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RESEARCH ARTICLE

REVISED Black, Asian and Minority Ethnic groups in England are at increased risk of death from COVID-19: indirect standardisation of NHS mortality data [version 2; peer review: 3 approved]

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Abstract
Background: International and UK data suggest that Black, Asian and Minority Ethnic (BAME) groups are at increased risk of infection and death from COVID-19. We aimed to explore the risk of death in minority ethnic groups in England using data reported by NHS England.
Methods: We used NHS data on patients with a positive COVID-19 test who died in hospitals in England published on 28th April, with deaths by ethnicity available from 1st March 2020 up to 5pm on 21 April 2020. We undertook indirect standardisation of these data (using the whole population of England as the reference) to produce ethnic specific standardised mortality ratios (SMRs) adjusted for age and geographical region.
Results: The largest total number of deaths in minority ethnic groups were Indian (492 deaths) and Black Caribbean (460 deaths) groups. Adjusting for region we found a lower risk of death for White Irish (SMR 0.52; 95%CIs 0.45-0.60) and White British ethnic groups (0.88; 95%CIs 0.86-0.0.89), but increased risk of death for Black African (3.24; 95%CIs 2.90-3.62), Black Caribbean (2.21; 95%CIs 2.02-2.41), Pakistani (3.29; 95%CIs 2.96-3.64), Bangladeshi (2.41; 95%CIs 1.98-2.91) and

Open Peer Review

Reviewer Status ✓ ✓ ✓

	Invited Reviewers		
	1	**2**	**3**
version 2 (revision) 24 Jun 2020	✓ report	✓ report	✓ report
version 1 06 May 2020	? report	? report	? report

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Indian (1.70; 95%CIs 1.56-1.85) minority ethnic groups.

Conclusion: Our analysis adds to the evidence that BAME people are at increased risk of death from COVID-19 even after adjusting for geographical region, but was limited by the lack of data on deaths outside of NHS settings and ethnicity denominator data being based on the 2011 census. Despite these limitations, we believe there is an urgent need to take action to reduce the risk of death for BAME groups and better understand why some ethnic groups experience greater risk. Actions that are likely to reduce these inequities include ensuring adequate income protection, reducing occupational risks, reducing barriers in accessing healthcare and providing culturally and linguistically appropriate public health communications.

Keywords

SARS-CoV-2, COVID-19, Mortality, minority ethnic groups
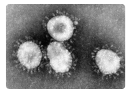
This article is included in the Coronavirus (COVID-19) collection.

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Any reports and responses or comments on the article can be found at the end of the article.

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Author roles: Aldridge RW: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Writing – Original Draft Preparation, Writing – Review & Editing; **Lewer D**: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Software, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Katikireddi SV**: Methodology, Writing – Original Draft Preparation, Writing – Review & Editing; **Mathur R**: Methodology, Writing – Original Draft Preparation, Writing – Review & Editing; **Pathak N**: Methodology, Writing – Original Draft Preparation, Writing – Review & Editing; **Burns R**: Methodology, Writing – Original Draft Preparation, Writing – Review & Editing; **Fragaszy EB**: Writing – Original Draft Preparation, Writing – Review & Editing; **Johnson AM**: Writing – Original Draft Preparation, Writing – Review & Editing; **Devakumar D**: Investigation, Methodology, Writing – Original Draft Preparation, Writing – Review & Editing; **Abubakar I**: Investigation, Methodology, Writing – Original Draft Preparation, Writing – Review & Editing; **Hayward A**: Conceptualization, Formal Analysis, Investigation, Methodology, Writing – Original Draft Preparation, Writing – Review & Editing

Background

There is increasing international evidence that Black, Asian and Minority Ethnic (BAME) people are at higher risk of death from COVID-19[1]. As of 26th April 2020, there were 20,732 reported COVID-19 deaths in hospital in the UK[2], but to date, there have been no officially reported analyses of the risk of death by ethnicity[3]. An inquiry has been announced that will examine the impact of COVID-19 on BAME people[4].

Ethnicity data are currently available in the intensive care national audit and research centre (ICNARC) reports on patients with confirmed COVID-19 that have been admitted to intensive care for at least 24 hours. On 24th April 2020 these data showed that BAME people were at higher risk of developing severe COVID-19 disease[5]. A total of 5,993 patients with confirmed COVID-19 had reported data on ethnicity and 34.2% (2,055/5,993) of these patients were from BAME groups. Analyses matched by area (ward) of residence showed differences are significant for all BAME groups but there is substantial variation by minority ethnic groups. There were 1.63 times more Black patients in critical care than expected based on the matched population (10.6% vs 6.5%). For Asian patients the differential is reduced but still significant with 1.25 times more Asian patients than expected (15.3% vs 12.2%).

Ethnicity is not recorded in death certificates in England which is an important limitation on our ability to study the differential impact of COVID-19 on mortality in different BAME groups. However, daily NHS hospital death data are provided by geographical region, age and ethnicity[6]. Adjusting for region is potentially important because in England COVID-19 has affected different parts of the country to a different extent. For example, London and the West Midlands, the two regions with the highest levels of BAME residents have had most COVID-19 cases. Using these data, we aimed to examine the risk of death from COVID-19 by BAME group and through a sensitivity analysis test whether differences between BAME groups could be explained by regional differences in the ethnic make-up of the population.

Methods

We used NHS data on patients with a positive COVID-19 test who died in hospitals in England, in separate tables by age group, region, and ethnicity. We used data published on 26th April, that included deaths by ethnicity from 1 March 2020 up to 5pm 21 April 2020[6]. Where the age group and region tables showed a different total number of deaths to the ethnicity table, we applied a

scaling factor to align the totals to the ethnicity table. We assumed that decedents with unknown ethnicity had the same ethnicity structure as other decedents.

We used indirect standardisation to calculate standardised mortality ratios (SMRs) by ethnic group (where the reference group is the whole population). We first calculated age-specific mortality rates using the COVID-19 deaths data and population estimates from the UK Census 2011. All ages were used, and age ranges included were 0–19; 20–39;40–59; 60–79 and 80+. We then calculated an expected number of deaths for each ethnic group by applying these mortality rates to population estimates by both ethnic group and age, also from the UK Census 2011. We calculated the SMR as the observed deaths divided by the expected deaths. We assumed that deaths occurred over the same time period for all ethnic groups, and used the population point estimate as the denominator for simplicity. We then conducted a sensitivity analysis to account for regional differences in the ethnicity of the population. The number of COVID-19 deaths by age and region was not available, and we assumed that the proportion of deaths in each age group was the same across regions. We calculated age- and region-specific mortality rates using this assumption, and calculated an expected number of deaths by applying these rates to population estimates by ethnic group, age, and region. The data included seven regions: London, South East, South West, Midlands, East of England, North West, and North East & Yorkshire and the Humber. We then estimated SMRs adjusted for region by dividing the observed by the expected deaths. We calculated 95% confidence intervals using the exact Poisson method. All analyses were conducted using R version 3.6.2. Data and code required for replication are provided as Underlying and Extended data[7].

Results

A total of 16,272 deaths were observed over the study period. Ethnicity was missing for 9.4% (1,537/16,272) of NHS England hospital deaths. The largest total number of deaths in minority ethnic groups were Indian (492 deaths) and Black Caribbean (460 deaths) people. In comparison to the whole population, SMRs in the unadjusted analysis were reduced for White British and White Irish groups, but were increased for all BAME groups. After adjusting for region, White Irish (SMR 0.52; 95%CIs 0.45-0.60) and White British (SMR 0.88; 95%CIs 0.86-0.89) ethnic groups continued to have a lower risk of death. Black African (3.24; 95%CIs 2.90-3.62), Black Caribbean (2.21; 95%CIs 2.02-2.41), Pakistani (3.29; 95%CIs 2.96-3.64), Bangladeshi (2.41; 95%CIs 1.98-2.91) and Indian (1.70; 95%CIs 1.56-1.85) minority ethnic groups continued to have a higher risk of death (Table 1). There was no statistical evidence that SMRs were increased or reduced for Chinese (1.14; 95%CIs 0.87-1.45), Mixed White and Black African (1.31; 95%CIs 0.70-2.25), Mixed White and Asian (0.93; 95%CIs 0.59-1.38) and Mixed White and Black Caribbean (1.10; 95%CIs 0.77-1.53) ethnic groups.

Discussion

Our analyses showed that several BAME groups have a higher risk of death from COVID-19 and that regional differences in ethnicity explains some but not all of the differences between

Table 1. NHS England COVID-19 deaths by ethnic group, adjusted and unadjusted by NHS region (Numbers in brackets show 95% confidence intervals).

Group	Subgroup	Observed deaths*	Expected deaths (adjusting for age)	SMR (adjusting for age)	p-value (adjusting for age)	Expected deaths (adjusting for age and region)	SMR (adjusting for age and region)	p-value (adjusting for age and region)
Asian	Chinese	63	40.1	1.57 (1.21-2.01)	<0.001	55.4	1.14 (0.87-1.45)	0.313
	Bangladeshi	110	27.7	3.97 (3.26-4.79)	<0.001	45.6	2.41 (1.98-2.91)	<0.001
	Asian other	271	78.9	3.44 (3.04-3.87)	<0.001	125.9	2.15 (1.90-2.42)	<0.001
	Pakistani	367	91	4.03 (3.63-4.47)	<0.001	111.6	3.29 (2.96-3.64)	<0.001
	Indian	543	208.1	2.61 (2.39-2.84)	<0.001	319.3	1.70 (1.56-1.85)	<0.001
	Total: Asian	1,354	445.8	3.04 (2.88-3.20)	<0.001	657.8	2.06 (1.95-2.17)	<0.001
Black	Black other	161	18.5	8.70 (7.41-10.15)	<0.001	30.8	5.23 (4.46-6.11)	<0.001
	African	320	56.3	5.68 (5.08-6.34)	<0.001	98.6	3.24 (2.90-3.62)	<0.001
	Caribbean	508	136.9	3.71 (3.39-4.05)	<0.001	230.3	2.21 (2.02-2.41)	<0.001
	Total: Black	989	211.8	4.67 (4.38-4.97)	<0.001	359.7	2.75 (2.58-2.93)	<0.001
Mixed	White and Black African	13	7.0	1.86 (0.99-3.18)	0.034	9.9	1.31 (0.70-2.25)	0.335
	White and Asian	24	19.7	1.22 (0.78-1.81)	0.311	25.9	0.93 (0.59-1.38)	0.844
	White and Black Caribbean	36	26.4	1.36 (0.95-1.89)	0.064	32.6	1.10 (0.77-1.53)	0.539
	Mixed other	53	19.2	2.76 (2.07-3.61)	<0.001	26.8	1.98 (1.48-2.59)	<0.001
	Total: Mixed	126	72.3	1.74 (1.45-2.07)	<0.001	95.2	1.32 (1.10-1.58)	0.002
Other	Total: Other	485	53.5	9.06 (8.27-9.90)	<0.001	86.4	5.62 (5.13-6.14)	<0.001
White	White Irish	178	262.8	0.68 (0.58-0.78)	<0.001	342	0.52 (0.45-0.60)	<0.001
	White other	601	333.3	1.80 (1.66-1.95)	<0.001	445.6	1.35 (1.24-1.46)	<0.001
	White British	12,538	14,892.5	0.84 (0.83-0.86)	<0.001	14,285.40	0.88 (0.86-0.89)	<0.001
	Total: White	13,317	15,488.6	0.86 (0.85-0.87)	<0.001	15,073.00	0.88 (0.87-0.90)	<0.001

* Ethnicity was missing for 1,537 deaths. We assumed that decedents with unknown ethnicity had the same ethnicity structure as other decedents and redistributed these deaths between ethnic groups. As a result, the numbers of deaths by minority ethnic group do not match those reported in the abstract and results section which presents numbers from NHS Data by ethnicity before this redistribution. CI=Confidence Interval SMR= Standardised Mortality Ratio

ethnic groups. After accounting for geographical region SMRs reduced, but there remained large differences in SMRs between ethnic groups - White British and White Other have lower SMRs, but Bangladeshi, Pakistani, Indian, Black African and Black Caribbean ethnic groups all have substantially increased SMRs.

There are limitations to these data relating to the reporting of COVID-19 deaths. The NHS data we have used are currently only available in broad age groups, and are not broken down by both region and age, which meant we had to assume there were no differences in age structure of deaths across regions within these age bands. Data are also not disaggregated by sex and social deprivation and therefore we were unable to explore the effect these would have on our adjusted SMR estimates. There is increasing evidence that men are more likely to die from COVID-19 and therefore our lack of disaggregation by sex could account for some of the remaining differences in SMRs we see between ethnic groups, particularly as those occupations found to be at

higher risk include greater numbers of men working in them. Publication of COVID-19 death data by age, region, gender, social deprivation, and ethnicity would improve these adjustments further. The data we used only include people who died in hospital. ONS data from 28 April suggest that 77.4% (14,796 deaths) of all deaths in England and Wales occurred in hospital with 3,096 deaths occurring in care homes[8] and the SMRs may be biased if deaths that occur in hospitals differ from those occurring in the community by ethnic group, which might arise due to, for example, differences in use of residential care homes[9]. Deaths in residential care homes are likely to include a larger number of White British people[10] which could lead to an under-estimation of the SMR in this group within our estimates. Our analysis was based on the 2011 census data and therefore will not reflect recent changes in the age, ethnic and region across England in the last nine years. Our use of census data from 2011 is likely to result in over-estimation of mortality ratios in minority ethnic groups that have grown the fastest during this time period. We found raised

SMRs in several BAME groups including Asian Other, Black Other, Mixed Other and White Other and further analysis should be undertaken to examine whether there are particular groups at risk within these broad groups to ensure we can better understand their increased mortality risk.

Our analysis is consistent with Intensive Care National Audit and Research Centre (ICNARC) data which suggests that Black ethnic groups are substantially over-represented amongst critical care patients, and that BAME groups in critical care are generally more likely to require ventilation and therefore more likely to die. Further analyses of the ICNARC data are required to assess the extent to which these associations are due to differences in age, comorbidity and socioeconomic status. A recent analysis of COVID-19 deaths in health and social care workers was undertaken using data from mainstream and social media reports. This analysis suggested that BAME deaths in nursing and support staff accounted for 64% of deaths, and 95% in medical staff, whilst these groups accounted for 20% and 44% percent of all staff[11]. This analysis of deaths in health and social workers, however, did not adjust for regional differences in the proportion of NHS staff coming from BAME groups.

Adjusting for geographic region reduced the high SMRs for BAME groups as shown in Figure 1. Several other factors, some of which will be associated with geographic region, may further

explain this increased risk. There is increasing evidence from ONS and Public Health England on the role of occupation and socio-economic deprivation in relation to risk of COVID-19 and the increased risk of infection and poor outcomes found in BAME communities[12–15]. Occupation is also likely to play an important role in terms of increased risk of infection as BAME people are more likely to have occupations that involve greater social mixing and less ability to work from home. For example, Black groups are overrepresented in caring and leisure industries; Pakistani and Bangladeshi groups are overrepresented in sales and consumer service occupations; and Black groups in public administration, education and health[16]. BAME groups are more likely to have a low income, be in zero hours contracts and non salaried jobs than white ethnic groups. This may make it harder to comply with social distancing restrictions that prevent people from working and those who are self-employed or working in the gig economy will have their earnings stop unless they sign up to a government scheme. There may be barriers to this and some migrants, for example, may not want to make themselves known to the authorities. Ethnicity is socially constructed and correlates poorly with biology. Biological differences are therefore highly unlikely to underpin these inequalities[17].

Living in overcrowded housing likely increases transmission risk, and BAME households were more likely to be overcrowded than White British households in recent analysis by ONS[18]. This
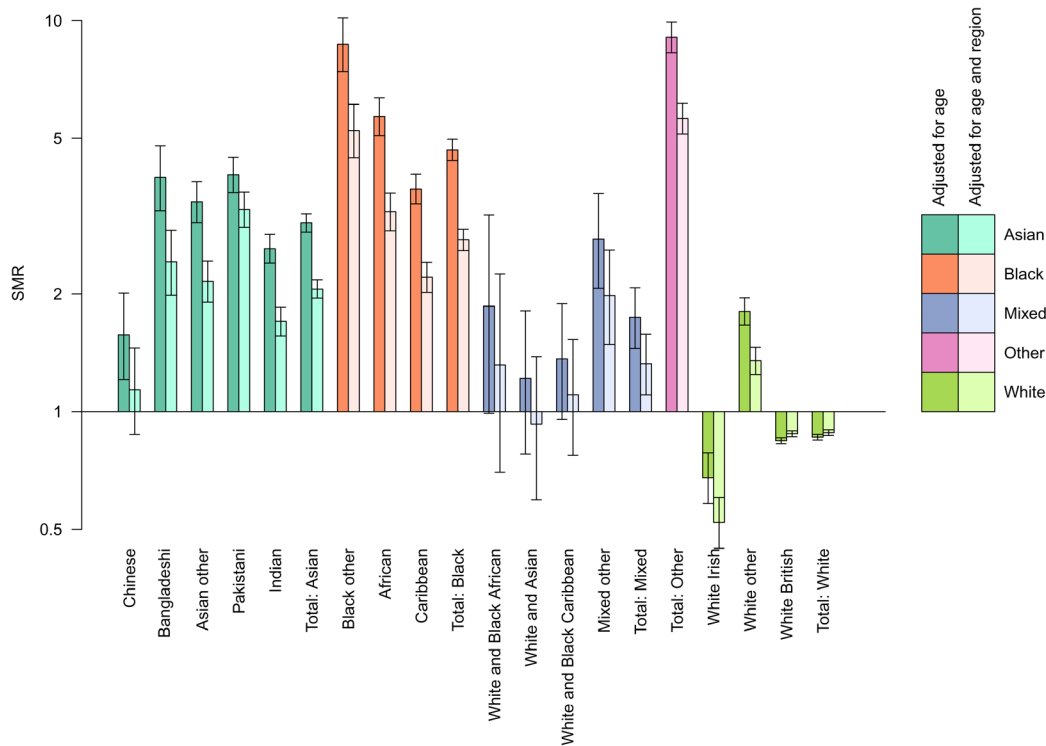

Figure 1. NHS England COVID-19 deaths by ethnic group, adjusted and unadjusted by NHS region (error bars show 95% confidence intervals).

is true even when restricting analyses to those living in poverty, where BAME groups living in poverty are more likely to be in overcrowded conditions than white groups living in poverty[19]. Increased levels of pre-existing medical conditions such as diabetes, hypertension and heart disease are known to increase the risk of severe COVID-19 disease[1] and these are also increased in some ethnic groups. Finally, differences in risk factors such as obesity, may also be relevant. Research to disentangle these potential pathways appears highly limited, with only one study having been conducted, to our knowledge[20]. This was based on laboratory-confirmed diagnoses using the UK Biobank study and suggested that socioeconomic differences might make an important contribution, but differences in pre-existing health and risk factors appeared less important. However, this study was based on a non-representative sample and relied on routine testing which is likely subject to substantial ascertainment bias.

Ethnicity is not recorded in death certificates in England, which is a major limitation in our ability to study the differential impact of COVID-19 on mortality in different ethnic groups. However, this has been achieved in Scotland and the COVID-19 pandemic highlights the potential utility of introducing it in England[21]. Further analysis of deaths for BAME people will require urgent linkage to other records that contain ethnicity information such as NHS hospital episode statistics and primary care electronic health records. A key unanswered question is to understand why mortality risks differ between ethnic groups. This may arise from an increased risk of developing infection, worse prognosis or care once infection has occurred or a combination of the above[22]. While it is important to conduct and report such analyses rapidly, this must not delay immediate action to begin to mitigate these extreme inequities.

We believe there are several important and urgent public health actions to be taken to address the high mortality rates in BAME groups described in our analyses. First, some BAME groups face barriers in accessing high quality healthcare. The NHS must remove these barriers working with minority ethnic people to understand the issues. For example, some people in BAME communities will also be international migrants and Public Health England recently reported the increased risk of death from COVID-19 in this group[15]. This analysis showed that the largest relative increase in death from COVID-19 was for people born in Central and Western Africa, the Caribbean, South East Asia, the Middle East and South and Eastern Africa. Some groups of international migrants in the UK avoid the use of the NHS because of the current NHS charging regime for migrants or through fear of their data being shared with the Home Office for immigration enforcement purposes[23]. Limited healthcare entitlement results in untreated conditions, poorly managed chronic conditions and deterrence from healthcare for migrants is well documented, rendering a context of distrust and fear[24]. Whilst migrants diagnosed with COVID-19 are exempt from healthcare charges, not all migrants will be aware of these exemptions and the exemption first requires a diagnosis. Some migrants may fear the charge being imposed through a lack of diagnosis due to limited testing opportunities. We therefore call for the removal of all NHS charges during this public health emergency to ensure that no

migrant or individual from a BAME group delays seeking healthcare and risks death through fear of being charged for their NHS care. Second, we must ensure that linguistically and culturally appropriate public health communication and engagement is being provided and appropriately targeted at those populations at greatest risk. This needs to be developed with affected communities and tailored to specific challenges including addressing culturally specific disinformation and, for example, addressing the difficulties of preventing transmission in overcrowded households or of shielding vulnerable people in multigenerational households. Third, we must take urgent action to reduce the risk of SARS-CoV-2 infection in BAME populations. For example, BAME groups are more likely to work in care settings such as nursing homes, where adequate PPE to prevent infection is vital. BAME groups are also more likely than others to be in key worker occupational groups who have high levels of exposure to the general public and therefore high risk of infection. The effectiveness of personal protective equipment in preventing infection outside health and social care settings remains uncertain, however, there are a range of other measures that are likely to reduce infection risk. These include: ensuring that workplaces are not overcrowded so that staff can maintain social distancing at work; providing distancing measures and physical barriers to reduce exposure to droplets from the members of the general public (e.g. perspex screens at supermarket counters); ready availability of handwashing materials at the workplace and access to testing and workplace contact tracing. Fourth, there is a risk that some ethnic minority groups might not only experience greater risks from COVID-19 itself, but also greater adverse consequences of the extensive social distancing measures in place[25]. There is a need for adequate income protection to ensure low paid, non-salaried and zero-hours contract workers can afford to follow isolation and "stay at home" recommendations.

The unacceptable differences in COVID mortality between white and BAME groups demand immediate action. They are an extreme example of the long-standing inequities affecting BAME groups in our society. As we emerge from the COVID-19 pandemic we must ensure that these unfair and avoidable disparities are addressed. Governments in the UK, and elsewhere, must consider how to best protect minority ethnic groups from experiencing further disadvantage and indirect health harms during the recovery process. The public health response to COVID-19 must be equitable and urgent if it is to address the unacceptable ethnic disparities our analyses show.

Data availability
Source data
Source data for this analysis comes from the NHS COVID-19 Daily Deaths

https://www.england.nhs.uk/statistics/statistical-work-areas/covid-19-daily-deaths/ which we have used and reproduced under the terms of the Open Government Licence v3.0.

Underlying data
UCL Discovery: Dataset: Black, Asian and Minority Ethnic groups in England are at increased risk of death from

COVID-19: indirect standardisation of NHS mortality data. https://doi.org/10.14324/000.ds.10096589[7]

This project contains the following underlying data:

- lookup_region.csv (Look up table to align region categories in Census population data with NHSE data)

- nomis_reformatted.csv (2011 Census population data)

- region_26apr2020.csv (NHSE COVID-19 death data by region)

- age_26apr2020.csv (NHSE COVID-19 death data by age)

- ethnicity_26apr2020 (NHSE COVID-19 death data by ethnicity)

- lookup_age.csv (Look up table to align age categories in Census population data with NHSE data)

- lookup_ethnicity.csv (Look up table to align ethnicity categories in Census population data with NHSE data)

Extended data

UCL Discovery: UCL Discovery: Dataset: Black, Asian and Minority Ethnic groups in England are at increased risk of death from COVID-19: indirect standardisation of NHS mortality data. https://doi.org/10.14324/000.ds.10096589[7]

This project contains the following extended data:

- Aldridge_covid19_ethnicity_smrs_v4_1 (Analysis replication code)

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

References

1. CDC: **Coronavirus Disease 2019 (COVID-19).** Centers for Disease Control and Prevention. 2020; (accessed April 26, 2020).
Reference Source

2. Department of Health, Care S: **Number of coronavirus (COVID-19) cases and risk in the UK.** GOV.UK. 2020; (accessed April 26, 2020).
Reference Source

3. **Statement of upcoming analysis on deaths and coronavirus (COVID-19) - Office for National Statistics.** 2020; (accessed April 26, 2020).
Reference Source

4. Siddique H, Marsh S: **Inquiry announced into disproportionate impact of coronavirus on BAME communities.** *The Guardian.* 2020; (accessed April 26, 2020).
Reference Source

5. **ICNARC – Latest news.** 2020; (accessed April 25, 2020).
Reference Source

6. Statistics: **Statistics » COVID-19 Daily Deaths**. (accessed April 28, 2020).
Reference Source

7. Aldridge R: **Dataset: Black, Asian and Minority Ethnic groups in England are at increased risk of death from COVID-19.** UCL Institute of Health Informatics: London, UK. 2020.
http://www.doi.org/10.14324/000.ds.10096589

8. Caul S: **Deaths registered weekly in England and Wales, provisional - Office for National Statistics. Office for National Statistics.** 2020; (accessed April 26, 2020).
Reference Source

9. Dixon J, King D, Matosevic T, *et al.*: **Equity in the Provision of Palliative Care in the UK: Review of Evidence**. 2015.
Reference Source

10. UK population by ethnicity: **Age groups.** 2018; (accessed April 28, 2020).
Reference Source

11. Cook T, Kursumovic E, Lennane S: **Exclusive: deaths of NHS staff from covid-19 analysed.** *Health Service Journal.* (accessed April 26, 2020).
Reference Source

12. **Employment by occupation.** 2018; (accessed April 28, 2020).
Reference Source

13. **Coronavirus (COVID-19) related deaths by occupation, England and Wales: deaths registered up to and including 20 April 2020; Office for National Statistics**. Centers for Disease Control and Prevention. 2020; (accessed April 26, 2020).

14. **Coronavirus-related deaths by ethnic group, England and Wales methodology**. Office for National Statistics. 2020; (accessed June 212, 2020).
Reference Source

15. **COVID-19: review of disparities in risks and outcomes**. Public Heath England. 2020; (accessed June 212, 2020).
Reference Source

16. **Employment by sector.** 2018; (accessed April 28, 2020).
Reference Source

17. Saini A: **Stereotype threat.** *Lancet.* 2020; **395**(10237): 1604–1605.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

18. **Overcrowded households.** 2018; (accessed April 26, 2020).
Reference Source

19. **Families and households.** 2019; (accessed April 29, 2020).
Reference Source

20. Niedzwiedz CL, O'Donnell CA, Jani BD, *et al.*: **Ethnic and socioeconomic differences in SARS-CoV-2 infection: prospective cohort study using UK Biobank.** *Public and Global Health.* 2020.
Publisher Full Text

21. Gruer L, Cézard G, Clark E, *et al.*: **Life expectancy of different ethnic groups using death records linked to population census data for 4.62 million people in Scotland.** *J Epidemiol Community Health.* 2016; **70**(12): 1251–4.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

22. Khunti K, Singh AK, Pareek M, *et al.*: **Is ethnicity linked to incidence or outcomes of covid-19?** *BMJ.* 2020; **369**: m1548.
PubMed Abstract | **Publisher Full Text**

23. Hiam L, Steele S, McKee M: **Creating a 'hostile environment for migrants': the British government's use of health service data to restrict immigration is a very bad idea.** *Health Econ Policy Law.* 2018; **13**(12): 107–17.
PubMed Abstract | **Publisher Full Text**

24. Burns R: **Medecins du Monde's (MdM) 2019 Observatory Report Left Behind: The State of Universal Healthcare Coverage.** MHADRI. 2019; (accessed April 28, 2020).
Reference Source

25. Douglas M, Katikireddi SV, Taulbut M, *et al.*: **Mitigating the wider health effects of covid-19 pandemic response.** *BMJ.* 2020; **369**: m1557.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

Open Peer Review

Current Peer Review Status: ✓ ✓ ✓

Version 2

Reviewer Report 27 August 2020

https://doi.org/10.21956/wellcomeopenres.17630.r39222

✓ **Matthew Wallace** iD

Demography Unit, Department of Sociology, Stockholm University, Stockholm, Sweden

The authors have responded in detail to each of my comments and addressed the most pressing ones. As of now, the revised version of this interesting manuscript has satisfied the previous reservations I had.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Demography, Population Studies, Geography.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 29 June 2020

https://doi.org/10.21956/wellcomeopenres.17630.r39223

✓ **Frances Darlington-Pollock** iD

Geography and Planning, University of Liverpool, Liverpool, UK

The additional clarification is welcome, as are the clearer signposts to the data used. The revisions have addressed my previous reservations.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Population Geography, Health Geography, Social and Spatial Inequality, Ethnicity.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 25 June 2020

https://doi.org/10.21956/wellcomeopenres.17630.r39221

✔️ **Odile Sauzet**
Department of Epidemiology & International Public Health, School of Public Health, Bielefeld University, Bielefeld, Germany
Oliver Razum iD
Department of Epidemiology & International Public Health, School of Public Health, Bielefeld University, Bielefeld, Germany

Our reservations have been taken care of adequately. We approve the manuscript as it now stands.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: epidemiology; public health; health of migrants and refugees; small area differentials in health; Covid-19

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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Version 1

Reviewer Report 28 May 2020

https://doi.org/10.21956/wellcomeopenres.17464.r38665

❓ **Frances Darlington-Pollock** iD

Geography and Planning, University of Liverpool, Liverpool, UK

Public and media attention has increasingly centred on the apparent disproportionate impact of COVID-19 on BAME groups. This paper adds empirical evidence to these discussions, going some way in highlighting that COVID-19 is far from a leveller or equalizer. The authors use publicly available daily NHS hospital death data provided by geographical region, age and ethnicity to create standardised mortality ratios (SMRs) by ethnic group which are first adjusted by age and then also by region (having looked at the data, the age groups are quite broad which may be worth stating). The indirect method of standardisation is used which is appropriate given the possibility of small numbers in some cases. Results are presented in a table and in a figure, illustrating that Asian (bar Chinese), Black, Mixed Other, and White Other ethnic groups all have a heightened risk of mortality from COVID-19 after adjusting for age and region. The authors go on to speculate as to possible reasons for the differences between ethnic groups, ranging from differences in experiences of poverty between regions and ethnic groups, differences in occupation and the resulting risk of exposure, housing situation, and differences in pre-existing medical conditions. The authors make a number of recommendations in terms of public health interventions during this crisis, as well as noting limitations. Though well written, clearly presented, and informative, there are a couple of factors that would strengthen this paper, particularly given the unavoidable limitations of the data used.

1. In the recommendations for intervention section, much is made of the barriers to healthcare access faced by some BAME groups. More evidence to support this would strengthen. Further, though concerns are rightly raised as to the impact of the NHS charging regime for migrants and general discussion of migrants and differential healthcare needs/access requirements, this does not feel well supported by the data used. These data are simply 'ethnicity', rather than migrant status, country of birth or length of residence in the UK – all of which matter for this theme of discussion. More reflection of this needed.

2. Relatedly, much is made of how differences in occupation and accordingly, socioeconomic position, matter for risk of exposure and the wider impact of COVID-19 policy responses. These are relevant and important debates, but are tangential to what is shown in the data due to the limitations of what is recorded. More set up/evidence as to why these will vary between ethnic groups, and the importance of region (which is a rather crude geographical scale and more could be made of this), would help counter this limitation.

3. Though not possible to produce SMRs by sex, more reflection on that is important given wider differences in COVID-19 mortality profiles between sexes, and the relationship with some of the discussion on occupation/socioeconomic factors etc.

4. Finally (minor point): as an open piece of research this is very useful. Yet, when looking through the link provided for the data I could only see deaths broken down by region, broad age group, and NHS Trust. More specifics as to the location of the ethnicity data would be welcome (NB, the authors provide the R code and underlying data, which is great).

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Partly

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Population Geography, Health Geography, Social and Spatial Inequality, Ethnicity.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 15 Jun 2020
Robert Aldridge, Institute of Health Informatics, UCL, London, UK

Thanks very much for this helpful review - we appreciate the time you have taken to carefully read and provide constructive feedback on the article. We have tried to address all the points you have raised and below we include your comments alongside in our responses *in bold italics.* We have numbered each of our responses in order that we can cross-reference them across all of the reviews to this article.

******

Public and media attention has increasingly centred on the apparent disproportionate impact of COVID-19 on BAME groups. This paper adds empirical evidence to these discussions, going some way in highlighting that COVID-19 is far from a leveller or equalizer. The authors use publicly available daily NHS hospital death data provided by geographical region, age and ethnicity to create standardised mortality ratios (SMRs) by ethnic group which are first adjusted by age and then also by region (having looked at the data, the age groups are quite broad which may be worth stating). The indirect method of standardisation is used which is appropriate given the possibility of small numbers in some cases. Results are presented in a table and in a figure, illustrating that Asian (bar Chinese), Black, Mixed Other, and White Other ethnic groups all have a heightened risk of mortality from COVID-19 after adjusting for age and region. The authors go on to speculate as to possible reasons for the differences between ethnic groups, ranging from differences in

experiences of poverty between regions and ethnic groups, differences in occupation and the resulting risk of exposure, housing situation, and differences in pre-existing medical conditions. The authors make a number of recommendations in terms of public health interventions during this crisis, as well as noting limitations. Though well written, clearly presented, and informative, there are a couple of factors that would strengthen this paper, particularly given the unavoidable limitations of the data used.

In the recommendations for intervention section, much is made of the barriers to healthcare access faced by some BAME groups. More evidence to support this would strengthen. Further, though concerns are rightly raised as to the impact of the NHS charging regime for migrants and general discussion of migrants and differential healthcare needs/access requirements, this does not feel well supported by the data used. These data are simply 'ethnicity', rather than migrant status, country of birth or length of residence in the UK – all of which matter for this theme of discussion. More reflection of this needed.

Author response 9: We agree that not all people in minority ethnic groups are migrants, but there is a large overlap between these groups and we feel that the particular issues faced by migrants are important to highlight along with potential important measures to reduce their increased risk of death from COVID-19. Public Health England has produced additional evidence on this point since our publication on this increased risk for migrants and we have now added the following sentence to qualify the points we make on migration in order to address this important issue raised by the reviewer:

"For example, some people in BAME communities will also be international migrants and Public Health England recently reported the increased risk of death from COVID-19 in this group. This analysis showed that the largest relative increase in death from COVID-19 was for people born in Central and Western Africa, the Caribbean, South East Asia, the Middle East and South and Eastern Africa."

Relatedly, much is made of how differences in occupation and accordingly, socioeconomic position, matter for risk of exposure and the wider impact of COVID-19 policy responses. These are relevant and important debates, but are tangential to what is shown in the data due to the limitations of what is recorded. More set up/evidence as to why these will vary between ethnic groups, and the importance of region (which is a rather crude geographical scale and more could be made of this), would help counter this limitation.

Author response 10: After our study was published ONS and Public Health England have completed several analyses that support the comments we make in this discussion. We have edited out some of our previous comments on these issues and replaced it with the following sentences in the discussion which provide direct evidence on the associations between occupation, socioeconomic position and COVID:

"There is increasing evidence from ONS and Public Health England on the role of occupation and socio-economic deprivation in relation to risk of COVID-19 and the increased risk of infection and poor outcomes found in BAME communities"

Though not possible to produce SMRs by sex, more reflection on that is important given

wider differences in COVID-19 mortality profiles between sexes, and the relationship with some of the discussion on occupation/socioeconomic factors etc.

Author response 11: We have attempted to address this and a similar point raised by Matthew Wallace in our "Author response 2"

Finally (minor point): as an open piece of research this is very useful. Yet, when looking through the link provided for the data I could only see deaths broken down by region, broad age group, and NHS Trust. More specifics as to the location of the ethnicity data would be welcome (NB, the authors provide the R code and underlying data, which is great).

Author response 12: Our updated code includes links to the data sources and metadata including links to these sources which we hope is more helpful in understanding where these data come from and how we broke them down.

Competing Interests: No competing interests were disclosed.

Reviewer Report 26 May 2020

https://doi.org/10.21956/wellcomeopenres.17464.r38681

Oliver Razum iD
Department of Epidemiology & International Public Health, School of Public Health, Bielefeld University, Bielefeld, Germany
Odile Sauzet
Department of Epidemiology & International Public Health, School of Public Health, Bielefeld University, Bielefeld, Germany

Preliminary reports indicate that Black, Asian and Minority Ethnic (BAME) people have a higher mortality from Covid-19 than the majority population. So far, it is unclear what the underlying reasons are. Clearly, if confirmed, these findings would be of public health relevance. Moreover, they would raise an urgent equity issue.

Robert Aldridge and colleagues have examined the mortality of people who tested positive for Covid-19 using NHS data from hospitals in England. Based on more than 16,000 deaths they found higher numbers of deaths in BAME people and lower numbers of deaths in White British and Irish groups, when compared to the expected number based on the total population. Standardised Mortality Ratios remained significantly different after adjustment for age and geographical region.

The statistical methodology used is transparently presented and adequate, assuming that the age distributions of the different sub-populations are broadly similar to that of the total population.

Limitations of the data set are explained. The authors could have performed a sensitivity analysis with different assumptions regarding the distribution of the various ethnicities among those persons in whom this information was missing.

The Discussion section of the manuscript is long as compared to the Results section, mainly due to problems of interpreting the findings. I see two issues here: Firstly, "ethnicity" is socially constructed; there is no plausible biological correlate (see, for example, Saini, A. (2020). Stereotype threat. The Lancet, 395(10237), 1604-1605[1]). This should be explained in order to avoid speculation of underlying "genetic" causes. Second, having said that, probable underlying causes are socioeconomic disadvantages and possibly differentials in access and quality of care. The available data, however, are not really informative in this respect. In consequence, the second-but-last paragraph (starting with "We believe…") should be shorter and less speculative.

Minor technical issue: Some journals require reporting of confidence intervals *and* p-values (the latter are not reported in Table 1).

References
1. Saini A: Stereotype threat. *The Lancet*. 2020; **395** (10237): 1604-1605 Publisher Full Text

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: epidemiology; public health; health of migrants and refugees; small area differentials in health; Covid-19

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.

Author Response 15 Jun 2020

Robert Aldridge, Institute of Health Informatics, UCL, London, UK

Thanks very much for this helpful review - we appreciate the time you have taken to carefully read and provide constructive feedback on the article. We have tried to address all the points you have raised and below we include your comments alongside in our responses *in bold italics.* We have numbered each of our responses in order that we can cross-reference them across all of the reviews to this article.

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Preliminary reports indicate that Black, Asian and Minority Ethnic (BAME) people have a higher mortality from Covid-19 than the majority population. So far, it is unclear what the underlying reasons are. Clearly, if confirmed, these findings would be of public health relevance. Moreover, they would raise an urgent equity issue.

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The statistical methodology used is transparently presented and adequate, assuming that the age distributions of the different sub-populations are broadly similar to that of the total population. Limitations of the data set are explained. The authors could have performed a sensitivity analysis with different assumptions regarding the distribution of the various ethnicities among those persons in whom this information was missing.

Author response 6: Since the submission we have spent time exploring whether there are between-census population estimates of ethnicity that include age that would enable us to explore this issue further. Unfortunately, we have not been able to locate data that we could use for this analysis and we feel these would be required to inform a sensitivity analysis as described. We agree it would be helpful to perform this sensitivity analysis, but the current lack of data restricts our ability to do an informative sensitivity analysis and so we have not included one in this update due to the lack of available data to inform it.

The Discussion section of the manuscript is long as compared to the Results section, mainly due to problems of interpreting the findings. I see two issues here: Firstly, "ethnicity" is socially constructed; there is no plausible biological correlate (see, for example, Saini, A. (2020). Stereotype threat. The Lancet, 395(10237), 1604-16051). This should be explained in order to avoid speculation of underlying "genetic" causes. Second, having said that, probable underlying causes are socioeconomic disadvantages and possibly differentials in access and quality of care. The available data, however, are not really informative in this respect. In consequence, the second-but-last paragraph (starting with "We believe…") should be shorter and less speculative.

Author response 7: We agree with the reviewers about the socially constructed nature of ethnicity and in our original submission we deliberately chose not to discuss biology or genetics because of this. In relation to this point raised by the review, we have added the following to sentence to the discussion to elaborate further in agreement with your suggestion:

"Ethnicity is socially constructed and correlates poorly with biology. Biological differences are therefore highly unlikely to underpin these inequalities."

We believe the paragraph referred to by the authors (starting with "We believe...") provides important and urgent public health actions that should be taken as a precautionary principle to reduce the increased mortality from COVID in BAME communities, and as such we feel it is important to restate them in this discussion. We also note the recent objections to other reports describing the inequalities in health for BAME communities that did not include recommendations such as ours on this precautionary note.

Minor technical issue: Some journals require reporting of confidence intervals and p-values (the latter are not reported in Table 1).

Author response 8: As suggested, we have added p-values to our updated Table 1.

Competing Interests: No competing interests were disclosed.

Reviewer Report 20 May 2020

https://doi.org/10.21956/wellcomeopenres.17464.r38664

? **Matthew Wallace** [iD]

Demography Unit, Department of Sociology, Stockholm University, Stockholm, Sweden

Summary: This article investigates variation in the risk of death from COVID-19 across ethnic minority groups in England using *National Health Service (NHS)* data from the beginning of March to the end of April 2020. The authors produced standardized mortality ratios adjusted for age, followed by age and geographical region, to contribute new findings on the COVID-19 pandemic. The findings have public health implications and should be of interest to a wide range of audiences including the general public, other researchers, and decision makers in the United Kingdom and beyond.

Main finding: the authors document an elevated risk of death from COVID-19 among Black African, Black Caribbean, Pakistani, Bangladeshi and Indian ethnic minority groups. This elevated risk of death persists after adjusting for age and geographical regions.

Comments: the limitations of this research (which are almost exclusively data-related) are well-covered in the main text and the authors are transparent about these issues. Nevertheless, I have some suggestions and clarifications.

First, given the number of caveats in the study, the authors should qualify their 'conclusion' part of the abstract to make clear that there are limitations in the article for those who, say, only read the abstract (of which there are more than we would like to believe).

Second, the authors tell us that biological sex is not available but they do not go on to elaborate upon the possible consequences of its absence. Some (short) discussion around this would be welcome in light of evidence that men are more susceptible to COVID-19.

Third, the study lacks adjustment for confounding factors such as SEP (socioeconomic position). This is simply because this information is not available with the data at hand. To offset this, the authors provide a welcome discussion of these SEP factors and how they likely vary across the different ethnic groups in England. I suspect that the sizable role that region plays in attenuating, but not eliminating, the excess risk of death in some ethnic groups is because this variable captures *some* of the excess that would otherwise be explained by these SEP factors. In any case, given the size of the some of the ethnic-specific SMRs, it is unlikely that further adjusting for SEP factors would fully equalize the substantial differences observed in the SMRs of different ethnic groups (although its presence would be welcome).

Finally, I recommend that the assumptions made in the methods section are revisited more strongly in the discussion section. Notably, the use of denominator data that is nearly a decade old for rapidly expanding ethnic groups (is this likely to results in some over-estimation of death in the fastest-growing groups?), more explicit information on exactly how broad the age groups are (I don't think this is here, but I may have missed it), what the age range is (I don't think I see this anywhere either - is it simply all ages?), clarifying what happened to decedents with missing ethnicity (were they excluded? Combined with Other? Did you calculate the mortality of the missing group to see if the missingness was selective?), and the assumption regarding the proportion of deaths in age groups over regions (could you perhaps have used another cause of death, such as influenza, as a base instead?).

As a final note, I wonder whether Figure 1 would be more easy to interpret if rotated (and even presented as points as opposed to bars - although this is more a personal preference). Currently, it is a little hard to read the labels and pick out specific ethnic groups.

Final reflections: this is an important new study (with, admittedly, several limitations) that showcases some alarming findings that demand further research.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Demography, Population Studies, Geography.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 15 Jun 2020
Robert Aldridge, Institute of Health Informatics, UCL, London, UK

Thanks very much for this helpful review - we appreciate the time you have taken to carefully read and provide constructive feedback on the article. We have tried to address all the points you have raised and below we include your comments alongside in our responses *in bold italics.* We have numbered each of our responses in order that we can cross-reference them across all of the reviews to this article.

******
First, given the number of caveats in the study, the authors should qualify their 'conclusion' part of the abstract to make clear that there are limitations in the article for those who, say, only read the abstract (of which there are more than we would like to believe).

Author response 1: We agree it would be useful to add a summary of the limitations to the abstract and have added the following to the conclusion:

"Our results were limited by the broad age groups, lack of data on deaths outside of NHS settings and denominator data on ethnicity being based on the 2011 census."

Second, the authors tell us that biological sex is not available but they do not go on to elaborate upon the possible consequences of its absence. Some (short) discussion around this would be welcome in light of evidence that men are more susceptible to COVID-19.

Author response 2: To address this point we have added the following to the discussion, which also adds in comments made by the helpful review from Frances Darlington-Pollock:

"There is increasing evidence that men are more likely to die from COVID-19 and therefore our lack of disaggregation by sex could account for some of the remaining differences in SMRs we see between ethnic groups, particularly as those occupations found to be at higher risk include greater numbers of men working in them."

Third, the study lacks adjustment for confounding factors such as SEP (socioeconomic position). This is simply because this information is not available with the data at hand. To offset this, the authors provide a welcome discussion of these SEP factors and how they likely vary across the different ethnic groups in England. I suspect that the sizable role that region plays in attenuating, but not eliminating, the excess risk of death in some ethnic groups is because this variable captures some of the excess that would otherwise be explained by these SEP factors. In any case, given the size of the some of the ethnic-specific SMRs, it is unlikely that further adjusting for SEP factors would fully equalize the substantial differences observed in the SMRs of different ethnic groups (although its presence would be welcome).

Author response 3: We agree with the reviewer on this point and would like to explore it further when data enabling us to do are available.

Finally, I recommend that the assumptions made in the methods section are revisited more strongly in the discussion section. Notably, the use of denominator data that is nearly a decade old for rapidly expanding ethnic groups (is this likely to results in some over-estimation of death in the fastest-growing groups?), more explicit information on exactly how broad the age groups are (I don't think this is here, but I may have missed it), what the age range is (I don't think I see this anywhere either - is it simply all ages?), clarifying what happened to decedents with missing ethnicity (were they excluded? Combined with Other? Did you calculate the mortality of the missing group to see if the missingness was selective?), and the assumption regarding the proportion of deaths in age groups over regions (could you perhaps have used another cause of death, such as influenza, as a base instead?).

Author response 4: We have clarified in the methods section that:

"All ages were used, and age ranges included were 0-19; 20-39;40-59; 60-79 and 80+."

We assumed that decedents with unknown ethnicity had the same ethnicity structure as other decedents.

In the discussion we have added the following which we hope address other points raised:

"Our use of census data from 2011 is likely to result in over-estimation of mortality ratios in minority ethnic groups that have grown the fastest during this time period."

Given the differing seasonal variation in influenza, and substantially different infection fatality ratios we are not sure that using this as a base instead would be helpful.

As a final note, I wonder whether Figure 1 would be more easy to interpret if rotated (and

even presented as points as opposed to bars - although this is more a personal preference). Currently, it is a little hard to read the labels and pick out specific ethnic groups.

Author response 5: In the updated manuscript we've tried to increase the label size and also increase the image quality to make the image easier to read.

Final reflections: this is an important new study (with, admittedly, several limitations) that showcases some alarming findings that demand further research.

Competing Interests: No competing interests were disclosed.

Comments on this article

Version 1

Reader Comment 10 Jun 2020

Steve Follmer, None., USA

Can we look at gender. Alone. And by race.

Competing Interests: None.

Reader Comment 07 May 2020

Mairianna Clyde, Open University, Edinburgh, UK

Is there a connection with Vitamin D? Are BAME people dying in comparable numbers in parts of the world which receive more sunshine than UK?

Competing Interests: No competing interests were disclosed.