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Body mass index and risk of COVID-19 across ethnic groups: analysis of UK Biobank study

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Coronavirus disease-2019 (COVID-19), an infectious disease caused by the 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 complications¹. Obesity is also associated with a higher risk of testing positive for, and dying from, COVID-19^{1,2}. 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 BMI and cardiometabolic health^{3,4}, 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 between March 2006 and July 2010⁵. UK Biobank data were linked to national COVID-19 laboratory test data through Public Health England (PHE)⁶. Data were available for the period 16th March 2020 to 14th June 2020.

We undertook an adjusted logistic regression to: 1) quantify the association of BMI with the risk of a positive test for COVID-19, stratified by ethnic group, 2) investigate whether the odds of COVID-19 in BME (SA and BAC) individuals relative to white Europeans (WEs) varied by BMI level. Nonlinear 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**) 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, BMI of 27.6 (24.8, 30.9) kg/m², 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/m², 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 differed by ethnic group (p for interaction = 0.05) (**Figure**): in WE individuals, there was no additional higher risk of COVID-19 beyond a BMI of 25 kg/m², 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**). For example, at a BMI value of 25 kg/m², there was no difference in risk (OR = 0.96; 95% CI: 0.61, 1.52), whereas at a BMI of 30 kg/m² or 35 kg/m², 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 particularly high-risk of contracting COVID-19, consistent with findings for associations of BMI and ethnicity with cardiometabolic dysfunction^{3,4}.

We declare no competing interests.

Author Contributions:

Concept and design: C Razieh, T Yates, K Khunti

Acquisition, analysis, or interpretation of data: All authors

Drafting of the manuscript: C Razieh, T Yates

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: C Razieh, T Yates

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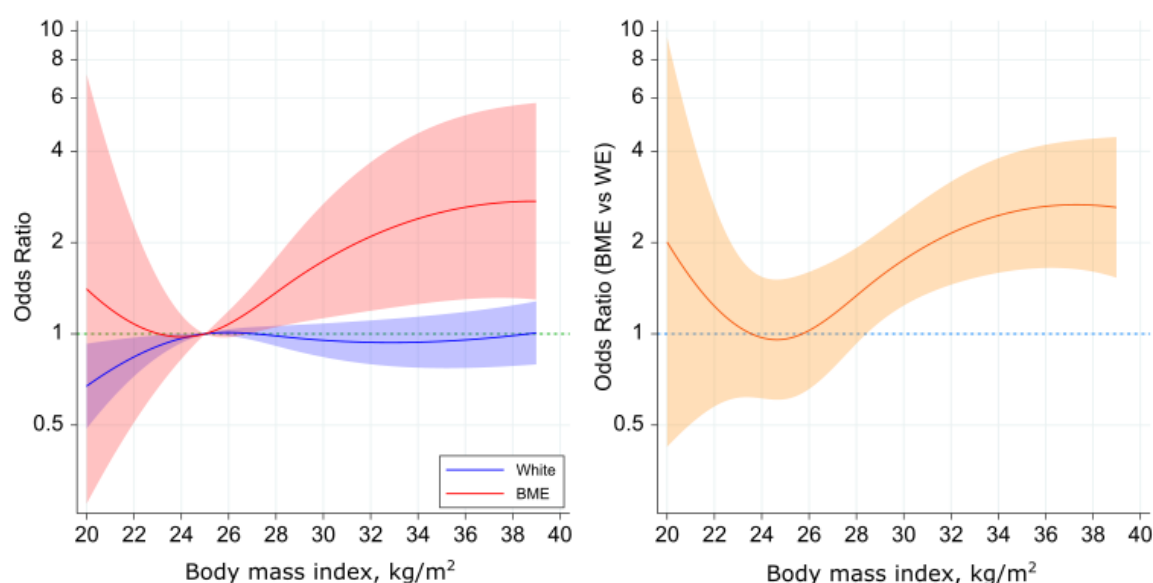
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Figure. Association of BMI with confirmed COVID-19 in white European and BME individuals.



Odds ratio for COVID-19 with BMI stratified by BME and WE groups (left) and in BME relative to WE (right)

Reference (odds ratio 1) were placed at BMI of 25 kg/m². Odds ratios (lines) and confidence intervals (areas) are plotted for across continuous BMI values (x axes) between the 2.5th (20kg/m²) and 97.5th (39kg/m²) 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.