, the first month of US surveillance. Data are from 99 counties in 14 states (California, Colorado, Connecticut, Georgia, Iowa, Maryland, Michigan, Minnesota, New Mexico, New York, Ohio, Oregon, Tennessee, and Utah). Among 580 hospitalized COVID-19 patients with race/ethnicity data, approximately 45% were white (compared to 59% of the general population in the sample counties), 33% were black (compared to 18% of the general population), and 8% were Hispanic (compared to 14% in the general population). Data are preliminary and should be interpreted with caution. Data on ethnicity were missing for many cases.

Results: Sub-question 2: Health differences between racial and ethnic groups are multifactorial, with deep structural inequalities driving disadvantage in economic and social conditions. Are differences in living and working conditions among ethnic groups associated with differences in COVID-19 incidence and outcomes?

Living conditions: Recent data show that London and Birmingham have become COVID19 hotspots and both have areas of extreme overcrowding. Birmingham has one of the highest

proportions of families sharing with elderly relatives in the country, with nearly 29,000 over 70s living with working-age households (Wall 2020). Thirty percent of Bangladeshi household and 15% of African (Black) households are overcrowded, compared to only 2% of white British households (Haque, 2020). Black, Bangladeshi, and Pakistani origin populations in the UK have poverty rates, after housing costs, are as high as 50%. Previous studies have found ethnic inequalities in health, housing, employment, and education across England and Wales (Lymperopoulou, 2017). These inequalities create conditions that disadvantage minority populations and make them more susceptible to illnesses. While the UK COVID19 data is limited, the current findings are concerning, they also closely resemble the United States data for racial minorities. David Williams' research demonstrates how the history of racial residential segregation exacerbates white-Black health disparities in the US (Williams, 2001). Black people are more likely to live in neighbourhoods without access to quality healthcare, grocery stores and safe places to exercise.

In addition to drawing on the academic literature, it is important also to pay attention to news reports because of the fast-moving nature of this epidemic. Newspapers are often the first to pick up and report important indicators and although we must be cautious in how we interpret such evidence because it may lack rigour, it is equally important not to ignore important early warning signals coming from this quarter. One newspaper article from New York City (NYC), USA compared two ZIP codes with substantially different rates of COVID-19 and found that the hardest-hit areas were the overcrowded Black and Latino communities (Malone 2020). Another US newspaper article reported that as the lockdown procedures were put in place there has been a reduction in train services, leading to crowded conditions on subways in NYC, which reduces the ability of people to exercise social distancing on their way to work (Goldbaum 2020). Although caution must be exercised when drawing conclusions on the basis of data from other countries, factors such as living in crowded inner-city areas, being dependent on public transport and having to leave home to go to work every day are just as relevant in UK and in US ethnic minority populations (see next section below).

Working conditions: We found 19 studies and articles relating to ethnic variations in working patterns and employment conditions (of which 7 relate to the UK, 10 to the USA, and 2 to other countries), which might affect risk factors for Covid-19. Many of these were newspaper articles or summaries of official data, rather than academic studies, and the general quality of data was **very low**.

Workforce data from the UK show significant disadvantage and inequalities in employment, with Black and minority ethnic (BME) groups twice as likely as others to be unemployed or in precarious employment (Haque-2020). Conversely, although people from BAME backgrounds make up over 12% of the working-age population, they represent only 6% of top-management positions (Haque-2020), thus missing out on the possible protective effect of those roles, as data from the US suggests that areas with lower rates of Covid-19 infections have more workers in managerial occupations (Maroko-2010).

People from BAME backgrounds are more likely to work in occupations with higher exposure risk, such as cleaners, public transport and retail (IS-2020). 40% of doctors and

20% of nurses in the NHS, and 17% of the social care workforce, are people from BME backgrounds (IS-2020).

Many of these are jobs that have been classified as "essential work", which are not possible to do remotely (Thebault-2020; Malone-2020). Workers in essential roles share more time with others, and are invariably more exposed to risk (Tomer-2020). Atchison-2020 found that the ability to adopt and comply with certain protective measures, including self-isolation, is lower in black and minority ethnic groups, and in the most economically disadvantaged groups in the UK.

The exigencies of "essential work" are reflected in two US reports (Goldbaum-2020; Valentino-de-Vries-2020) which described movements of people: both finding that people in poorer areas, or from poorer socioeconomic groups, continue to use public transport, including during the working week, to a greater extent than their richer counterparts. Thus it is not only the work, but the need to get to and from work, which may disproportionately expose people from ethnic minority backgrounds to risk.

Finally, Liem-2020 identifies specific risks faced by migrant domestic workers in Hong Kong, which include being tied to their employer, and therefore limited in their ability to adopt social distancing and other protective measures. Dyer-2020 reports that undocumented immigrants in the USA may feel unable to report Covid-19 symptoms because of their immigration status. Neither of these are from the UK context, and care should be taken in generalising their results; however, both highlight that immigration and employment status can be closely linked, and may combine to increase risk of exposure to Covid-19 in certain circumstances.

Results: Sub-question 3: Are differential rates of relevant comorbid conditions associated with differences in COVID-19 outcomes?

Patients with certain pre-existing cardiovascular disease or diabetes are at increased risk of complications and death from covid-19 (Li et al, 2020; Ruan et al, 2020, Chen et al, 2020; Lippi et al, 2020). There are differential rates of these conditions in ethnic minority populations, which may translate into poorer outcomes. Adams et al (2020) analysed 2017 Behavioral Risk Factor Surveillance System (BRFSS) data to estimate the proportion of the US population with comorbidities that make them vulnerable to COVID-19 complications. They found that significantly more black and native American than white and Hispanic respondents reported having at least one of six chronic conditions associated with adverse COVID-19 outcomes. The six conditions are: cardiovascular disease, chronic obstructive pulmonary disease (COPD), diabetes, asthma, hypertension, and/or cancer other than skin. Whilst 48% (95% CI 47.7 – 48.4) of white respondents reported having at least one of these conditions, the comparable proportions were 52.1% (51.1 – 53.1) for blacks; 35.5% (34.5 – 36.5) for Hispanics and 55.5% (52.9 – 58.1) for native Americans. This study had limitations: the response rate was low, it was a telephone survey and it excluded nursing home residents, so the results may not be representative of the wider population. This was a US study, so is not directly applicable to a UK population; however the findings are consistent with UK data showing that ethnic minority populations have higher rates of cardiovascular

disease (Khunti et al, 2020) and diabetes (Khunti et al, 2020; Tillin et al, 2013). Tillin et al (2013) found that diabetes prevalence was greater in South Asians and African Caribbeans than in Europeans.

Discussion:

This rapid evidence review involves two elements: an analysis of intensive care data (INARC, 2020) and a rapid literature review. Our analysis of ICU data found evidence that, when compared to the general population, BAME people are more likely to be **admitted to ICU**. When compared to ICU patients in the UK with white ethnicity, BAME people are more likely to **require renal support and advanced respiratory support** and are more likely to **die**. Findings were similar when the analysis was restricted to patients of Asian or Black ethnicity. These differences were highly statistically significant. Longitudinal UK Biobank evidence (Niedzwiedz et al, 2020) found that BAME people were more likely to have confirmed infection and to be **admitted to hospital** compared with white British people.

Increased risk of hospitalisation, ICU admission, ICU advanced support and death from COVID-19 correlates with **higher rates of cardiovascular disease** (Adams, 2020; Khunti et al, 2020) and **diabetes** (Khunti et al, 2020; Tillin et al, 2013; Adams, 2020) among BAME people. Data from China show that patients with pre-existing cardiovascular disease or diabetes are at increased risk of complications and death from covid-19 (Li et al, 2020; Ruan et al, 2020, Chen et al, 2020; Lippi et al, 2020).

Previous studies have found **ethnic inequalities in health, housing, employment, and education** across England and Wales (Lymperopoulou, 2017). These inequalities create conditions that disadvantage minority populations and make them more susceptible to illnesses. **Household overcrowding** is much more prevalent in BAME than in white households (Haque, 2020). Data from the UK is consistent with emerging evidence from USA, where newspaper reports suggest that the areas hardest hit by COVID-19 are overcrowded inner city Black and Latino communities (Malone 2020). **Living in an overcrowded community** creates vulnerability by making social distancing more difficult to achieve, for example whilst using public transport (Goldbaum 2020).

Workforce data from the UK show significant disadvantage and inequalities in employment, with Black and minority ethnic (BME) groups twice as likely as others to be **unemployed or in precarious employment** and much **less likely to be able to work remotely** (Haque, 2020). People from BAME backgrounds are more likely to work in **essential occupations with higher exposure risk**, such as health and social care and cleaning (IS, 2020). A recent cross-sectional survey (Atchison, 2020) found that BAME and economically disadvantaged people are **less able to adopt and comply with protective measures, such as self-isolation**. Again, this is consistent with emerging evidence from USA, where two recent reports (Goldbaum, 2020; Valentino-de-Vries, 2020) found that people in poorer areas, or from poorer socioeconomic groups, continue to use public transport, including during the working week, to a greater extent than their richer counterparts. Thus it is not only the work, but the **need to get to and from work**, which may disproportionately expose people from ethnic minority backgrounds to risk.

This review has a number of **limitations**. In order to meet the very tight deadline for this study, various strategies were employed which may reduce quality of the review. The search strategy was limited so it is possible that some key articles have been missed. Data extraction and quality assessment were conducted by one person per article, so this may have biased the results. For the ICU data analysis (INARC, 2020), we did not have access to individual-level data so it was not possible to adjust for potential confounding factors including age, sex, obesity and other comorbidities. ICNARC are in the process of conducting multivariable analyses of risk factors for critical care outcomes for ICU patients with confirmed COVID-19. We will update our findings with any new results that become available. The **overall quality of the evidence from the literature was very low**. In the middle of a novel and fast-moving pandemic, much of the evidence does little more than provide a **snapshot in time**. We decided to include selected newspaper reports, particularly those reporting on innovative real-time data sources (e.g. the New York Times report by Valentino de Vries et al (2020), which reports on population movement behaviour using data from 15 million cell phones across USA). Although it is essential to interpret newspaper reports with caution, it is equally important not to ignore important early warning signals coming from this quarter. We are committed to reviewing the literature on this topic regularly as new data emerge, to refining and improving review quality and to focusing future reviews on marginalised refugee and asylum-seeker populations not covered explicitly by this review.

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

Key references:

Adams M et al (2020) Population based estimates of comorbidities affecting risk for complications from COVID-19 in the US available at:
<https://www.medrxiv.org/content/10.1101/2020.03.30.20043919v1.full.pdf>[accessed 29 April 2020]

Atchison C et al (2020) Perceptions and behavioural responses of the general public during the COVID-19 pandemic A cross-sectional survey of UK Adults available at:
<https://www.medrxiv.org/content/10.1101/2020.04.01.20050039v1>[accessed 29 April 2020]

Badawi O et al (2020) Impact of COVID-19 pandemic on severity of illness and resources required during intensive care in the greater New York City area available at:
<https://www.medrxiv.org/content/10.1101/2020.04.08.20058180v1>[accessed 29 April 2020]

Chen M et al (2020) Key to successful treatment of COVID-19 accurate identification of severe risks and early intervention of disease progression available at:
<https://www.medrxiv.org/content/10.1101/2020.04.06.20054890v1.full.pdf>[accessed 29 April 2020]

de Noronha N (2020) Why are more black and minority ethnic people dying from Covid-19 in hospital? Race and Equality Foundation.available at:
<https://raceequalityfoundation.org.uk/health-care/why-are-more-black-and-minority-ethnic-people-dying-from-covid-19-in-hospital/>[accessed 29 April 2020]

Goldbaum C and Cook LR (2020)They Can't Afford to Quarantine. So They Brave the Subway. New York Times.available at: <https://www.nytimes.com/2020/03/30/nyregion/coronavirus-mta-subway-riders.html>[accessed 29 April 2020]

Haque Z (2020)Coronavirus will increase race inequalities. Race Matters. Runnymede.available at: <https://www.runnymedetrust.org/blog/coronavirus-will-increase-race-inequalities>[accessed 29 April 2020]

Improvement Service (2020)Poverty, Inequality and COVID-19available at:
https://www.improvementservice.org.uk/__data/assets/pdf_file/0013/16402/Poverty-inequality-and-COVID19-briefing.pdf[accessed 29 April 2020]

INARC (2020) Report on COVID-19 in critical care. 24 April 2020. Intensive Care National Audit & Research Centre. Available at: <https://www.icnarc.org/Our-Audit/Audits/Cmp/Reports> [Accessed 29 April 2020].

Johnson MRD, Bhopal RS, Ingleby JD, Gruer L, Petrova-Benedict RS. (2019) A glossary for the first World Congress on Migration, Ethnicity, Race, and Health. Public Health. 2019;172:85-8

Khunti K et al (2020) Is ethnicity linked to incidence or outcomes of covid-19? BMJ 2020;369:m1548 available at: <https://www.bmj.com/content/369/bmj.m1548>[accessed 29 April 2020]

Li B et al (2020)Prevalence and impact of cardiovascular metabolic diseases on COVID-19 in Chinaavailable at: <https://link.springer.com/article/10.1007/s00392-020-01626-9> [accessed 29 April 2020]

Lippi G et al (2020) Clinical and demographic characteristics of patients dying from COVID-19 in Italy versus Chinaavailable at:
<https://onlinelibrary.wiley.com/doi/abs/10.1002/jmv.25860>[accessed 29 April 2020]

Lymperopoulou K and Finney N (2017)Socio-spatial factors associated with ethnic inequalities in districts of England and Wales, 2001–2011available at:
<https://journals.sagepub.com/doi/full/10.1177/0042098016653725>[accessed 29 April 2020]

Malone C (2020) New York's Inequalities Are Fueling COVID-19. Five Thirty Eightavailable at:
<https://fivethirtyeight.com/features/wealth-and-race-have-always-divided-new-york-covid-19-has-only-made-things-worse/>[accessed 29 April 2020]

Niedzwiedz C et al (2020) Ethnic and socioeconomic differences in SARS-CoV2 infection in the UK Biobank cohort studyavailable at:
<https://www.medrxiv.org/content/10.1101/2020.04.22.20075663v1>[accessed 29 April 2020]

ONS (2018) Available at:

<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2018> [accessed 29 April 2020].

Ruan Q et al (2020) Ethnic and socioeconomic differences in SARS-CoV2 infection in the UK Biobank cohort study available at: <https://link.springer.com/content/pdf/10.1007/s00134-020-05991-x.pdf> [accessed 29 April 2020]

Shokraneh F. (2020) Keeping up with studies on covid-19: systematic search strategies and resources BMJ 2020; 369:m1601 <https://doi.org/10.1136/bmj.m160>

Thebault R et al (2020) The coronavirus is infecting and killing black Americans at an alarmingly high rate. Washington Post available at: <https://www.washingtonpost.com/nation/2020/04/07/coronavirus-is-infecting-killing-black-americans-an-alarmingly-high-rate-post-analysis-shows/?arc404=true> [accessed 29 April 2020]

Tillin T et al (2013) The Relationship Between Metabolic Risk Factors and Incident Cardiovascular Disease in Europeans, South Asians, and African Caribbeans: SABRE (Southall and Brent Revisited)—A Prospective Population-Based Study available at: <https://www.sciencedirect.com/science/article/pii/S0735109713007894> [accessed 29 April 2020]

Tomer A and Kane J (2020) How to protect essential workers during COVID-19. Brookings. available at: <https://www.brookings.edu/research/how-to-protect-essential-workers-during-covid-19/> [accessed 29 April 2020]

Valentino-de-Vries J et al (2020) Location Data Says It All: Staying at Home During Coronavirus Is a Luxury. New York Times available at: https://www.nytimes.com/interactive/2020/04/03/us/coronavirus-stay-home-rich-poor.html?fbclid=IwAR0Le_QTOuE0USEdXw-WU75CM_dzVkMbYpfXsFpy-GxCHENMlwi-bowxU54 [accessed 29 April 2020]

Appendix:

COVID-19 evidence summary sites scrutinised 26 April 2020 for prior reviews:

- Cochrane Collaboration COVID Rapid Reviews <https://covidrapidreviews.cochrane.org/>
- COVID reviews question bank hosted by Cochrane <https://covidrapidreviews.cochrane.org/search/site>
- CEBM at Oxford (primary care focus): <https://www.cebm.net/covid-19/>
- EvidenceAid <https://www.evidenceaid.org/coronavirus-covid-19-evidence-collection/>
- HIQA (Health Information and Quality Authority in Ireland) https://www.hiqa.ie/reports-and-publications/health-technology-assessments?tid_1=All&field_hta_topics_target_id=112
- Joanna Briggs Institute <https://joannabriggs.org/ebp/covid-19>
- NICE <https://www.nice.org.uk/covid-19>
- Saw Swee Hock School of Public Health <https://sph.nus.edu.sg/covid-19/research/>
- WHO Country & Technical Guidance - Coronavirus disease (COVID-19) <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance>

Google search for grey literature and prior reviews

Advanced search: covid-19 AND (ethnic OR racial OR minority) filetype:pdf

Search histories

PubMed search date 2020-04-26

Credit: PubMed COVID-19 search string (Shokraneh 2020)

72 results

```
(race OR racial OR ethnic* OR migrant* OR refugee* OR displaced OR minorit*) AND  
(("Betacoronavirus"[Mesh] OR "Coronavirus Infections"[MH] OR "Spike Glycoprotein, COVID-19  
Virus"[NM] OR "COVID-19"[NM] OR "Coronavirus"[MH] OR "Severe Acute Respiratory Syndrome  
Coronavirus 2"[NM] OR 2019nCoV[ALL] OR Betacoronavirus*[ALL] OR Corona Virus*[ALL] OR  
Coronavirus*[ALL] OR Coronovirus*[ALL] OR CoV[ALL] OR CoV2[ALL] OR COVID[ALL] OR  
COVID19[ALL] OR COVID-19[ALL] OR HCoV-19[ALL] OR nCoV[ALL] OR "SARS CoV 2"[ALL] OR  
SARS2[ALL] OR SARSCoV[ALL] OR SARS-CoV[ALL] OR SARS-CoV-2[ALL] OR Severe Acute Respiratory  
Syndrome CoV*[ALL]) AND ((2019/11/17[EDAT] : 3000[EDAT]) OR (2019/11/17[PDAT] :  
3000[PDAT])))
```

medRxiv via <https://mcguinlu.shinyapps.io/medrxivr/> search date 2020-04-26

51 results

```
topic1 <- c("[Rr]ace", "[Rr]acial", "[Ee]thnic", "[Mm]igrant", "[Rr]efugee", "[Dd]isplaced",  
"[Mm]inorit")
```

```
topic2 <- c("COVID-19", "coronavirus", "SARS-CoV-2", "2019-nCoV")
```

```
mx_results <- mx_search(query, from.date = 20191130, to.date = 20200426, NOT = c(""), deduplicate  
= TRUE)
```

PubMed search date 2020-04-28

Credit: PubMed COVID-19 search string (Shokraneh 2020)

527 results

"Ethnic Groups"[Mesh] OR Socioeconomic Factors[MeSH Terms] "social determinant"[Text Word] OR occupation*[Text Word] OR movement[Title/Abstract] OR public transport[MeSH Terms] OR Demography[MeSH Terms] OR demographic[Title/Abstract] OR smoking[MeSH Terms] OR smoker*[Title/Abstract] OR diabet*[Title/Abstract] OR hypertens*[Title/Abstract] OR obes*[Title/Abstract] OR overweight[Title/Abstract] OR beta-Thalassemia[MeSH Terms] OR "beta-Thalassemia"[Title/Abstract] OR "beta thalassaemia"[Title/Abstract] OR comorbidity[MeSH Terms] OR "underlying condition"[Title/Abstract] OR comorbidit*[Title/Abstract] OR Overweight[MeSH Terms] OR Obesity[MeSH Terms] OR Hypertension[MeSH Terms] OR Diabetes Mellitus[MeSH Terms] OR "sickle cell"[Title/Abstract] OR Anemia, Sickle Cell[MeSH Terms] OR genetic[Title/Abstract] OR Genetic Predisposition to Disease[MeSH Terms] OR "care home"[Title/Abstract] OR "nursing home"[Title/Abstract] OR Residential Facilities[MeSH Terms] OR life style[MeSH Terms] OR (Health Behavior[MeSH Terms] OR depriv*[Title/Abstract] OR poverty[MeSH Terms] OR "gig economy"[Title/Abstract] OR ((work*[Title/Abstract] OR employment[Title/Abstract])) AND (insecur*[Title/Abstract] OR precari*[Title/Abstract] OR temporary[Title/Abstract])) OR (migrant*[Title/Abstract] OR refugee*[Title/Abstract] OR asylum[Title/Abstract] OR immigrant*[Title/Abstract] OR ethnic* [Title/Abstract] OR racial [Title/Abstract] OR "displaced person"[Title/Abstract] OR Refugees[MeSH Terms] OR Emigrants and Immigrants[MeSH Terms] OR Transients and Migrants[MeSH Terms]) OR ("multiple tenancy" OR "House in multiple occupation" OR "multiple occupancy hous*" OR (accommodation AND (breakfast OR hostel OR rental)) OR "food desert"[Title/Abstract] OR "food bank"[Title/Abstract] OR Urban Population[MeSH Terms] OR Over-crowding[Title/Abstract] OR Over-crowded[Title/Abstract] OR Multi-generational[Title/Abstract] OR Housing[MeSH Terms] OR access*[Title/Abstract] OR equit*[Title/Abstract] OR disparit*[Title/Abstract] OR Health Services Accessibility[MeSH Terms] OR Healthcare Disparities[MeSH Terms] OR "language barrier"[Title/Abstract] OR Punjabi[Title/Abstract] OR Bengali[Title/Abstract] OR Sylheti[Title/Abstract] OR Polish[Title/Abstract] OR Urdu[Title/Abstract] OR Gujarati[Title/Abstract] OR Tamil[Title/Abstract] OR Arabic[Title/Abstract] OR Somali[Title/Abstract] OR Romanian[Title/Abstract] OR Italian[Title/Abstract] OR Turkish[Title/Abstract] OR "communication barriers"[MeSH Terms] OR mistrust[Title/Abstract] OR "cultural mistrust"[Title/Abstract] OR "public transport"[Title/Abstract] OR movement[Title/Abstract]

AND

(("Betacoronavirus"[Mesh] OR "Coronavirus Infections"[MH] OR "Spike Glycoprotein, COVID-19 Virus"[NM] OR "COVID-19"[NM] OR "Coronavirus"[MH] OR "Severe Acute Respiratory Syndrome Coronavirus 2"[NM] OR 2019nCoV[ALL] OR Betacoronavirus*[ALL] OR Corona Virus*[ALL] OR Coronavirus*[ALL] OR Coronovirus*[ALL] OR CoV[ALL] OR CoV2[ALL] OR COVID[ALL] OR COVID19[ALL] OR COVID-19[ALL] OR HCoV-19[ALL] OR nCoV[ALL] OR "SARS CoV 2"[ALL] OR SARS2[ALL] OR SARSCoV[ALL] OR SARS-CoV[ALL] OR SARS-CoV-2[ALL] OR Severe Acute Respiratory Syndrome CoV*[ALL]) AND ((2019/11/17[EDAT] : 3000[EDAT]) OR (2019/11/17[PDAT] : 3000[PDAT])))

AND

Epidemiology[MeSH Terms] OR morbidity[MeSH Terms] OR epidemiolog*[Title/Abstract] OR incidence[Title/Abstract] OR prevalence[Title/Abstract] OR prognosis[MeSH Terms] OR "Critical Care Outcomes"[Mesh] OR "Fatal Outcome"[Mesh] OR "Treatment Outcome"[Mesh] OR "Population Health"[Mesh] OR outcome*[Title/Abstract] OR impact[Title/Abstract] OR Hospitalization[MeSH Terms] OR hospitali*[Title/Abstract] OR hospital admission*[Text Word] OR Continuous Positive Airway Pressure[MeSH Terms] OR CPAP[Title/Abstract] OR "Intensive Care Units"[MeSH Terms] OR "Critical Illness"[MeSH Terms] OR "Critical Care"[MeSH Terms] OR "Critical Care Outcomes"[MeSH Terms] OR "intensive care"[Title/Abstract] OR ITU[Title/Abstract] OR ICU[Title/Abstract] OR "critical

care"[Title/Abstract] OR survival[MeSH Subheading] OR mortality[MeSH Subheading] OR
surviv*[Title/Abstract] OR death*[Title/Abstract] OR mortality[Title/Abstract]

medRxiv via <https://mcguinlu.shinyapps.io/medrxivr/> search date 2020-04-28

314 results

population cluster combined with OR:

[Dd]emographic

[Rr]ace

[Rr]acial

[Ee]thnic

[Mm]igrant

[Rr]efugee

[Dd]isplaced

[Aa]sylum

[li]mmigrant

[Mm]inorit

[Oo]ccupation

[Ee]mployment

[li]nsecur

[Pp]recari

[Pp]overty

[Dd]epriv

[Cc]omorbid

[Gg]enetic

Covid-19 cluster combined with OR:

COVID-19

[Cc]oronavirus

SARS-CoV-2

2019-nCoV

The two clusters combined together using AND

Date limit 2020-01-01 onward