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Ethnic differences in multimorbidity after accounting for social-economic factors, findings from The Health Survey for England

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Background: Social-economic factors and health behaviours may be driving variation in ethnic health inequalities in multimorbidity including among distinct ethnic groups. **Methods:** Using the cross-sectional nationally representative Health Surveys for England 2011–18 ($N = 54\ 438$, aged 16+), we performed multivariable logistic regression on the odds of having general multimorbidity (≥2 longstanding conditions) by ethnicity [British White (reference group), White Irish, Other White, Indian, Pakistani, Bangladeshi, Chinese, African, Caribbean, White mixed, Other Mixed], adjusting for age, sex, education, area deprivation, obesity, smoking status and survey year. This was repeated for cardiovascular multimorbidity ($N = 37\ 148$, aged 40+: having ≥2 of the following: self-reported diabetes, hypertension, heart attack or stroke) and multiple cardiometabolic risk biomarkers (HbA_{1c} ≥6.5%, raised blood pressure, total cholesterol ≥5mmol/L). **Results:** Twenty percent of adults had general multimorbidity. In fully adjusted models, compared with the White British majority, Other White [odds ratio (OR) = 0.63; 95% confidence interval (CI) 0.53–0.74], Chinese (OR = 0.58, 95% CI 0.36–0.93) and African adults (OR = 0.54, 95% CI 0.42–0.69), had lower odds of general multimorbidity. Among adults aged 40+, Pakistani (OR = 1.27, 95% CI 0.97–1.66; $P = 0.080$) and Bangladeshi (OR = 1.75, 95% CI 1.16–2.65) had increased odds, and African adults had decreased odds (OR = 0.63, 95% CI 0.47–0.83) of general multimorbidity. Risk of cardiovascular multimorbidity was higher among Indian (OR = 3.31, 95% CI 2.56–4.28), Pakistani (OR = 3.48, 95% CI 2.52–4.80), Bangladeshi (OR = 3.67, 95% CI 1.98–6.78), African (OR = 1.61, 95% CI 1.05–2.47), Caribbean (OR = 2.18, 95% CI 1.59–2.99) and White mixed (OR = 1.98, 95% CI 1.14–3.44) adults. Indian adults were also at risk of having multiple cardiometabolic risk biomarkers. **Conclusion:** Ethnic inequalities in multimorbidity are independent of social-economic factors. Ethnic minority groups are particularly at risk of cardiovascular multimorbidity, which may be exacerbated by poorer management of cardiometabolic risk requiring further investigation.

Introduction

Multimorbidity is increasing, given an ageing population, affecting individuals' quality of life and increasing mortality.[1,2] Understanding the factors related to different levels of multimorbidity in ethnic groups could be used to prevent harm and reduce ethnic inequalities. Non-White ethnic groups were disproportionately affected by coronavirus disease 2019 (COVID-19), with multimorbidity potentially being one contributing factor. It was found that compared with the White population, non-White ethnicities with multimorbidity had almost triple the risk of having COVID-19.[3]

Ethnic health inequalities in multimorbidity, including cardiovascular multimorbidity, exist.[4–9] A study in East London found the Black and South Asian population had higher rates of cardiovascular multimorbidity than the White majority.[4] Studies of ethnic health inequalities in multimorbidity in England often use General Practitioner records, which may not reflect differences in a national population sample.[4,5] Furthermore, studies in England have not comprehensively explored what may be accounting for some of the health differences, such as socioeconomic differences. Deprivation and lower socioeconomic status could increase the risk of multimorbidity.[6–8,10–12] Behavioural risk factors could also confound the relationship. Smoking and obesity were found to be risk factors for multimorbidity,[7,10,13] and may have a stronger effect than deprivation and ethnicity.[7,13] Smoking and obesity were found to vary by ethnicity in The Health Survey for England (HSE) 2011–19.[14]

Furthermore, broad ethnic groups such as 'South Asian' and 'Black' may mask heterogeneity within groups, for example among Indian vs. Pakistani/Bangladeshi, and Black African vs. Black Caribbean groups.[15] The aims of this study were to examine how the risk of multimorbidity including cardiovascular multimorbidity varied among distinct ethnic groups, and whether this relationship was explained by differences in social-economic status or behavioural risk factors for cardiovascular diseases, namely smoking and obesity.

Methods

Data sources

The HSE is a cross-sectional, nationally representative survey of the population occurring annually. Data are collected via new multistage stratified probability sampling each year, as described elsewhere.[16] The two-stage sampling from the small user Postcode Address File yields a nationally representative, random sample of private residences. This study uses data spanning from 2011 to 2018, to maximize the number of participants from different ethnic groups. An initial

letter was sent to each selected address, followed by a visit from a trained interviewer, who collected self-reported data using computer-assisted personal interviewing. All household residents aged 16+ (and a random sample of children) were eligible, provided they had the mental capacity and sufficient English to give informed consent and understand and respond to questions. The interviewers also measured height and weight. At the second stage, further biophysical measurements were collected at a nurse visit using standard protocols.[17] All data collection took place within participants' homes. Response rates have gradually declined over the period, e.g. from 59% in 2011 to 54% in 2018 for the face-to-face interview. NHS Research Ethics Committee approval was obtained prior to the commencement of each year's survey.

General and cardiovascular multimorbidity

This study examines ethnic group differences in two types of multimorbidity: general multimorbidity and cardiovascular multimorbidity, using the information provided by participants at the interview stage. General multimorbidity was derived through self-reported responses to a question on longstanding conditions: whether the participant had any longstanding physical or mental health conditions or illnesses expected to last over a period of time (2011) or 12 months or more (2012–18). Participants were then asked to list up to six conditions that affected them. We derived a summary variable to indicate the number of longstanding conditions (none/one/two or more). Participants having two or more longstanding conditions were classified as having general multimorbidity.

Self-reported doctor-diagnosed cardiovascular multimorbidity was defined as having two or more of the following conditions: reporting having doctor-diagnosed diabetes or high blood pressure (in response to specific questions on whether participants were ever told by a doctor they had diabetes/high blood pressure) or reporting stroke or heart disease when responding to the aforementioned follow-up question to the longstanding illness question. We included doctor-diagnosed hypertension following the example of Mathur et al.,[4] although other definitions of cardiovascular multimorbidity do not include hypertension.[18]

Multiple cardiometabolic risk biomarkers

Using objective health examination measures, we also examined differences by ethnicity in multiple cardiometabolic risk biomarkers. Cardiometabolic biomarkers were treated separately from doctor-diagnosed conditions (cardiovascular multimorbidity) to identify uncontrolled risk factors. Having multiple cardiometabolic risk biomarkers was defined as two or more of the following: raised glycated haemoglobin (HbA_{1c} levels $\geq$6.5%); raised blood pressure (systolic blood pressure $\geq$140 mmHg and/or diastolic blood pressure $\geq$90 mmHg); and/or raised total cholesterol level ($\geq$5 mmol/L), suggesting uncontrolled risk factors or diseases such as diabetes or hypertension. Glycated haemoglobin and cholesterol levels were taken from non-fasting blood samples collected from participants during the nurse visit and sent to the Newcastle Universities Hospitals laboratory for the analyses. Blood pressure readings were taken three times by a nurse using an Omron HEM207 digital monitor following a standardized protocol. The mean of the second and third blood pressure readings were used in these analyses. Those who had eaten, smoked or drank alcohol 30 min prior to the readings were excluded. Further details on data collection during the nurse visit have been published elsewhere.[15]

Ethnicity and other covariates

Ethnicity was self-reported at the main interview and grouped in the following way: White British, White Irish, Other White, Indian, Pakistani, Bangladeshi, Chinese, African, Caribbean, White mixed, Other Mixed, Other.

Other covariates included the Index of Multiple Deprivation, a standard measure of area deprivation covering different social and economic dimensions, assigned based on participants' residence,[17] grouped into quintiles. Highest educational qualification was self-reported and grouped into degree or higher; lower than degree; no qualifications. Self-reported smoking status was grouped into never, former and current smokers. Body mass index (BMI) categories were based on height and weight measurements of the participants performed by the trained interviewer at the main interview using a portable stadiometer with a sliding head plate and class III electronic scales. Detailed information on the collection can be found elsewhere.[17]

Statistical analyses

Complete case analyses were used and the sample was limited to (i) adults aged 16+ for general multimorbidity ($N = 54\,438$), (ii) adults aged 40+ for self-reported cardiovascular multimorbidity ($N = 37\,148$) and (iii) adults aged 16+ with biological measurements for multiple cardiometabolic biological risk factors ($N = 24\,203$). The complete case approach resulted in a reduction in sample size of around 17.5%; this was predominately driven by missing data for BMI, which required physical measurements of height and weight (17.0%). Few participants (<0.5%) had missing responses on key variables: general multimorbidity ($n = 46$), cardiovascular multimorbidity ($n = 7$) and ethnicity ($n = 220$). Missing data on biomarkers were high due to not all the participants providing blood samples (59.8%). We accounted for group differences in non-response by using the weighting variables, specific to non-response at the interview or blood sample stage. The complex survey design (geographical clustering of participants) was accounted for in all analyses.

Characteristics of ethnic groups were explored and the chi-squared statistic was used to test for bivariate associations. Logistic regression was carried out on the odds of having multimorbidity for each of the three definitions of multimorbidity. Since longstanding conditions are broader, and multimorbidity is not restricted to older participants,[8,19] analyses of general multimorbidity focused on all adults. However, we also stratify results by age (aged under 40, and 40 and over). A cut-off of age 40 has been used in other large-scale studies,[20] and sample sizes among some of the ethnic groups were too small if limiting to an older sample (e.g. <100 if based on adults aged 65 and over).

To explore whether the relationship between ethnicity and multimorbidity may be confounded by social-economic status or behavioural risk factors, variables were added in the following way, with changes in odds ratios examined to explore the effect of adjusting for each additional potential confounder:

Model 1: Sex + age in years
Model 2: Model 1 + area deprivation
Model 3: Model 1 + educational qualifications
Model 4: Model 1 + smoking status
Model 5: Model 1 + BMI category
Model 6: All covariates + survey year

As a sensitivity analysis, we replicated the final models on a sample including participants without BMI measurements (without adjusting for BMI), resulting in fewer missing cases (1%). Analyses were conducted in Stata 17.[21]

Results

There were variations among ethnic groups across all variables including age, education, area deprivation, smoking status, BMI categories, and both general and cardiovascular multimorbidity ($P < 0.001$). Chinese, Indian and Other White adults had the highest proportion of adults with the highest educational qualifications (53–44%), whereas Bangladeshi, White Irish, Pakistani and Caribbean had the highest proportions with no qualifications (29–25%) (table 1). Over two-fifths of adults in the Bangladeshi, Pakistani, African and Caribbean groups lived in the most deprived areas; this proportion was lowest for White British adults (15%).

Table 1 Characteristics of ethnic groups (column %), Health Survey for England 2011–18

	White British	White Irish	Other White	Indian	Pakistani	Bangladeshi	Chinese	African	Caribbean	White Mixed	Other Mixed	Other	Total	*P* value
Sample size (*N*)	44 922	440	2876	1382	859	368	278	804	496	477	268	1268	54 438	
Mean age (years)	48.8	53.4	37.6	40.6	36.8	36.5	36.2	37.3	48.6	34.1	38.8	39.8	46.8	
Standard deviation	19	17.2	12.5	14.1	13	12.4	13.9	13.1	17.4	13.4	14	14.6	18.5	
Female	50	47	52	48	50	49	53	52	56	49	51	51	50	0.103
Highest educational qualification														
Degree or higher	25	39	44	45	29	26	53	37	23	31	40	41	28	
Lower than degree	57	33	32	38	45	45	32	48	52	54	51	43	53	
No qualifications	18	28	25	17	26	29	14	15	25	15	10	17	19	<0.001
Index of multiple deprivation														
Least deprived	23	18	13	15	5	3	19	5	8	12	11	13	20	
2nd	23	15	16	17	7	7	15	9	7	16	18	16	21	
3rd	22	20	20	20	11	8	24	12	14	17	24	17	21	
4th	18	26	27	25	29	26	27	31	28	25	27	25	20	
Most deprived	15	21	24	23	49	56	15	43	43	30	20	29	19	<0.001
Smoking status														
Current smoker	19	20	27	8	15	18	10	7	21	29	17	12	19	
Ex-smoker	27	34	22	8	8	8	7	8	18	17	17	12	25	
Never smoker	54	47	52	84	77	74	83	85	61	54	67	76	57	<0.001
BMI category														
Not overweight	36	38	48	44	36	44	74	36	29	46	44	43	38	
Overweight	37	35	33	38	37	42	22	33	32	31	35	35	36	
Obese	27	27	20	18	27	15	3	31	39	23	21	22	26	<0.001
Number of longstanding conditions														
None	58	57	76	70	71	67	86	77	55	68	72	71	61	
One	21	17	14	17	15	16	7	14	22	17	15	16	20	
Two or more	22	25	10	13	15	17	7	9	24	15	13	13	20	<0.001
Number of longstanding conditions (aged 40 and over, $N = 37\,135$)														
None	49	50	63	55	53	49	79	67	46	51	64	56	51	
One	23	20	17	22	19	18	10	17	24	24	16	23	22	
Two or more	28	31	20	23	29	33	12	16	30	25	20	21	27	<0.001
Number of cardiovascular conditions (aged 40 and over, $N = 37\,148$)[a]														
None	62	59	75	62	62	64	81	64	51	69	67	65	63	
One	31	32	21	26	23	22	15	28	33	22	29	26	30	
Two or more	7	9	4	12	15	15	4	7	16	9	4	9	7	<0.001
Cardiometabolic risk biomarkers (aged 16 and over with blood samples, $N = 24\,203$)[b]														
None	38	31	53	44	44	45	58	53	36	56	54	47	40	
One	47	52	40	42	48	47	35	38	45	39	39	43	46	
Two or more	14	17	7	15	8	9	7	10	19	6	7	10	14	<0.001

a: Doctor-diagnosed hypertension, diabetes or self-reported stroke or heart attack.
b: Raised blood pressure, raised glycated haemoglobin or raised total cholesterol.

Obesity was highest among Caribbean and African adults (39–31%); and was lowest among Chinese, Bangladeshi and Indian adults (3–18%). The proportion of never smoking was highest among African, Indian, Chinese, Pakistani and Bangladeshi adults (85–74%) and was lowest among White Irish, White and White mixed adults (47–54%).

20% of all adults had general multimorbidity (27% of adults aged 40+); this was higher among White Irish and Caribbean adults (24% and 25%, respectively), and lowest among Chinese and African adults (7% and 9%) (Supplementary table S1). 7% of adults aged 40+ had cardiovascular multimorbidity. This was highest among Caribbean, Pakistani and Bangladeshi adults (15%) and lowest among Chinese and Other White adults (4%).

Among those aged 40+ with cardiovascular multimorbidity, the combination of diabetes and hypertension was the most common dyad (70%) followed by hypertension and stroke or heart attack (12%) (Supplementary figure S1). 14% of adults aged 16+ had multiple cardiometabolic risk biomarkers; this varied by ethnicity, being highest among White Irish, Caribbean and Indian adults (15–19%). This largely comprised the combination of raised blood pressure and raised total cholesterol (76%), followed by raised total cholesterol and raised glycated haemoglobin (9%).

Those with general multimorbidity were more likely to have no qualifications than those with no longstanding conditions, lived in the most deprived areas, were obese or were a current or former smoker ($P < 0.001$) (Supplementary table S1). Among those classified as having cardiovascular multimorbidity (aged 40+), 73% were classified as having general multimorbidity ($P < 0.001$). The prevalence of general multimorbidity increased steadily over the period, from 18% in 2011 to 22% in 2018 ($P < 0.001$).

In age-sex adjusted models, compared with White British adults, Other White [odds ratio (OR) = 0.66, 95% confidence interval (CI) 0.57–0.77], Indian (0.78, 95% CI 0.65–0.93), Chinese (0.42, 95% CI 0.26–0.68), African (0.63, 95% CI 0.50–0.80) and other adults (0.76, 95% CI 0.63–0.91) had lower odds of general multimorbidity. The odds for other ethnic groups were not statistically significant although Bangladeshi adults had higher odds (1.34, 95% CI 0.98–1.84, $P = 0.069$) (figure 1, Supplementary table S2). In fully adjusted models, the results remained significant only for Other White (0.63, 95% CI 0.53–0.74), Chinese (0.58, 95% CI 0.36–0.93) and African adults (0.54, 95% CI 0.42–0.69).

In models adjusting for single additional covariates, significant effect sizes of reduced risk were strengthened after adjusting for area deprivation, while adjusting for current smoking status reduced effect sizes. Bangladeshi adults had higher odds of general multimorbidity after adjusting for smoking status or BMI status; however, this association was not significant after fully adjusting for all covariates.

Among adults aged under 40, in fully adjusted models, African (0.37, 95% CI 0.21–0.62), Indian (0.37, 95% CI 0.24–0.57), Other White (0.41, 95% CI 0.29–0.58), Pakistani (0.51, 95% CI 0.32–0.78) and Other adults (0.50, 95% CI 0.34–0.75), had reduced odds of general multimorbidity compared with White British adults

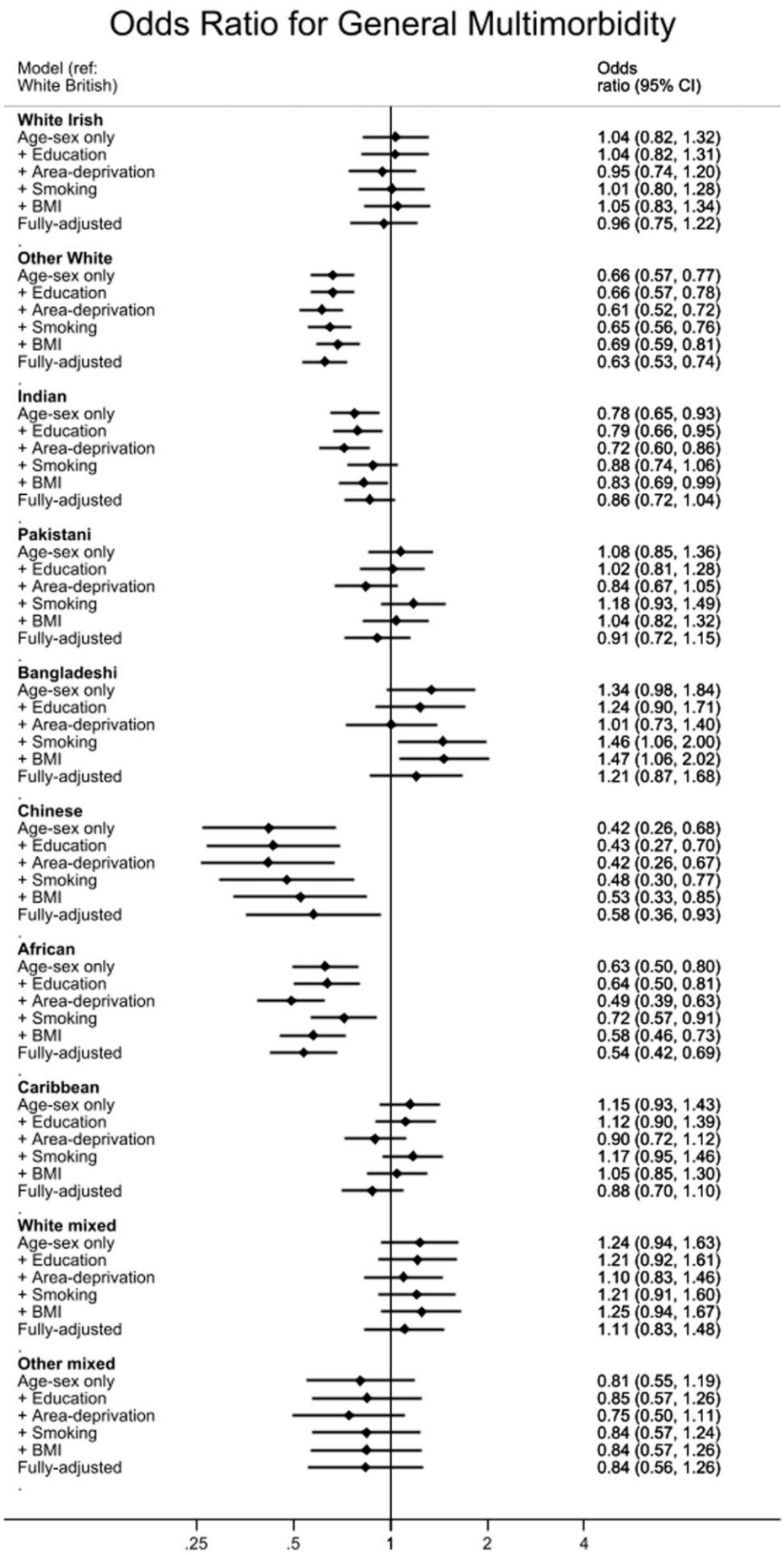

Figure 1 General multimorbidity

(Supplementary table S3). Among adults aged 40 and over in fully adjusted models (Supplementary table S4), compared with White British adults, Bangladeshi (1.27, 95% CI 0.97–1.66, $P = 0.080$) and Pakistani adults (1.75, 95% CI 1.16–2.65) had higher odds of having general multimorbidity, whereas Other White (0.81, 95% CI 0.68–0.96), Chinese adults (0.62, 95% CI 0.36–1.07, $P = 0.086$) and African adults had lower odds (0.63, 95% CI 0.47–0.83).

Figure 2 (Supplementary table S5) presents ORs for cardiovascular multimorbidity among adults aged 40+. In age-sex adjusted models, compared with White British adults, Pakistani (4.01, 95% CI 2.94–5.46), Bangladeshi (3.73, 95% CI 2.15–6.47), Caribbean (2.93, 95% CI 2.15–3.98), Indian (2.52, 95% CI 1.97–3.24), White mixed (2.23, 95% CI 1.32–3.76), Other (1.93, 95% CI 1.46–2.54) and African adults (1.86, 95% CI 1.23–2.81) had higher odds of having cardiovascular multimorbidity. In fully adjusted models, the relationship remained significant for all ethnicities. The effect sizes were attenuated for Caribbean (2.18, 95% CI 1.58–2.99), African (1.61, 95% CI 1.05–2.47), Pakistani (3.48, 95% CI 2.52–4.80), White mixed (1.98, 95% CI 1.14–3.44) and Bangladeshi (3.67, 95% CI 1.98–6.78) adults and strengthened for Indian (3.31, 95% CI 2.56–4.28) and Other adults (2.12, 95% CI 1.60–2.82).

Broadly, introducing area deprivation reduced effect sizes for all significant effects, whereas adjusting for smoking strengthened the effects (with the exception of White mixed adults). Adjusting for BMI status had a differential effect, slightly attenuating effect sizes for African and Caribbean adults while strengthening effect sizes for Bangladeshi, Indian, Other Mixed and Pakistani adults.

In age-sex adjusted models, among adults aged 16+, compared with White British adults, Indian (1.54, 95% CI 1.17–2.03) and Caribbean adults (1.46, 95% CI 0.98–2.19, $P = 0.064$) had greater odds of multiple risk biomarkers (figure 3). In fully adjusted models, the results were strengthened for Indian adults (1.81, 95% CI 1.36–2.41) and were no longer significant for Caribbean adults.

When based on a larger sample (not restricted to those with BMI measurements), statistically significant results were apparent for similar ethnic groups in the same direction (Supplementary table S5). Additionally, Indian adults had lower odds of general multimorbidity (0.78, 95% CI 0.66–0.91) and Caribbean adults had increased odds of multiple risk biomarkers (1.47, 95% CI 1.01–2.14).

Discussion

Ethnic inequalities in multimorbidity differ for general and cardiovascular multimorbidity, vary with age and are independent of social-economic factors, obesity and smoking. Ethnic minority groups (Indian, Pakistani, Bangladeshi, African, Caribbean, White mixed) were particularly at risk of cardiovascular multimorbidity, with Indian adults also having a greater risk of multiple cardiometabolic risk biomarkers.

General multimorbidity varied with age among ethnic groups, with the risk being greater among the British White population aged under 40, and greater among ethnic minorities (Pakistani and Bangladeshi) aged 40 and over. Similar age-related differences in patterns of multimorbidity by ethnicity were also found in a recent study, where a lower prevalence of multiple long-term conditions was found among younger ethnic groups compared with the White majority, based on data from primary care records.[22] A greater risk of cardiovascular multimorbidity, but not general multimorbidity, among ethnic groups suggests a higher prevalence of non-cardiovascular longstanding conditions among the White population and/or variations in reporting or in being diagnosed among ethnic groups. Chinese and Asian Indian adults were less likely to report having multimorbidity in the USA according to a study by Zhang et al.; however, they were more likely to have a combination of high cholesterol and hypertension, risk factors for CVD consistent with our study.[9] Cultural barriers or differences in considering what constitutes a long-term condition could be a possible explanation for the discrepancy, which requires further investigation. In this study, among those who had cardiovascular multimorbidity, around one in four did not report having general multimorbidity, indicating a discrepancy between definitions, supporting this theory. Healthier ethnic minorities and subsequently lower levels of multimorbidity, compared with the British White majority, could also be due to a 'healthy migrant effect': the theory that migrants have a better health status particularly at migration, than the majority population.[23] In our study, African, Chinese, Other White and Indian adults (<40 years) had a lower risk of general multimorbidity. Likewise, similar groups were found to be less likely than the majority White population to report poorer self-rated health in a different study by Mindell et al. using the HSE,[15] further highlighting the need to separate these distinct ethnic groups.

Despite the reduced risk of general multimorbidity for some ethnic groups, Indian and African adults and other ethnic groups (Pakistani, Bangladeshi, Caribbean and White mixed), were at increased risk of cardiovascular multimorbidity, consistent with the study by Mathur et al. which found the South Asian and Black populations to have the highest rates of cardiovascular multimorbidity in East London.[4] It is established that ethnic minorities have greater cardiometabolic risk factors.[24] In particular, South Asian and Black adults are more likely to have hypertension and type 2 diabetes.[23–26] Moreover, for the South Asian population, the risks of type 2 diabetes and dyslipidaemia are apparent at lower levels of BMI compared with the White population.[24] We too found Indian and Bangladeshi adults to be at greater risk of cardiometabolic multimorbidity despite having lower levels of obesity than the average in this study. The exact mechanisms behind the differences in risk among ethnicities are not fully understood but are likely due to a complex interplay between genetics and environmental factors.[24]

The association between ethnicity and multimorbidity remained after adjusting for socioeconomic factors, obesity and smoking, suggesting ethnicity to be an independent risk factor for general and cardiovascular multimorbidity. Other studies which adjust for socioeconomic factors have found the greater risk of multimorbidity for ethnic minorities remains,[6,8] or even strengthens, when based on a younger sample.[8] In our models, adjusting for area deprivation and education tended to reduce the effect, whereas adjustment for smoking and obesity tended to strengthen the effect. In general, after full adjustment, the net effect was a slight reduction in risk, although the Indian population was an exception with a slightly stronger effect after full adjustment, suggesting that the risk for the Indian population is greater despite lower levels of smoking and obesity, and higher levels of educational attainment, which requires further investigation.

Multiple cardiometabolic risk biomarkers exceeding recommended targets, particularly among Indian and Caribbean adults, would increase the risk of cardiovascular multimorbidity. Exceeding targets could be exacerbated by poorer management. For example, data from inner-city London boroughs found poorer blood pressure control rates among Black and South Asian adults with chronic conditions.[27,28] Ethnic minority groups may face barriers to treatment or health-seeking behaviours. Difficulties with healthcare access are well-recognized.[5] Discrimination, which we were unable to account for, was found to be a risk factor for multimorbidity in the USA[29] and for metabolic syndrome in the Netherlands.[30]

Strengths and limitations

Strengths of this study include the use of a nationally representative sample in England, where studies based on GP records may only capture people in contact with health services,[5] and studies using a selective sample of volunteers may generate conservative prevalence estimates of multimorbidity.[20] Furthermore, we were able to separate out distinct ethnic groups where differences were found especially in terms of general multimorbidity.

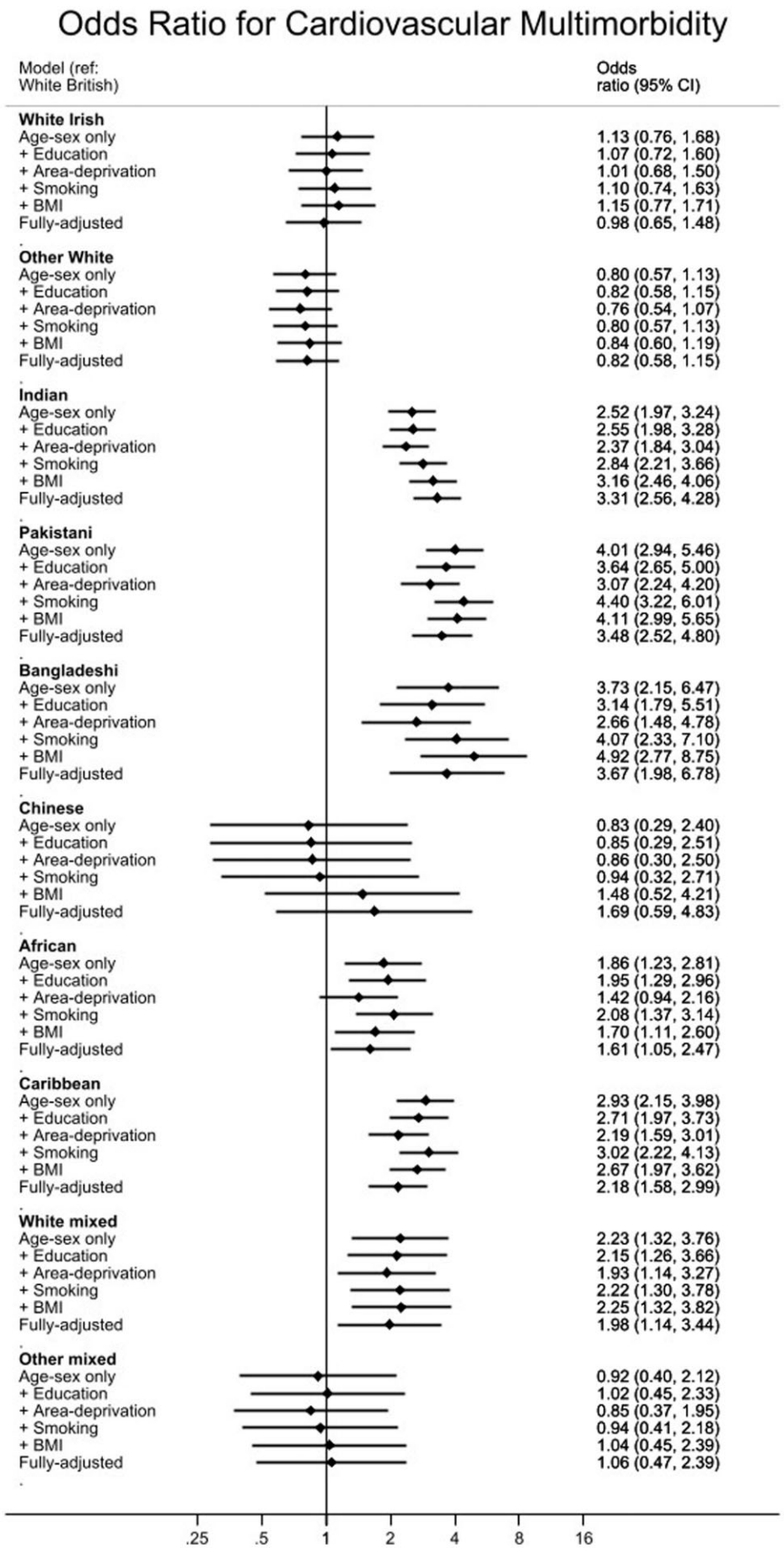

Figure 2 Cardiovascular multimorbidity

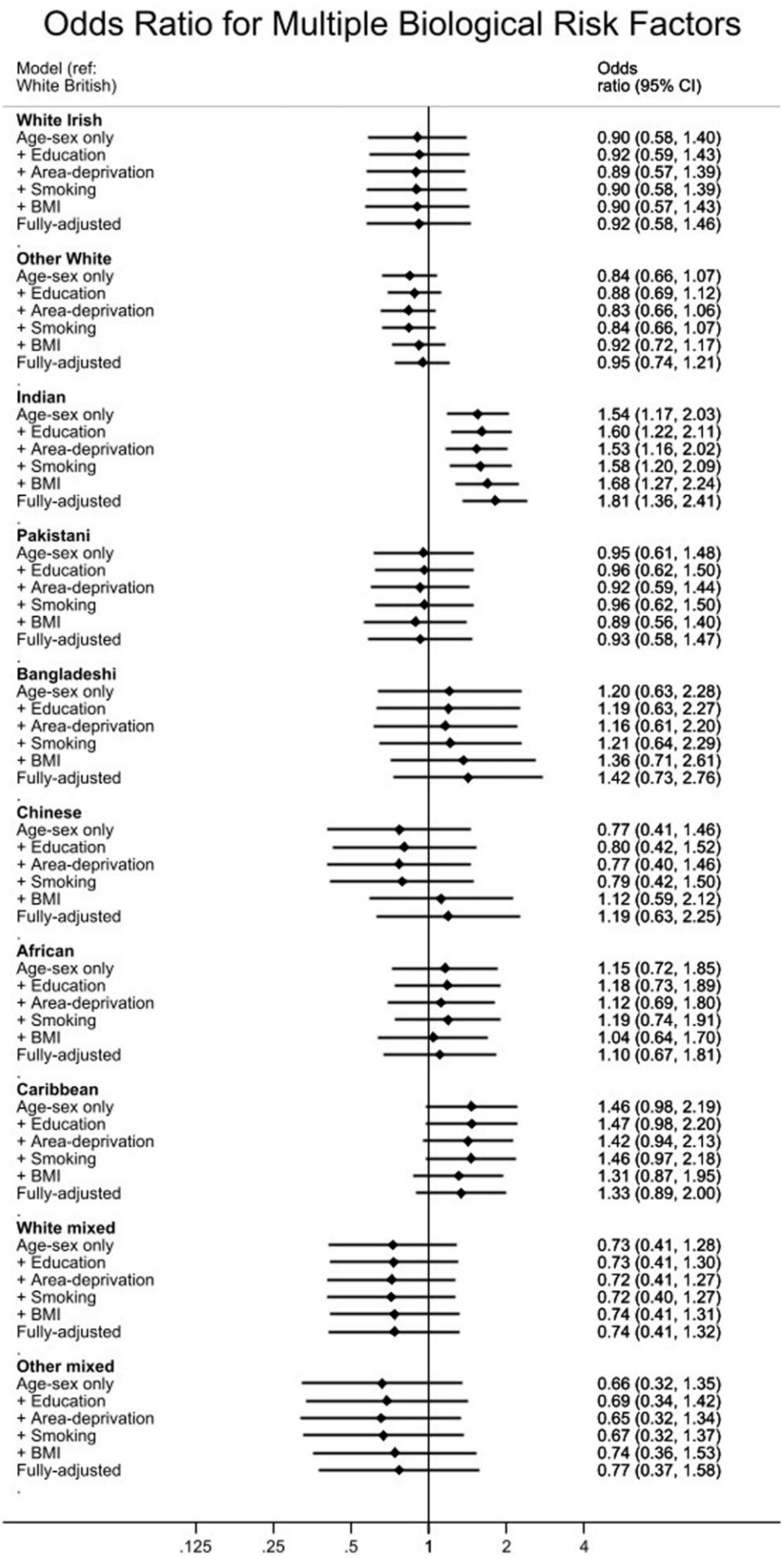

Figure 3 Multiple cardiometabolic risk biomarkers

There are many limitations to this study. Even though eight years of annual data were pooled, sample sizes within distinct ethnic minorities were still relatively small. Consequently, except for cardiovascular multimorbidity, combinations of conditions could not be explored in detail and we were unable to stratify analyses by smaller age groups. We could not adjust for important covariates, such as foreign-born status, which could have suggested a healthy migrant effect, as the question was not asked in the survey years assessed. Furthermore, diet, physical activity, and mental health were not accounted for due to a lack of consistency in data being collected in all years. The extent to which culture, including influences on diet, affects multimorbidity risk could also not be assessed.

There is no agreed definition of multimorbidity, and the conditions listed by participants did not include conditions that may be counted in the definition elsewhere, such as alcohol problems,[12] which makes comparing prevalence rates across studies challenging. Finally, our study was cross-sectional therefore we cannot determine the temporal order of events between variables such as deprivation and multimorbidity. However, we believe the use of a nationally representative sample and the ability to assess distinct ethnic groups offset this limitation, where research on ethnicity and multimorbidity is lacking.

Ethnic inequalities in multimorbidity vary between older and younger adults, distinct ethnic groups, and are independent of social-economic status, smoking and obesity. Several ethnic minority groups among the South Asian and Black ethnic groups are at risk of cardiovascular multimorbidity. Further research is needed to explore the exact mechanisms behind these variations including research studies using longitudinal data.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Author contribution

LNF designed and conceived the idea of the study, conducted analyses and drafted the manuscript. PP, JM, LM, SS advised on analyses, and contributed to revisions of the manuscript and approved the final version.

Conflicts of interest: None declared.

Ethical approval

Ethical approval was obtained from the following Research Ethics Committees (REC): HSE 2011 and 2012: Oxford A REC: 10/H0604/56; HSE 2013 and 2014: Oxford A REC: 12/sc/0317; HSE 2015: West London NRES Committee: 14/LO/0862; HSE 2016: Nottingham REC: 15/EE/0299, HSE 2017: East of England Research Ethics Committee (Reference no 15/EE/0229), HSE 2018: East Midlands Nottingham 2 Research Ethics Committee (Reference no. 15/EM/0254). Ethical approval was obtained ahead of data collection, no further ethical approval is needed for secondary analyses.

Data availability

The Health Survey for England is available to UK Academic Institutions from the UK Data Archive subject to their end-user licence. This study utilised a dataset used for the Health Survey for England report on ethnicity, which the authors were funded to produce.

Key points

- Ethnic inequalities in multimorbidity in a nationally representative sample in England vary between older and younger adults, distinct ethnic groups, and are independent of socioeconomic status, smoking and obesity.
- African, Caribbean, Bangladeshi, Indian, Pakistani and White mixed adults aged 40 and over had higher risk of self-reported cardiovascular multimorbidity compared with British White adults.
- Indian adults were also at risk of multiple uncontrolled cardiometabolic risk biomarkers.
- African, Chinese, Other White and Indian adults (<40 years) had lower risk of general multimorbidity compared with the British White majority.
- Further research is needed to explore whether differences in interpretation of chronic conditions, underdiagnosis and/or poorer management of cardiometabolic risk factors among ethnic groups may be driving factors behind inequalities in self-reported cardiovascular multimorbidity.

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