

LETTER TO THE EDITOR

# Body mass index and the risk of COVID-19 across ethnic groups: Analysis of UK Biobank

To the Editor:

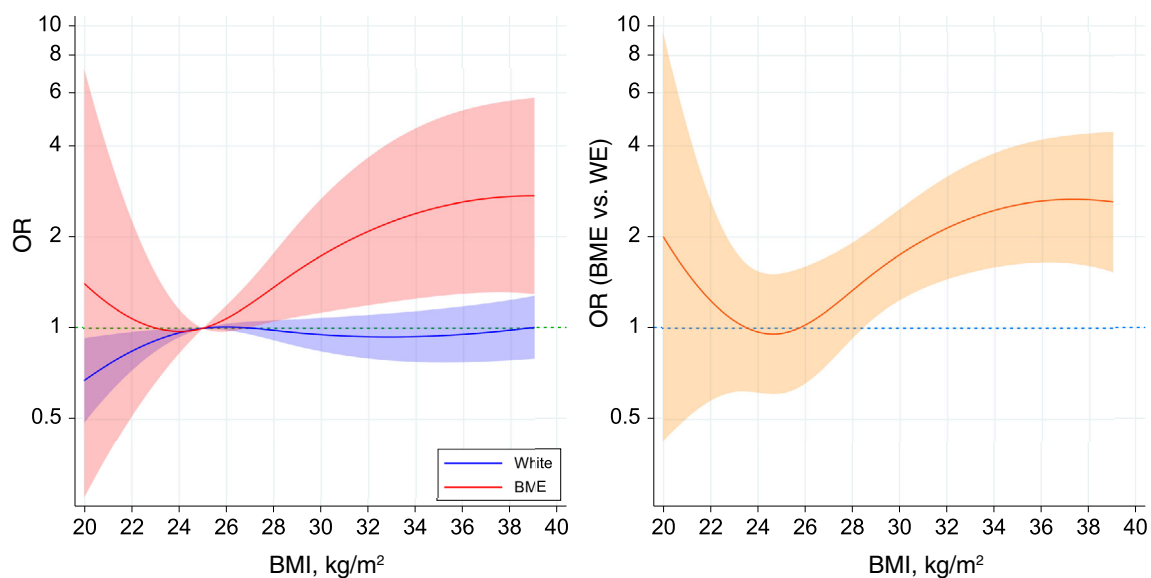
Coronavirus disease-2019 (COVID-19), an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2 virus), has devastated global economies and put unprecedented strain on clinical services. Emerging evidence has suggested that black and minority ethnic (BME) groups, particularly South Asian (SA) and black African or Caribbean (BAC) populations, are at an increased risk of COVID-19 and resulting complications.<sup>1</sup> Obesity is also associated with a higher risk of testing positive for, and dying from, COVID-19.<sup>1,2</sup> However, the interaction between ethnicity and obesity on the risk of COVID-19 has not been tested. As ethnicity is known to modify the association between body mass index (BMI) and cardiometabolic health,<sup>3,4</sup> we hypothesise that BMI also acts to modify the relative risk of COVID-19 across ethnic groups.

We used UK Biobank, a large prospective cohort of 502 543 individuals with baseline assessments conducted from March 2006 to July 2010.<sup>5</sup> UK Biobank data were linked to national COVID-19 laboratory test data through Public Health England.<sup>6</sup> Data were available for the period from 16 March to 14 June 2020.

We undertook an adjusted logistic regression to (a) quantify the association of BMI with the risk of a positive test for COVID-19, stratified by ethnic group, and (b) investigate whether the odds of COVID-19 in BME (SA and BAC) individuals relative to white Europeans (WEs) varied by BMI level. Non-linear interactions were investigated using restricted cubic splines with knots placed at the 33th and 66th centile of BMI distribution. Models were adjusted for potential confounders (Figure 1) and the interaction was formally assessed using the likelihood ratio test.

There were 5623 unique test results available (WE: 5352; BME: 271), of which 1087 (19.3%) were positive (WE: 1000 [18.7%]; BME: 87 [32.1%]). WE individuals with test data had a median (IQR) age of 71.3 (62.3, 76.1) years, a BMI of 27.6 (24.8, 30.9) kg/m<sup>2</sup> and 2650 (49.5%) were women. Comparatively, BME individuals were 64.8 (57.9, 73.2) years old, had a BMI of 28.2 (25.2, 33.1) kg/m<sup>2</sup> and 136 (50.2%) were women. The majority of the BME population (83%) were first-generation migrants to the UK.

BMI was associated with the risk of a positive test for COVID-19 in both BME and WE individuals. However, the dose response association



**FIGURE 1** Association of body mass index (BMI) with confirmed COVID-19 in white European (WE) and black and minority ethnic (BME) individuals. Odds ratio (OR) for COVID-19 with BMI stratified by BME and WE groups (left) and in BME relative to WE (right). Reference (OR 1) were placed at BMI of 25 kg/m<sup>2</sup>. OR (lines) and confidence intervals (CI; areas) are plotted across continuous BMI values (x axes) between the 2.5th (20 kg/m<sup>2</sup>) and 97.5th (39 kg/m<sup>2</sup>) centile of the distribution. Shaded area as 95% CI. Analysis adjusted for: age at test, sex, social deprivation (Townsend score), smoking status, cancer illnesses (number) and non-cancer illnesses (number), systolic blood pressure, HDL-cholesterol, total cholesterol and HbA1c

differed by ethnic group ( $P$  for interaction = .05) (Figure 1): in WE individuals, there was no additional higher risk of COVID-19 beyond a BMI of 25 kg/m<sup>2</sup>, whereas in BME individuals the risk was greater for higher BMI values. Greater risk of COVID-19 in BME individuals relative to WEs was only apparent at higher BMI values (Figure 1). For example, at a BMI value of 25 kg/m<sup>2</sup>, there was no difference in risk (OR = 0.96; 95% CI: 0.61, 1.52), whereas at a BMI of 30 or 35 kg/m<sup>2</sup>, the odds of COVID-19 were 1.75 (1.24, 2.48) and 2.56 (1.63, 4.03) higher in BME individuals relative to WEs, respectively.

Although limited by non-random testing for COVID-19 within the UK, these data suggest that the association between BMI and the risk of COVID-19 may vary by ethnicity and act as an important effect modifier for the increased risk of COVID-19 in BME populations. These results suggest that the combination of obesity and BME status may place individuals at a particularly high risk of contracting COVID-19, consistent with findings for associations of BMI and ethnicity with cardiometabolic dysfunction.<sup>3,4</sup>

## ACKNOWLEDGMENTS

This study uses data from UK Biobank under application number 36371. This work was supported by the NIHR Leicester Biomedical Research Centre. The funder/sponsor had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review or approval of the manuscript; and decision to submit the manuscript for publication.

## CONFLICT OF INTEREST



None declared.

## FUNDING INFORMATION

This work was supported by the NIHR Leicester Biomedical Research Centre.

## AUTHOR CONTRIBUTIONS

Concept and design: C.R., T.Y. and K.K. Acquisition, analysis or interpretation of data: all authors. Drafting of the manuscript: C.R. and T.Y. Critical revision of the manuscript for important intellectual content: all authors. Statistical analysis: C.R. and T.Y. Statistical oversight: F.Z. Note that K.K. and T.Y. are joint senior authors.

Cameron Razieh MSc<sup>1,2</sup>   
 Francesco Zaccardi PhD<sup>1,3</sup>  
 Melanie J. Davies PhD<sup>1,2,4</sup>   
 Kamlesh Khunti PhD<sup>1,3,4,5</sup>

Thomas Yates PhD<sup>1,2</sup>

<sup>1</sup>Diabetes Research Centre, University of Leicester, Leicester General Hospital, Leicester, UK

<sup>2</sup>National Institute for Health Research (NIHR) Leicester Biomedical Research Centre (BRC), Leicester General Hospital, Leicester, UK

<sup>3</sup>Leicester Real World Evidence Unit, Diabetes Research Centre, University of Leicester, Leicester, UK

<sup>4</sup>Leicester Diabetes Centre, University Hospitals of Leicester, Leicester General Hospital, Leicester, UK

<sup>5</sup>NIHR Applied Research Collaboration – East Midlands (ARC-EM), Leicester General Hospital, Leicester, UK

## Correspondence

Cameron Razieh, MSc, Diabetes Research Centre, University of Leicester, Leicester General Hospital, Leicester, LE5 4PW, UK.

Email: cr288@le.ac.uk

## Peer Review

The peer review history for this article is available at <https://publons.com/publon/10.1111/dom.14125>

## ORCID

Cameron Razieh  <https://orcid.org/0000-0003-3597-2945>

Melanie J. Davies  <https://orcid.org/0000-0002-9987-9371>

## REFERENCES

1. The OpenSAFELY Collaborative, Williamson E, Walker AJ, Bhaskaran K, et al. OpenSAFELY: factors associated with COVID-19 death in 17 million patients. *Nature*. 2020. <https://doi.org/10.1038/s41586-020-2521-4>
2. Yates T, Razieh C, Zaccardi F, Davies MJ, Khunti K. Obesity and risk of COVID-19: analysis of UKBiobank. *Prim Care Diabetes*. 2020. <https://doi.org/10.1016/j.pcd.2020.05.011>
3. Chiu M, Austin PC, Manuel DG, Shah BR, Tu JV. Deriving ethnic-specific BMI cutoff points for assessing diabetes risk. *Diabetes Care*. 2011;34:1741-1748, 1748.
4. Razak F, Anand S, Vuksan V, et al. Ethnic differences in the relationships between obesity and glucose-metabolic abnormalities: a cross-sectional population-based study. *Int J Obes*. 2005;29(6):656-667.
5. Sudlow C, Gallacher J, Allen N, et al. UKbiobank: an open access resource for identifying the causes of a wide range of complex diseases of middle and old age. *PLoS Med*. 2015;12(3):e1001779.
6. Armstrong A, Rudkin JK, Allen N, et al. Dynamic linkage of COVID-19 test results between Public Health England's Second Generation Surveillance System and UK Biobank. *Microb Genom*. 2020. <https://doi.org/10.1099/mgen.0.000397>