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Original Research

The influence of ethnicity on frailty in a United Kingdom (UK) population

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ABSTRACT

Background: Frailty is an important and increasing clinical and public health problem. Within the United Kingdom (UK). Most data relating to the occurrence of frailty is derived from Caucasian groups. This study aimed to determine the influence of ethnicity on the occurrence of frailty in a large UK urban conurbation. We also looked at frailty-related risk of severe illness related to COVID-19 infection.

Methods: Using data from the Greater Manchester Health Record (GMCR), we analysed primary care electronic medical records of 534,367 men and women aged 60 years and over who were alive on 1st January 2020. We assessed frailty using an electronic frailty index (eFI) and categorised subjects as fit, mild, moderate, and severe frailty. We used logistic regressions to examine the association between moderate and severe frailty (eFI $\geq$ 0.25) and ethnicity adjusted with age, sex and area deprivation (as measured using Townsend Index). We also looked among those with a first positive COVID test, the influence of frailty on subsequent admission to the hospital within 28 days.

Results: The majority of subjects were White (84 %), with 4.7 % describing themselves as Asian or Asian British, and 1.3 % Black or Black British. The unadjusted prevalence of moderate to severe frailty (eFI $\geq$ 0.25) was 22.1 %. Compared to the prevalence of frailty in Whites (22.5 %), the prevalence was higher in those of Asian or Asian British ethnicity (28.1 %) and lower in those of Black/Black British descent (18.7 %). After adjustment for age, gender, and deprivation, the risk of frailty remained higher in Asians (Odds Ratio = 1.61; 95 % Confidence Intervals = 1.56–1.66) and lower in Black British (OR = 0.73; 95 % CI 0.68–0.78) compared to White British. Among those with a positive COVID-19 test, those with frailty were more likely to require admission to the hospital within 28 days (OR = 1.61; 95 % CI = 1.53, 1.69).

Conclusion: There is variation in the occurrence of frailty across Greater Manchester across ethnic groups, with higher frequency among those of Asian or Asian British descent and lower frequency among those of Black or Black British descent. This study has added to our understanding of the way that frailty prevalence maps across communities, in this case in a large European conurbation. Further research is required to understand the causes of ethnic variation in frailty and whether ethnicity influences frailty outcomes.

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1. Introduction

Frailty is a widely recognised clinical condition affecting older adults and is linked with a variety of adverse health outcomes, including considerable morbidity, mortality and healthcare costs [1–4]. It is characterised by increased vulnerability to poor resolution of homeostasis following a stressor event, which increases the risk of adverse outcomes including falls, delirium and disability [1]. Prevalence increases with age, and is influenced by the method used to define frailty. In a recent systematic review, the prevalence of frailty using the deficit accumulation model (those using a frailty index [FI]), was estimated at 24 % among those aged ≥50 years, with evidence of variation in the occurrence of frailty worldwide [5]. In a 2021 study using English Longitudinal Study of Ageing (ELSA) data and a more stringent frailty definition, the prevalence was 8.1 % [6].

While the prevalence of frailty has been widely studied among White populations, there are few data concerning frailty in ethnic minority subgroups in the UK. Based on the 2021 census data, there are a large proportion of people in the UK who identify with an ethnic minority background (https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/national-and-regional-populations/population-of-england-and-wales/latest/). In the 2021 census, of the 59.6 million population of England and Wales 81.7 % of the population self-reported as White. People self-reporting as from Asian ethnic groups made up the second largest percentage of the population (9.3 %), followed by Black (4.0 %), Mixed (2.9 %) and other (2.1 %) ethnic groups.

In a recent study based on electronic health records of 13,510 people in London and using the electronic frailty index (eFI) the overall prevalence of frailty was estimated at 18.1 %. Prevalence was notably higher among Bangladeshis (32.9 %) and lowest among Black ethnic groups (14.0 %) [7]. The underlying explanation for these differences was unclear, and it was suggested that further research be conducted to confirm the findings. Knowledge of variation in occurrence by ethnic group is important and can help address inequity, determine health needs, including increased sensitivity to illness and opportunities for prevention.

Using data from a large population-based electronic health record system in Greater Manchester, we examined occurrence of frailty in different ethnic groups and also whether any differences could be explained by differences in levels of deprivation. Frailty was quanitifed using the using the electronic frailty index (eFI) [8].

We also examined whether levels of frailty contributed to an increased risk of severe COVID-19.

2. Methods

2.1. Subjects

We used the Greater Manchester Care Record (GMCR) database, which is an integrated database of de-identified primary care, secondary care and mental health trust data from across Greater Manchester (https://gmwearebettertogether.com/research-and-planning/: accessed 18th August 2023) for retrospective analyses covering a population of approximately 3 million people. Health and care data were collected from 433 of 435 (99.5 %) primary care general practices in Greater Manchester. The 2 practices that do not contribute data have chosen to opt out of data sharing into the GMCR. Data were de-identified at source and were extracted from the GMCR database. Coded diagnoses used the READ code system historically [9] and more recently, the SNOMED classification [10]. We reviewed the health records of anyone aged 60 or over living in Greater Manchester on 1st January 2020. The project was ethically reviewed and approved by Health Innovation Manchester and the Greater Manchester Care Record (GMCR) review board (ref: IDCR-RQ-038). This research was performed with anonymised data, in line with the Health Research Authority's Governance arrangements for research ethics.

2.2. Frailty

Frailty was assessed using the electronic frailty index (eFI) [10]. The eFI comprises 36 age-related deficits identified by coded data in primary care electronic medical records and was developed using a standard procedure described by Rockwood and colleagues [11–14].

The deficits included in the eFI are shown in the Supplementary Table 1. The eFI score is calculated as an equally weighted proportion of the total number of deficits present in an individual, divided by 36 as the maximum total possible and ranges from a value of 0 to 1. Further details of the original development and validation of the eFI are described elsewhere [10]. The eFI has been validated in multiple databases, and criterion validity has been demonstrated by comparing the eFI to other frailty instruments, including the phenotype model of frailty and the Clinical Frailty Scale [10,15,16]. In order to apply the eFI in practices using the SNOMED coding system, we mapped the original eFI Read code lists to SNOMED codes using mapping tables from the National Health Service Data Migration Programme [17]. The eFI was determined at the date of data extraction and based on previously published thresholds, was categorised as fit (eFI≤0.12), mild frailty ($0.12 < \text{eFI} \leq 0.24$), moderate frailty ($0.24 < \text{eFI} \leq 0.36$), and severe frailty (eFI > 0.36) [10].

2.3. Ethnicity

Ethnic group was assigned by Graphnet prior to data extraction, using an algorithm drawing on multiple electronic health record sources for each individual. NHS ethnic group categories were recoded according to NHS 5 groups [18]). The categories comprise Asian/Asian British, Black/Black British, Mixed, White, and Other. Asian/Asian British in this analysis refers to people predominantly from India, Pakistan, and Bangladesh. Asian ethnicities that were not South Asian (e.g., Chinese) were classified under 'Other'.

2.4. Deprivation

Deprivation was assessed using the Townsend score [19], which is based on UK postcode and can be calculated using a combination of four census variables for any geographical area (provided census data is available for that area). The measure has been widely used in research on health, education and crime to establish whether relationships exist with deprivation. A higher Townsend score equates to greater social disadvantage. Information was provided by quintile using categorisations based on published data from the UK [20]

2.5. Severe COVID-19

During the COVID-19 pandemic, information about the date of people's SARS-Cov-2 (COVID-19) positive tests was recorded centrally and linked to the GMCR. Information concerning hospital admissions, as well as the date of those admissions, was also included. We defined severe COVID-19 as those who had a positive test and were admitted to the hospital between 4 days before and 28 days after a positive test.

2.6. Statistics

Descriptive statistics were used to characterise the study population, including the number and proportion of males and females, number and proportion of subjects in different age categories (60–64 yrs; 65–69 yrs; 70–74 yrs; 75–79 yrs; 80–84 yrs and 85 yrs and over) and number and proportion in each of the Townsend quintiles and ethnic groups. We looked at the mean eFI score overall and separately in males and females and the proportion of subjects in each of the 4 frailty categories (none [$\text{eFI} \leq 0.12$], mild [$0.12 < \text{eFI} \leq 0.24$], moderate [$0.24 < \text{eFI} \leq 0.36$] and severe [eFI >0.36]). We then looked at the proportion of subjects with moderate and severe frailty ($\text{eFI} \geq 0.25$) by sex, age group,

Townsend quintile and ethnic group.

We used logistic regression to determine the association between frailty (outcome – categorised as moderate and severe vs none or mild) and covariates including ethnicity (with 'white' as the reference), age (expressed as a continuous variable), sex (with 'female' as the reference) and Townsend index (with the least deprived quintile as referent group) and with the results expressed as odds ratios (OR) and 95 % confidence intervals (CI). We looked initially at the association between these covariates and frailty unadjusted (model 1), adjusted for age group and sex (model 2) and after mutual adjustment (model 3).

We used logistic regression also to determine, among those people who had a first positive COVID-19 test, the association between hospital admission (between −4 to +28 days of a positive test) and influence of frailty (categorised as moderate and severe vs none or mild) with adjustments made for age, gender, Townsend quintile and ethnicity. The exact numbers in each analysis differed slightly in relation to the specific analysis conducted.

3. Results

3.1. Subject characteristics

There were 534,567 people alive on 1st January 2020, who were 60 years of age or older. Of these, 254,125 (47.5 %) were male (mean age 72 yrs (SD = 8 yrs) and 280,442 (52.5 %) were female with a mean age of 73 yrs (SD = 9 yrs). The numbers of males and females by age band are shown in Table 1. The majority of people in the study group identified themselves as white (84 %), with 4.7 % identifying as Asian or Asian British, 1.3 % as Black or Black British and 0.5 % identifying as of mixed ethnicity. 'Other' ethnic groups made up 3.3 % of the population with 6.2 % not wishing to declare ethnicity or not stated (see Table 1).

3.2. Frailty - influence of age, gender and Townsend score

The overall mean eFI score was 0.16 (SD = 0.12). eFI score was greater in females than in males (0.17 vs 0.14). Overall, 6.9 % of individuals had evidence of severe frailty; 15.2 % moderate, 32.0 % mild frailty and 45.9 % were robust (Table 1 and Fig. 1). The proportion of subjects with moderate or severe frailty (eFI ≥ 0.25) was 22.1 %. The prevalence of moderate to severe frailty was also greater in females than males (25.3 % vs 18.5 %) and increased with age, from 8.3 % at age 60–64 years rising to 52.4 % at age 85 years and over (Table 2). Prevalence of moderate or severe frailty (eFI ≥ 0.25) increased with increasing quintile of Townsend score from 17.4 % among those residing in the least deprived areas to 26.4 % among those residing in the most deprived areas (Table 2).

Table 1
Subject characteristics.

Participant characteristic	Number	Percentage (%)
Male	254,125	47.5 %
Female	280,442	52.5 %
Age Group (years)		
60–64	133,021	24.9 %
65–69	113,050	21.2 %
70–74	109,009	20.4 %
75–79	77,450	14.5 %
80–84	54,803	10.3 %
≥85	47,238	8.8 %
Townsend quintile		
Least deprived 1	125,566	23.5 %
2	97,250	18.2 %
3	93,140	17.4 %
4	102,417	19.2 %
Most deprived 5	115,965	21.7 %
Ethnic Group		
Asian or Asian British	24,757	4.7 %
Black or Black British	6688	1.3 %
Mixed	2850	0.5 %
Other Ethnic Groups	17,083	3.3 %
Refused and not stated	32,464	6.2 %
White	441,071	84.0 %
Frailty category		
None	245,308	45.9 %
Mild	171,164	32.0 %
Moderate	81,090	15.2 %
Severe	37,009	6.9 %

3.3. Frailty - influence of ethnicity

The prevalence of frailty among whites was 22.5 %. Frailty was less common among those of Black/Black British descent (18.7 %) and more prevalent among those of Asian or Asian British descent (28.1 %), see Table 2. Among Asians, the majority (91 %) defined themselves as Bangladeshi or Bangladeshi British (n = 1926), Pakistani or Pakistani British (n = 14,172) and Indian or British Indian (n = 6199). Prevalence of moderate to severe frailty was higher in those of Bangladeshi or Bangladeshi British origin (34.2 %) and Indian or Indian British origin (31.8 %) than those of Pakistani or Pakistani British origin (26.9 %). Among people of Black ethnicity, the majority (87 %) defined themselves as African (n = 3138) or Caribbean (n = 2664). Prevalence of moderate to severe frailty was higher in those of Caribbean origin (27.8 %) than those of African origin (11.7 %)

3.4. Regression analysis

In an unadjusted logistic regression analysis (Model 1) and with age expressed as a continuous variable, moderate to severe frailty was associated with increasing age (Odds Ratio [OR] 1.10; 95 % CI [Confidence Interval] 1.10, 1.10), and was less likely in males than females (OR 0.68; 95 % CI 0.67–0.68), see Table 3. Compared to those in the least deprived area those in the most deprived areas were more likely to be frail (OR 1.71; 95 % CI 1.67, 1.74). Compared to those identifying as White, those identifying as Asian/Asian British were more likely to be frail (OR = 1.35; 95 % CI 1.31–1.39) while those identifying as Black/Black British ethnicity were less likely to be frail (OR 0.80; 95 % CI 0.75–0.85). After adjustment for age and gender (Model 2) the strength of the association increased for the comparison between Asian/Asian British and Whites (OR = 1.92) and reduced for the comparison between Black/Black British and Whites (OR = 0.93). After further adjustment for deprivation (Model 3) the strength of the association with frailty reduced though remained significant for the comparison between Asian/Asian British and Whites (OR = 1.61; 95 % CI 1.56–1.66) and became more marked for the comparison between Black/Black British and Whites (OR = 0.73 95 % CI 0.68–0.78) see Table 3.

3.5. Risk of hospital admission following a first positive COVID test

Within the cohort there were 86,844 people who had a positive COVID test recorded in their clinical record. After adjustment for age, gender, deprivation and ethnic group moderate or severe frailty (vs none or mild) was associated with a significant increased risk of admission following a positive COVID test (OR 1.61; 95 % CI 1.53, 1.69). Specifically an increased risk of hospital admission was asscociated with increasing age, being male (OR 1.42), living in a more deprived area (most deprived vs least deprived; OR = 1.84) and being of Asian/Asian British descent (vs White; OR = 1.47) or Black/Black British descent (vs White; OR = 1.86), see Table 4.

4. Discussion

In our analysis, we found a higher prevalence of moderate to severe frailty among self-identified Asian and Asian British individuals and a lower prevalence among Black and Black British individuals than among Whites in a large North-West England conurbation with a mixed ethnic

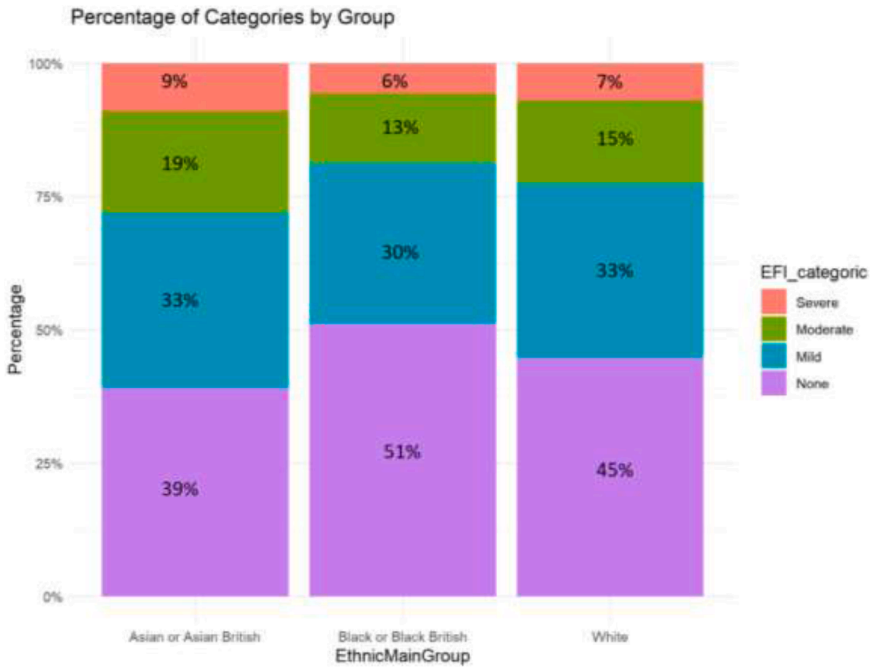

Fig. 1. Frailty categories (none / mild / moderate / severe); percentage (%) by ethnic group.

Table 2
Prevalence of Frailty* by gender, age-group, deprivation (Townsend quintile) and ethnic group.

Subject Characteristic	Number with frailty	Percentage with frailty (%)
Gender		
Male	47,102/254,125	18.5 %
Female	70,997/280,442	25.3 %
Age Group (years)		
60–64	11,046	8.3 %
65–69	14,977	13.3 %
70–74	20,807	19.1 %
75–79	23,389	30.2 %
80–84	23,120	42.2 %
≥85	24,760	52.4 %
Townsend quintile		
Least deprived 1	21,809	17.4 %
2	19,153	19.7 %
3	20,891	22.4 %
4	25,588	25.0 %
Most deprived 5	30,612	26.4 %
Ethnic Group		
Asian or Asian British	6950	28.1 %
Black or Black British	1251	18.7 %
Mixed	477	16.7 %
Other Ethnic Groups	3554	20.8 %
Refused / not stated	6356	19.6 %
White	99,066	22.5 %

*Frailty defined as moderate or severe (vs mild or none).

Table 3
Risk of Frailty: by gender, age, ethnicity, Townsend index.

	Model 1* OR (95 % CI)	Model 2 * OR (95 % CI)	Model 3* OR (95 % CI)
Gender			
Female (Reference)	1.0	1.0	1.0
Male	0.68 (0.67, 0.68)	0.76 (0.74, 0.77)	0.75 (0.74, 0.77)
Age (years)	1.10 (1.10, 1.10)	1.10 (1.10, 1.10)	1.10 (1.10, 1.10)
Townsend Index			
1 Least deprived (Reference)	1.0	1.0	1.0
2	1.16 (1.14, 1.19)	1.16 (1.13, 1.18)	1.16 (1.13, 1.18)
3	1.37 (1.34, 1.40)	1.40 (1.36, 1.43)	1.39 (1.36, 1.42)
4	1.58 (1.55, 1.61)	1.67 (1.63, 1.70)	1.63 (1.63, 1.70)
5 Most deprived	1.71 (1.67, 1.74)	2.03 (1.99, 2.07)	1.96 (1.92, 2.00)
Ethnic Group			
White (Reference)	1.0	1.0	1.0
Asian or Asian British	1.35 (1.31, 1.39)	1.92 (1.86, 1.98)	1.61 (1.56, 1.66)
Black or Black British	0.80 (0.75, 0.85)	0.93 (0.87, 1.00)	0.73 (0.68, 0.78)
Mixed	0.70 (0.63, 0.77)	0.84 (0.75, 0.93)	0.75 (0.67, 0.83)
Other	0.91 (0.88, 0.94)	0.97 (0.93, 1.00)	0.94 (0.90, 0.98)
Refused	0.84 (0.82, 0.86)	0.67 (0.65, 0.69)	0.66 (0.64, 0.68)

+Frailty - defined as moderate or severe (vs mild or none). OR = Odds Ratio; 95 % CI = 95 % confidence interval. * Model 1 – unadjusted; Model 2 – adjusted for age (years - continuous variable) and gender; Model 3 – adjusted for all other covariates.

population. These differences were not explained by differences in socioeconomic status. Frailty was associated with an increased risk of hospital admission following a positive COVID test, an effect which could not be explained by differences in demographics, ethnicity or socioeconomic status.

The prevalence of frailty varies worldwide. In a systematic review of published data and based on measures of physical frailty, prevalence appeared highest in Africa (22 %) and lowest in Europe (8 %) although CIs were very wide for the Africa estimate [5]. For studies using the FI, frailty was highest in Oceania (31 %), followed by Asia (25 %), the Americas (23 %) and Europe (22 %) but all CIs overlap (no estimate is reported for Africa). Prevalence defined using both approaches, though varied within individual countries and regions [5]. Data from the Study on Health, Ageing, and Retirement in Europe (SHARE), which includes European countries only, suggest variation in occurrence among migrant groups [21,22]. In northwest Europe, frailty was more frequent among those who had migrated to the area from low- and

Table 4
Risk of admission to hospital following positive COVID test : by frailty, age, gender, ethnic group and Townsend index.

	OR (95 % CI)*
Frailty+	
None / Mild (Reference)	1.0
Moderate / Severe	1.61 (1.53, 1.69)
Gender	
Female (Reference)	1.0
Male	1.42 (1.35, 1.48)
Age (years)	1.04 (1.04, 1.05)
Townsend quintile	
1 Least deprived (Reference)	1.0
2	1.14 (1.06, 1.23)
3	1.26 (1.17, 1.36)
4	1.40 (1.30, 1.50)
5 Most deprived	1.84 (1.72, 1.97)
Ethnic Group	
White (Reference)	1.0
Asian or Asian British	1.47 (1.34, 1.61)
Black or Black British	1.86 (1.56, 2.20)
Mixed	1.14 (0.81, 1.56)
Other	1.03 (0.90, 1.18)
Refused	1.41 (1.29, 1.54)

Outcome : Admission to hospital following +ve COVID test (vs Not admitted to hospital following +ve COVID test).
OR = Odds Ratio; 95 % CI = 95 % confidence intervals.
* Mutually adjusted model.

middle-income countries than among those who were native-born [21,22]. There is, however, a relative paucity of data looking at the occurrence of frailty within specific ethnic minority groups living in the UK.

In a survey utilising primary care data from London, UK and based on the electronic frailty index, which included 13,500 men and women, the overall prevalence of frailty was 18.1 % [7]. The reported prevalence of frailty increased with age and body mass index (BMI). The highest prevalence of frailty was observed for Bangladeshi individuals (32.9 %) and the lowest prevalence for Blacks (14.0 %) [7]. These differences persisted after adjustment for age gender, BMI and deprivation.

Using data from a retrospective open cohort study using electronic health records from the Royal College of General Practitioners (RCGP) Research and Surveillance Centre (RSC) sentinel network and including over 2 million patients, the crude incidence of frailty (2006–2017) was reported to be greater in Asians (57.3/1000 person-years) than among Whites (50.9/1000 person-years) with Blacks having a slightly lower incidence (49.1 / 1000 person-years) [23]. Older age, female sex, higher deprivation, urban dwelling and Asian ethnicity were reported to be independently associated with an increased risk of transition from fit to any level of frailty [23].

Using data from the English Longitudinal Survey of the Aging, frailty (assessed using the eFI) was reported to be less common among non-whites (11.6 % vs 13.3 %), however, the number of non-whites was relatively small (712), and their ethnic origin was not specified [24].

Finally, a study using data from the Whitehall study, and using the Fried definition of frailty, frailty was more frequent among Asian/Asian British individuals and also Black/Black British individuals compared with whites though the number of Asian/Asian British individuals (n = 289) and Black/Black British individuals (n = 166) was relatively small [25].

Our findings are consistent with these data showing a higher prevalence of frailty in Asian British individuals (compared to whites), with differences persisting after adjustment for age, gender and Townsend score. Also, with data from East London suggesting that within the Asian community, the prevalence was higher in those of Bangladeshi origins. They are consistent also with most though not all studies suggesting a lower prevalence among UK Black/Black British individuals. To our knowledge, however, there are no comparative data which have focused separately within this group at those who self-identify as African and Afro-Caribbean.

How can these differences be explained? Within the UK there is evidence of poorer health among ethnic minority groups [26–29]. Older people from most ethnic minority groups are more likely to report their health as limiting their typical activities, to report poor self-rated health than white British older people [26,27]. There is variation also in lifestyle with those from ethnic minority groups generally less likely to take regular exercise [26]. Furthermore there are higher rates of central obesity, diabetes ischemic heart disease and stroke among people of Asian/Asian British compared to people of white ethnicity while among people of Black/Black British ethnicity there is a lower frequency of ischemic heart disease, though a higher frequency of hypertension and stroke [29–31]. We did not have information in our analysis about birthplace and participants in our study may have included first generation migrants or those of families of migrants born in the UK and for which further information is needed. There is some evidence though that health inequalities may persist across generations, despite health benefits resulting from upward intergenerational social mobility, among ethnic minority groups in the UK [32].

As in previous studies [33] the risk of severe COVID-19 increased with age, was greater in men than women and in both Black and Asian groups vs Whites. The reason for the excess in ethnic minority groups is unclear, though it is likely related to genetic / environmental factors. In our study, frailty further increased the likelihood of COVID-19-related hospital admission and was an independent predictor of hospital admission. The overall rate of hospital admissions post Acute COVID-19 infection is similar to that reported in a previous paper from the UK which was also based on general practice recorded COVID-19 infection [34]. However causality cannot be inferred, given disparities across society in COVID-19 testing, especially early in the COVID-19 pandemic.

Our study has a number of strengths including the large sample, access to the coded electronic medical record including linked primary and secondary care data and use of a validated frailty index. There are though limitations to be considered in interpreting the findings. The data on frailty was based on the eFI which is based on primary care attendance; and also coding. Variation in health seeking behaviour (and therefore coding of deficits) may vary between ethnic groups and potentially explain some of the observed variation in eFI. Speciclaly there are systemic ethnic disparities in healthcare utilization, coding completeness, and diagnostic delay. The occurrence of comorbidity and degree of frailty may be underestimated also by the electronic medical records compared to a more detailed assessment such as a comprehensive geriatric assessment, which may reveal health deficits that had not previously come to clinical attention; the effect of which would be to tend to underestimate the degree of frailty. Data on ethnicity were derived from several sources, though ultimately were self-reported and this is an accepted limitation. We had no information on medical history, lifestyle or anthropometric factors, including obesity, to explore the causes of the observed variation in frailty. A significant minority of people's self-reported ethnicity was as 'mixed', which makes data more challenging to interpret. Information concerning social disadvantage was based on the Townsend Index, which is based on census data; and thus, relies on current address rather than prior address. Also it assumes uniform deprivation within small areas, which may not reflect local disparities within those area

In summary, we have shown important variation in the occurrence of frailty by ethnic group, with a greater prevalence among those identifying as Asian/Asian British and a lower prevalence among those identifying as Black/Black British compared to Whites. Our findings are supported by a recent review [35] which highlighted the need to design tailored interventions targeting cardiometabolic typologies to prevent and delay frailty. Some of the ethnic differences that we describe may well relate to difference in obesity and related diabetes rates plus cardiovascular disease rates between ethnic groups [36].

Further research is needed to confirm these findings in other populations, to understand the causes of the variation, to determine whether

ethnicity impacts on clinical outcomes and to begin to identify opportunities for prevention with a view to reducing the adverse consequences of frailty.

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CRediT authorship contribution statement

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Declaration of competing interest

There has no conflict of interest

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.tjfa.2025.100089.

Data availability

All datasets generated analysed during the current study are not publicly available but are available from the corresponding author on reasonable request.

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