Is age discrimination a risk factor for frailty progression and frailty development among older adults? A prospective cohort analysis of the English Longitudinal Study of Ageing.

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Is age discrimination a risk factor for frailty progression and frailty development among older adults? A prospective cohort analysis of the English Longitudinal Study of Ageing

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HIGHLIGHTS

- Prevalence of age discrimination was 38.4 % among UK older adults aged 65+ years in the analysed ELSA study.
- Frailty prevalence was 12.1 % at baseline and more women were frail compared to men.
- Age discrimination was significantly associated with frailty in the longitudinal analyses using GEE.
- Long-standing illness had the strongest association with frailty.

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ABSTRACT

Background: With the increasing global burden of frailty on healthcare resources, it is important to understand the modifiable risk factors of frailty. This study examined perceived age discrimination as a potential risk factor for frailty progression and frailty development among older adults.
Methods: Prospective cohort study using data from Waves 5 to 9 of the English Longitudinal Study of Ageing (ELSA). Data on perceived age discrimination was collected only in Wave 5 of ELSA and analysed as baseline data in this study. Frailty was defined using the Frailty Index (FI) scores (0 to 1), calculated using the multidimensional deficits (scores $\geq$ 0.25 were considered frail). Binomial generalised estimating equation models (GEE) were fitted in R studio using perceived age discrimination as the main predictor with age, gender, long-standing illness, cognition, subjective social status status (SSS) and psychological wellbeing as covariates. Odd ratios were reported with 95 % confidence intervals (CI).
Results: A total sample of 2,385 ELSA participants were included in the analysis. 55.8 % ($n = 1312$) were female, mean age 71.9 (SD $\pm$ 5.27) years and baseline frailty prevalence was 12.1 % ($n = 288$). Perceived age discrimination was reported by 38.4 % ($n = 916$) of the participants. Both frailty progression (OR 1.50, CI [1.26-1.70]) and frailty development (OR 1.39, CI [1.14–1.62]) were significantly associated with perceived age discrimination in the fully adjusted models. Age (80+ years) (OR 3.72, CI [2.84–4.86]) and long-standing illness (OR 5.45, CI [4.43–6.67]) had the strongest association with respondents' frailty progression.
Conclusion: Perceived age discrimination significantly increased the risk of frailty progression and frailty development among ELSA participants.

1. Introduction

Frailty is a condition characterised by a decrease in physiological reserves and an increased in vulnerability to stressors, leading to a higher risk of adverse outcomes such as falls, disability, mortality and hospitalisation (Fedarko, 2011). Frailty is commonly associated with ageing, as it is more prevalent in older adults (Cesari et al., 2017). The implications of frailty for the globally ageing population are concerning

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and the United Kingdom (UK) is not an exception (O'Caoimh et al., 2021). There is a higher risk of hospitalisation for frail individuals compared to those who are not frail, corresponding to 61.5 million additional days of hospital stay annually following an emergency admission in the UK (Han et al., 2019). Healthcare costs could potentially increase in the UK by an extra annual >£2K for each patient living with frailty, currently estimated at £6 billion per year overall using 2013/14 reference costs (Han et al., 2019). Frailty has been assessed as physical decline or multidimensional deficits in research to explore its determinants (Cesari et al., 2014). Factors such as smoking, alcohol intake, poor nutrition, polypharmacy (five or more medications), gait impairment, reduced hand-grip strength, chronic inflammation and cardiovascular diseases have all been significantly associated with increased risk of frailty among the older population (Niederstrasser et al., 2019; Yannakoulia et al., 2017). Other studies have found that psychosocial risk factors such as cognitive decline, social discrimination and poor social contacts might be associated with frailty (Chamberlain et al., 2016; Mehrabi & Béland, 2020).

Age discrimination has been reported as the most common form of social discrimination against older individuals (Swift & Chasteen, 2021; WHO, 2021). As described in the Swift and Abram (2016) risk of ageism model (RAM), age discrimination is an unfair treatment towards an individual or a group of people by another group primarily based on some internalised ageing stereotypes or prejudice (Swift et al., 2017). The World Health Organisation global ageism report shows that age discrimination is experienced by older adults in different spheres of life including healthcare, media representation, employment and everyday activities (WHO, 2021). However, frailty and age discrimination can be intertwined in several ways. First, frailty and age discrimination can lead to barriers in accessing healthcare services or disparities in the level of care provided to older adults (Ferrante et al., 2018; Lawler et al., 2014). Additionally, age discrimination can lead to increased risk of poor physical health (Jackson et al., 2019). Everyday discrimination has been shown to significantly increase an individual's level of inflammatory C-Reactive Proteins that are implicated with a rapid decline of the health of older people (Zahodne et al., 2019).

Although age is a protected characteristic in many countries including the UK, older individuals might still be at risk of being discriminated because of their perceived vulnerability (Marques et al., 2020). According to the Centre for Ageing Better, three in five older people perceived the UK as ageist (CAB, 2021). The prevalence of reported age discrimination was 36.8 % among individuals aged 65 years and over in England (Rippon et al., 2014). Despite the possibility of a double detrimental 'jeopardy' of age discrimination and frailty for older people, there is a paucity of studies that examine age discrimination as a potential risk factor of frailty in the UK population and any possible relationship. Therefore, this study aimed to examine the association between perceived age discrimination on frailty among older individuals by longitudinally analysing a cohort of community-dwelling older adults.

2. Material and method

2.1. Study sample

A prospective cohort study utilising longitudinal data from the English Longitudinal Study of Ageing (ELSA) covering an eight-year period (2010–2018). ELSA is a panel survey in England and includes anonymised demographic data, economic data, health indicators and social participation data of the participants (Clemens et al., 2019). Data collection for ELSA started in 2002 (Wave 1) and then every following two years. The data from Waves 5 (2010), 6 (2012), 7 (2014), 8 (2016) and Wave 9 (2020; the most recent at the time of the analysis) was utilised in this study. Individuals aged 65+ years who participated in all the Waves of ELSA and completed both the self-administered questionnaires and computer-assisted interviewer administered questions were included in this study. Ethical approval was obtained from Robert Gordon University, School of Nursing, Midwifery and Paramedic Practice Ethics Committee for the study. As the study is a secondary analysis of an archived data, authors had no access to any potentially identifiable participants data, and all data were anonymised.

2.2. Outcome measure

2.2.1. Frailty development and frailty progression

Frailty was assessed using the multidimensional FI - Frailty Index (Gahbauer Evelyne et al., 2008; Rockwood et al., 2017). The FI measures impairments/deficits across physical, cognitive and psychosocial health domains of health (Rockwood & Howlett, 2018). To calculate the FI scores, 51-item scores were generated using diagnosed long-term conditions, self-reported health and impairments in activities of daily living. The deficits were assigned values between 0 and 1 to generate the frailty score. The FI score was then calculated for every participant by dividing the participant's composite scores with the total number of deficits included as the denominator. The output score is expected to range between 0.0 and 1.0 (Gahbauer Evelyne et al., 2008). Frailty progression referred to the frail population at baseline, who continued to be frail across the entire study period (Waves 5 to 9) whereas frailty development was examined among those were *not frail* at baseline (Wave 5) but became frail in the future Waves (6 to 9). Both frailty outcomes were analysed as binary outcomes.

2.3. Independent variables

2.3.1. Predictor

The perceived age discrimination variable was the main predictor and dichotomised into 0 = No discrimination and 1 = Reported age discrimination. This variable was derived from the perceived discrimination questions in the Wave 5 of ELSA (Clemens et al., 2019). The perceived discrimination questionnaire is a peer-reviewed five-item scale, which was developed for the American Health and Retirement Survey and harmonised with ELSA. Participants were asked five questions on their experiences of discrimination during daily activities. "In your daily activities, do you experience any of the following? Treated with less courtesy or respect, treated in a way to show you are not clever, Poor service in restaurants and stores as compared to others, treated poorly by doctors or in hospital services as compared to others, you are threatened or harassed" (Clemens et al. 2019). Subsequently, participants were asked to indicate their perceived reasons for the reported discrimination such as age, gender, physical appearance and race. Data from individuals that attributed discrimination due to age were included in the data analysis.

2.4. Covariates

Age was categorised into 65–69 years, 70–74 years, 75–79 years and 80+ years. The long-standing illness variable was included in the analysis and coded as 0 = No and 1 = Yes. Education qualification was categorised as 1 = Primary 2 = Secondary and 3 = Degree. The cognitive variable was derived from the total cognitive scores of the respondents (memory + executive function) and ranged from 0 to 60 (Steel et al., 2002), where ≤Q1 represented 'poor cognitive performance' and >Q1 represented 'good cognitive performance. Subjective Social Status (SSS) was measured by asking respondents where they perceived themselves on a 10-step ladder of social status with the first step representing people worst-off in income, education, job and step 10 representing people who are best-off in the same item. The reliability and the predictive ability of the ten levels of the SSS on health outcomes has been reported in previous research (Operario et al., 2004). Subjective social status scores were categorised into quartiles and re-coded as Low = <Q1; Medium = ≥Q1 to <Q3; High = ≥Q3 (Goodman et al., 2015). The CASP 19 quality of life questionnaire (scored 0 to 3 for each question) was used to assess

psychological wellbeing (Hedonic and Eudemonic date), with possible total scores ranging from 0 to 57. Psychological wellbeing status was categorised using tertiles including 1 = Low 2 = Medium 3 = High (Okely & Gale, 2016).

2.5. Statistical analysis

Statistical analysis was conducted using the R studio software. Missing data in the covariates and outcome variables were imputed using the missForest package in the R studio. Descriptive analyses were conducted using Chi-squared tests to examine the association between the predictor variables and frailty outcome.

The frailty scores at the five time-points (Waves 5 to 9) were plotted on a line graph. Reliability and sensitivity tests were conducted using two measures (S1 Table). Firstly, internal consistency between the frailty scores was checked using the Cronbach reliability test. Secondly, the analyses were conducted with the outcome variables as continuous variables to ensure that the categorisation would not change the direction of association with the independent variables (Steptoe et al., 2013). A multicollinearity test was conducted to examine if there was a correlation between the independent variables included in the main analyses. This was important because the strength of association with the outcome variable can be affected when the independent variables are highly correlated. Multicollinearity is usually reported as variance inflation factor (VIF) and a VIF score of >5 can indicate moderate to high level of correlation or collinearity.

The relationship between the independent variables and frailty was examined longitudinally using the generalised estimating equation (GEE) analysis (S2 Table). The GEE has been shown to be appropriate for analysing repeated data as it accounts for the correlated structure of the outcome data (Hubbard et al., 2010). At first, only perceived age discrimination was included in the models (unadjusted) and then other covariates were introduced in a step wise approach with the adjusted models. Statistical significance was reported at $p < 0.05$ and confidence interval of 95 %.

3. Results

Table 1 shows the summary characteristics of the study population. 2385 ELSA respondents aged 65 years and over were included in the analysis, 55.8 % ($n = 1331$) were female, 38.4 % ($n = 916$) of the respondents reported age discrimination, overall age mean (SD) was 71.9 (± 5.27) years and baseline prevalence of frailty was 12.1 % ($n = 288$). The overall mean variance inflation factor in the fully adjusted models was <2, which indicated little or no correlation between the independent variables and suggesting that there was no collinearity between the independent variables (S3 and S4 Tables).

The Cronbach reliability test showed a high level of consistency in the FI scores of the respondents in the ELSA data (Cronbach alpha = 0.94). The overall mean (SD) FI scores for Waves 5 to 9 were 0.15 (0.07), 0.16 (0.08), 0.17(0.08), 0.18 (0.08) and 0.19 (0.09) respectively, showing that participants became frail over time. Mean frailty scores were higher at baseline for women compared to men and the differences remained consistent across the timepoints/waves (Fig. 1).

3.1. Frailty progression

Table 2 shows the result for frailty progression ($n = 2385$) in the GEE analyses. Those who reported age discrimination were more likely to be frail compared to those who did not report age discrimination in the unadjusted model (OR 1.63, CI [1.38–1.93]). When the presence of a long-standing illness was introduced into the model, it reduced the association between age discrimination and frailty by 20 % (OR 1.43, CI [1.21–1.70]). In the adjusted GEE analyses (Model 7), age (80+ years) and long-standing illness had the strongest association with frailty progression; odds ratios (OR 3.67, CI [2.81–4.80]) and (OR 5.61, CI [4.55- 6.92]) respectively (Table 2). All the other covariates included in the adjusted models were longitudinally associated with a frailty outcome, except for age group 70–74 years compared to 65–69 years (OR 1.23, CI [0.91- 1.40]) and those with secondary education compared to individuals with degree qualification (OR 1.21, CI [0.96–1.53]). There was little or no change in the effect estimates when psychologically wellbeing was introduced into the GEE analyses (Model 8), and no significant difference in frailty progression for the participants based on the psychological wellbeing status (Table 2).

Table 1
Baseline association between the independent variables and frailty outcome ($n = 2385$).

Variables	Non-frail Total = 2097 n (%)	Frail Total = 288 n (%)	*P*-value
Age			<0.01
65 to 69	859 (41.0)	81 (28.1)	
70 to 74	658 (31.4)	84 (29.2)	
75 to 79	393 (18.7)	67 (23.3)	
80+	187 (8.9)	56 (19.4)	
Gender			<0.01
Male	961 (45.8)	93 (32.3)	
Female	1136 (54.2)	195 (67.7)	
Age Discrimination			<0.01
Yes	780 (37.2)	136 (47.2)	
No	1317 (62.8)	152 (52.8)	
Long-standing illness			<0.01
Yes	1051 (50.1)	271 (94.1)	
No	1046 (49.9)	17 (5.9)	
Cognitive status			<0.01
Poor	391 (18.7)	91 (31.6)	
Good	1706 (81.3)	197 (68.4)	
Subjective social status			<0.01
Low	337 (16.1)	76 (26.4)	
Medium	976 (46.5)	151 (52.4)	
High	784 (37.4)	61 (21.2)	
Educational level			<0.01
Primary	668 (31.9)	153 (53.1)	
Secondary	695 (33.1)	64 (22.2)	
Degree	734 (35.0)	71 (24.7)	
Psychological wellbeing (CASP 19)			<0.037
-Low	740 (35.3)	106 (36.8)	
-Medium	703 (33.5)	103 (35.8)	
-High	654 (31.2)	79 (27.4)	

*Note: Non-frail (FI < 0.25) and Frail (FI ≥ 0.25).

3.2. Frailty development

The analysis involving non-frail ($n = 2097$) respondents at baseline showed that reported age discrimination was significantly associated with frailty development (unadjusted OR 1.52 [1.24–1.86]) (Table 3). The association between perceived age discrimination and frailty outcome reduced by 16 % (OR 1.36, CI [1.12–1.67]) after adjusting for long-standing illness (Model 4). The result of the GEE analyses (Model 7) showed that long-standing illness was significantly associated with frailty development (OR 3.48, CI [2.78–4.35]), as were lower social (OR 1.67, CI [1.24–2.25]) and educational status (OR 1.92, CI [1.46–2.52]). In the adjusted model that includes psychological wellbeing status, the age group (80+ years) had the strongest association with frailty development (OR 3.97, CI [2.92–5.38]). Those in age group 70–74 years had no significant difference in frailty outcome compared to those 65–69 years (OR 1.15, CI [0.89–1.49]). There was also no significant difference in the odds of frailty development based on cognitive status and psychological wellbeing status (Table 3).

4. Discussion

The results have shown perceived age discrimination was significantly associated with frailty progression and frailty development in the

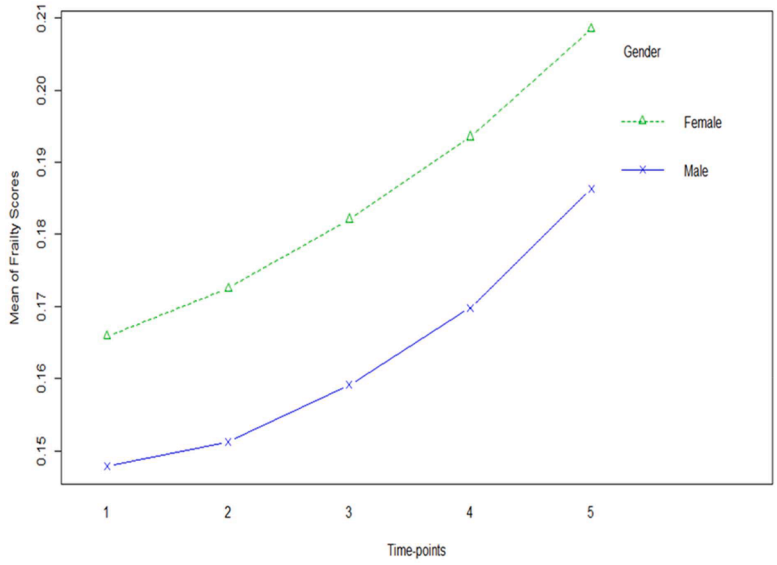

Fig. 1. Frailty trajectory in the study population ($n = 2385$) from Waves 5 through to 9.

Table 2
Multivariate analyses using the generalised estimating equation to longitudinally examine the association between age discrimination and frailty progression.

Outcome: Frailty progression ($n = 2385$)	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Variables	**OR [95 % CI] Unadjusted**	**OR [95 % CI] Adjusted (Age)**	**OR [95 % CI] Adjusted (Age, Gender)**	**OR [95 % CI] Adjusted (Age,Gender, LSI)**	**OR [95 % CI] Adjusted (Age, Gender,LSI,CS)**	**OR [95 % CI] Adjusted (Age, Gender,LSI,CS. SS)**	**OR [95 % CI] Adjusted (Age, Gender,LSI,CS. SS,ED)**	**OR [95 % CI] Adjusted (Age, Gender,LSI,CS.SS, ED, CASP 19)**
Age discrimination -(Yes)	1.63 [1.38–1.93]	1.64 [1.38–1.94]	1.64 [1.39–1.95]	1.43 [1.21–1.70]	1.48 [1.25–1.75]	1.43 [1.20- 1.69]	1.50 [1.26- 1.78]	1.50 [1.26–1.70]
Age categories -(70–74)		1.30 [1.05–1.62]	1.29 [1.04–1.61]	1.28 [1.03-1.58]	**1.23 [1.00–153]**	**1.20 [0.97–1.48]**	**1.23 [0.91- 1.40]**	**1.16 [0.93–1.43]**
-(75–79)		1.99 [1.56–2.51]	1.99 [1.57–2.51]	1.91 [1.52-2.41]	1.78 [1.41–2.24]	1.78 [1.42–2.24]	1.65 [1.31- 2.08]	1.71 [1.36–2.16]
-(80+)		4.22 [3.26–5.46]	4.11 [3.17–5.32]	4.65 [3.59–6.04]	3.93 [3.01–5.14]	3.83 [2.93–5.01]	3.67 [2.81–4.80]	3.72 [2.84–4.86]
Gender (Female)			1.69 [1.41–2.01]	1.68 [1.41–1.99]	1.78 [1.50–2.13]	1.71 [1.43–2.04]	1.52 [1.27- 1.82]	1.52 [1.27- 1.82]
Long-standing illness (LSI): -Yes				5.62 [4.55-6.93]	5.61 [4.55–6.93]	5.51 [4.46–6.79]	5.61 [4.55- 6.92]	5.45 [4.43–6.67]
Cognitive status (CS): -Poor					1.75 [1.44–2.13]	1.63 [1.33–1.98]	1.44 [1.18–1.76]	1.42 [1.16–1.74]
Social Status (SS): -Medium						1.68 [1.37–2.06]	1.53 [1.24–1.88]	1.52 [1.23–1.86]
-Low						2.23 [1.75–2.85]	1.92 [1.50–2.47]	1.93 [1.51–2.48]
Education (ED): Secondary							**1.21 [0.96–1.53]**	**1.19 [0.95–1.50]**
Primary							1.92 [1.54–2.40]	1.89 [1.51–2.36]
Psychological wellbeing (CASP 19) -Medium								**0.97 [0.79–1.18]**
-Low								**0.99 [0.78–1.26]**

*Odds ratio in bold were $p > 0.05$ and are not significant.
- All the variables were all significantly associated with frailty progression at $P < 0.05$, except age category (70–74years) which was not significant for Models 5 to 8, education in Models 7 & 8 and psychological wellbeing in Model 8.
-Reference groups in the models: Age discrimination (No), Age (65–69), Gender (Male), Long-Standing illness (No), Cognitive Status (Good), Social Status (High), Education (Degree), CASP 19 (High).

eight years of ELSA data analysed (Wave 5 to 9). Individuals who reported age discrimination were significantly at risk of being frail or becoming frail compared to those who did not report perceived age discrimination. Furthermore, women were significantly more likely to be frail compared to men after adjusting for age, as were those with low social/education status compared to highly skilled participants. Age was

Table 3
Multivariate analyses using the generalised estimating equation to longitudinally examine the association between age discrimination and frailty development.

Outcome: frailty development ($n = 2097$)	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Variables	**OR [95 % CI] Unadjusted**	**OR [95 % CI] Adjusted (Age)**	**OR [95 % CI] Adjusted (Age, Gender)**	**OR [95 % CI] Adjusted (Age, Gender,LSI)**	**OR [95 % CI] Adjusted (Age, Gender,LSI,CS)**	**OR [95 % CI] Adjusted (Age, Gender,LSI,CS. SS)**	**OR [95 % CI] Adjusted (Age, Gender,LSI,CS. SS,ED)**	**OR [95 % CI] Adjusted (Age, Gender,LSI,CS.SS, ED, CASP 19)**
Age discrimination -(Yes)	1.52 [1.24–1.86]	1.52 [1.24–1.86]	1.53 [1.24–1.87]	1.36 [1.12–1.67]	1.38 [1.13–1.68]	1.34 [1.09–1.63]	1.39 [1.13–1.69]	1.39 [1.14–1.62]
Age categories -(70–74)		**1.25 [0.95–1.63]**	**1.23 [0.94–1.61]**	**1.22 [0.94–1.58]**	**1.19 [0.92–1.55]**	**1.16 [0.90–1.50]**	**1.11 [0.86–1.44]**	**1.15 [0.89–1.49]**
-(75–79)		1.96 [1.49–2.59]	1.96 [1.49–2.59]	1.90 [1.45–2.50]	1.82 [1.38–2.39]	1.80 [1.37–2.36]	1.27 [1.67–2.20]	1.77 [1.35–2.31]
-(80+)		4.15 [3.07-5.61]	4.07 [3.01–5.50]	4.45 [3.31–5.99]	3.96 [2.91–5.38]	3.88 [2.85–5.28]	3.80 [2.79–5.17]	3.97 [2.92–5.38]
Gender (Female)			1.50 [1.22–1.85]	1.49 [1.22–1.83]	1.57 [1.28–1.93]	1.49 [1.21–1.84]	1.34 [1.08–1.66]	1.34 [1.09–1.66]
Long-standing illness (LSI): -Yes				3.47 [2.77–4.34]	3.46 [2.76–4.33]	3.40 [2.72- 4.26]	3.48 [2.78–4.35]	3.35 [2.69–4.16]
Cognitive status (CS): -Poor					1.44 [1.13–1.83]	1.34 [1.06–1.71]	**1.21 [0.95–1.55]**	**1.21 [0.95–1.54]**
Social Status (SS): -Medium						1.74 [1.36–2.21]	1.56 [1.22–1.99]	1.53 [1.21–1.95]
-Low						1.99 [1.48–2.66]	1.67 [1.24–2.25]	1.66 [1.23–2.23]
Education (ED): Secondary							1.53 [1.16–2.01]	1.46 [1.12–1.90]
Primary							1.92 [1.46–2.52]	1.85 [1.41–2.41]
Psychological wellbeing (CASP 19) -Medium								**0.98 [0.75–1.28]**
-Low								**1.00 [0.72–1.38]**

*Odds ratio in bold were $p > 0.05$ and are not significant.
-All the variables were all significantly associated with frailty development at $P < 0.05$, except age category (70–74years) which was not significant for all Models 2 to 8 and cognitive status in Model 7&8 and psychological wellbeing not significant in Model 8.
-Reference groups in the models: Age discrimination (No), Age (65–69), Gender (Male), Long-Standing illness (No), Cognitive Status (Good), Social Status (High), Education (Degree), CASP 19 (High).

significantly associated with frailty progression and frailty development, and individuals aged 75+ and 80+ years had twice and three times increased odds of frailty respectively, compared to those who were below 70 years in the study population. Long-standing illness had the greatest impact on the strength of association between age discrimination and frailty in the study population. Although poor psychological wellbeing have been associated with physical illness in previous studies (Kim et al., 2021; Okely & Gale, 2016), the results from this study have shown that there was no significant difference in frailty progression and frailty development for the ELSA participants based on their psychological wellbeing status.

Age discrimination is a component of ageism (Butler, 1969), and previous studies have examined ageism and health of older adults in a wider context (Hadbavna & O'Neill, 2013; Kornadt et al., 2021). Jackson et al. found a significant association between perceived age discrimination, depression and other health conditions in the ELSA study (Jackson et al., 2019). However, to our knowledge, there is a paucity of studies that analysed the association between perceived age discrimination and frailty development/progression among older adults in the UK. After scoping the literature, we found only one study has directly examined both conditions in Europe (Zora et al., 2022). Zora et al. (2022) found a significant association between perceived age discrimination and frailty among 1337 community-dwelling older people aged 65 years in Italy who are members of the University of Third Age. Although our finding was consistent with the reports from Zora et al., we have analysed diverse populations. Zora et al. recruited only those who are highly educated, and their results could have been positively skewed. This is because education can influence the awareness of ageism and perceived age discrimination (Burnes et al., 2019). Additionally, we have utilised a longitudinal approach to examine frailty and our results may provide a plausible background to probe a causal relationship with perceived age discrimination.

The relationship between perceived age discrimination and frailty can be attributed to a number of factors. Age discrimination has been reliably shown to be a barrier to the utilisation of healthcare services (Eymard & Douglas, 2012; Inouye, 2021). Older persons face significant delays in emergency care and are susceptible to missed diagnosis due to possible ageing stereotypes from health professionals (Erasmus, 2020). According to the results of a survey conducted on a sample of older adults and students, 24 older individuals (30 %) reported age discrimination in healthcare institutions, while 47 students (47 %) witnessed such discrimination (Dobrowolska et al., 2019). The incidents were reported to have mainly occurred at the hospital and involving clinicians. The experience of age discrimination is not peculiar to healthcare only, as it is shown that ELSA participants reported age discrimination in everyday activities such as malls, restaurants, stores, and leisure centres. The older population consists of a heterogenous mix of individuals at different spectrums of health and well-being. While there are people who maintain good health condition as they age, most individuals above 65 years in the UK live with one or more long-standing illness (Barnett et al., 2012), and might be at higher risk of frailty as shown in this study. Thus, discrimination or inequalities in access to health services might

aggravate the health decline among vulnerable older adults.

Perceived age discrimination and internalised ageing stereotypes can lead to poor health seeking behaviours, and interfere with frequency of healthcare use (Levy, 2009; Swift et al., 2017). When this happens, it might lead to further decline of health and increase the risk of frailty. In a survey conducted among 6095 Irish participants aged 50 years and over, it was observed that individuals who held a negative perception of ageing were significantly more susceptible to depression (Freeman et al., 2016). Although, the link between age discrimination and frailty have not been clearly defined previously, a conceptual framework from a systematic review and meta-analysis of 132 papers linking perceived discrimination and health might be helpful (Pascoe & Smart Richman, 2009).The authors proposed that perceived discrimination is a social stressor that can heighten body inflammation leading to poor physical health and well-being. This is an interesting point to explore separately considering that social factors such as social isolation and loneliness have been reported to increase the risk of frailty (Jarach et al., 2021). Similarly, it could be hypothesised that individuals who face discrimination might become socially withdrawn, which in turn can affect their health and well-being.

There are limitations to the data included in the analyses, for instance age discrimination was self-reported and is therefore potentially subject to recall bias. However, the ELSA questionnaire on perceived discrimination was validated and adopted from the American Health and Retirement Survey and was designed to include other possible reasons for discrimination such as disability, weight, gender, and race to avoid leading questions (Smith et al., 2017). As were for most community-based survey, the ELSA participants included were likely to be healthier compared to the older and vulnerable group who discontinued their participation (Enzenbach et al., 2019; Mendes de Leon, 2007). Although we adjusted for selected confounders based on data availability, there is a possibility that other potential residual confounders have not been considered. Additionally, there is a possible selection bias because ELSA refreshment data are pooled from specific households (Health Survey for England households) every two years and thus, individuals not included in the HSE survey are repeatedly left out.

The results from this study are however relevant in understanding the impact of potential socioenvironmental variables on frailty progression and frailty development among older adults. Our study is strengthened by examining the same cohort over a period of eight years, minimising individual variations in the analyses, and providing a more reliable association between perceived age discrimination and frailty. Additionally, by analysing a diverse population of people with different educational, health and socioeconomic backgrounds, we were able to validate the association between perceived age discrimination and frailty among the ELSA participants after adjusting for possible confounders. This study also has implications for future research considering that frailty trajectories among older adults have changed since the COVID-19 pandemic (Pilotto et al., 2022). There is evidence of age-based discrimination in COVID-19 management and vaccine prioritisation policies in many countries (Lloyd-Sherlock et al., 2022), which could have affected the health outcomes of older adults. Further investigation of age discrimination during the COVID-19 pandemic and the impact on the health and wellbeing of older adults in the UK is warranted.

5. Conclusion

Perceived age discrimination significantly increased the risk of frailty development and frailty progression among ELSA participants over an eight-year period. This suggests that age-based discrimination is not only detrimental to health but could accelerate frailty progression or frailty development among older adults. It is therefore crucial to recognise the burden of both perceived age discrimination and frailty on the ageing society and foster awareness that will promote healthy ageing. Future research should explore the impact of age discrimination during the COVID-19 pandemic on the health of older adults.

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CRediT authorship contribution statement

Abodunrin Quadri Aminu: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Nicola Torrance:** Writing – review & editing, Supervision, Resources, Methodology. **Aileen Grant:** Writing – review & editing, Supervision, Resources. **Angela Kydd:** Writing – review & editing, Supervision, Resources, Funding acquisition, Conceptualization.

Declaration of Competing Interest

All the authors have no conflict of interest to declare.

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