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Dementia and disadvantage in the USA and England: population-based comparative study

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ABSTRACT

Objectives To compare dementia prevalence and how it varies by socioeconomic status (SES) across the USA and England.

Design Population-based comparative study.

Setting Non-Hispanic whites aged over 70 population in the USA and England.

Participants Data from the Health and Retirement Study and the English Longitudinal Study of Ageing, which are harmonised, nationally representative panel studies. The sample includes 5330 and 3147 individuals in the USA and England, respectively.

Main outcome measures Between country differences in age-gender standardised dementia prevalence, across the SES gradient. Dementia prevalence was estimated in each country using an algorithm based on an identical battery of demographic, cognitive and functional measures.

Results Dementia prevalence is higher among the disadvantaged in both countries, with the USA being more unequal according to four measures of SES. Overall prevalence was lower in England at 9.7% (95% CI 8.9% to 10.6%) than the USA at 11.2% (95% CI 10.6% to 11.8%), a difference of 1.4 percentage points (pp) (p=0.0055). Most of the between country difference is driven by the bottom of the SES distribution. In the lowest income decile individuals in the USA had 7.3 pp (p<0.0001) higher prevalence than in England. Once past health factors and education were controlled for, most of the within country inequalities disappeared; however, the cross-country difference in prevalence for those in lowest income decile remained disproportionately high.

Conclusions There is inequality in dementia prevalence according to income, wealth and education in both the USA and England. England has lower dementia prevalence and a less steep SES gradient. Most of the cross-country difference is concentrated in the lowest SES group, which provides evidence that disadvantage in the USA is a disproportionately high risk factor for dementia.

Strengths and limitations of this study

- ► This is the first study to compare dementia prevalence across countries using the same survey methodology and the exact same measure of dementia. The surveys have similar sample selection and questionnaire design. We standardise our estimates by age and gender to the English population aged over 70 in 2016. Any differences in overall prevalence across the two countries should represent true differences.
- ► We measure the socioeconomic status (SES) gradient of dementia across four different measures of SES: income; education; wealth and non-housing wealth.
- ► Dementia disproportionately affects the most disadvantaged in both countries, although the gradient is steeper in the USA according to all four measures of SES.
- ► We do not ascertain dementia directly but predict cases using a common battery of measures in English Longitudinal Study of Ageing and Health and Retirement Study. One of the SES measures, education, is also used as a predictor of dementia.

INTRODUCTION

Dementia, a severe and irreversible decline in memory and other cognitive functions, is a major and increasing global health challenge. It is the fifth leading cause of death globally and is one of the most common comorbidities for COVID-19 morbidity.[1 2] It results in large social and economic costs.[3 4]

Americans are more likely to be in poor health than their English counterparts in multiple dimensions, including heart disease and diabetes.[5] These differences are large along all points of the socioeconomic status (SES) gradient, although the gradient is generally steeper in the USA. While the SES gradient for many diseases has been well established,[6–8] only a few studies have focused specifically on dementia.[9 10] The available evidence is summarised in online supplemental table A1. The evidence of the SES gradient for dementia is also less clear, as in England while a strong association has been established between wealth and dementia incidence, the same was not observed for education level.[11]

The Global Burden of Disease Study (GBD) reported that in 2017 among those aged over 70, the USA had a lower overall prevalence of dementia at 7.89% compared with the UK

at 8.91%.[12] However, the GBD has identified substantial heterogeneity in case-ascertainment methods throughout the dementia literature, resulting in location-specific inconsistencies and potentially biased cross-country comparisons. This has led to calls for analyses with more consistent and comparable measures of dementia to inform policy makers, researchers and clinicians about global differences in dementia.[13]

In this study, we compared dementia prevalence in England and the USA among non-Hispanic whites aged 70+, and how it varied across the SES gradient of each country. Location-specific inconsistencies caused by differences in diagnostic practices were not an issue in our study because we used an identical case definition for dementia, and the surveys in the analysis shared the same design and sampling techniques. More specifically, we used two large surveys, the US Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA), that contain a battery of the same demographic, cognitive and functional measures, and we applied the same prediction algorithm in both countries to detect undiagnosed as well as diagnosed cases. We compared dementia prevalence within and across England and the USA using important indicators of SES, specifically: income; education; wealth and non-housing wealth.

METHODS

Description of surveys

Data were extracted from the 2016 and earlier waves of the HRS and ELSA, which are nationally representative biennial surveys of the USA and English populations, respectively.[14 15] Both the HRS and ELSA follow respondents longitudinally until death, with new cohorts entering to maintain population representativeness as the study sample gets older. The design of ELSA was based on the HRS, making the two surveys analogous, with both collecting data on health, ability, demographics, employment and wealth. In addition to measuring health conditions and difficulties respondents have with Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs), sample members also have their cognitive function assessed. A range of tests adapted from the Telephone Interview for Cognitive Status (TICS) have been carried out in HRS since 1996 and ELSA since 2014. If a sample member was unable to respond in person, a proxy respondent was asked questions about the respondent's change in memory. Both surveys have a high response rate, which is displayed in the online supplemental appendix A2. We describe these surveys in more detail in the online supplemental appendix.

Cohort description

Our samples are restricted to non-Hispanic whites over the age of 70 years old that live in the community or in nursing homes in 2016. This provides a study sample of 5330 participants in the HRS and 3147 participants in ELSA. We restrict our sample to non-Hispanic whites to ensure estimates are comparable across countries. Summary statistics of both the raw and selected samples are displayed in online supplemental table A3 and A4, and specifications that include ethnic minorities are also displayed.

Patient and public involvement

No study participants were involved in setting the research question or outcome measures, nor were they involved in any other area of the design, implementation and analysis of the study. There are no direct plans to disseminate the results of the research to study participants.

Dementia case definition

The HRS included a detailed clinical substudy (ADAMS: Aging, Demographics and Memory Study) of 856 sample members aged 70+ who completed an in-depth in-home assessment of cognitive status conducted by experienced teams at the Duke University Dementia Epidemiology Research Center who diagnosed each participant as normal, cognitively impaired but not demented or demented.[3] Data from ADAMS are regarded as the gold-standard dementia diagnoses against which to train algorithms to predict dementia.[16] Hurd *et al* estimated separate ordered probit models in the ADAMS subsample for self-respondents and proxy-respondents to generate a predictive algorithm for cognitive status, based on the ADAMS diagnoses, for the whole HRS sample. The algorithm uses a range of variables including demographic information, ADLs, IADLs, TICS questionnaire as well as the change in these variables across waves.[3] Proxy respondents had a separate predictive algorithm as they were asked a different set of questions from self-respondents, which included the short form of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE). The use of a proxy to assess cognitive decline and dementia in elderly people is a recognised accepted standard method for identifying severe cognitive impairment and has been validated many times.[17] Importantly, the same set of questions used in the Hurd *et al* algorithm is asked of self-respondents and proxy-respondents in both HRS and ELSA. Summary statistics for a variety of predictors are displayed in online supplemental table A5.

We applied Hurd *et al*'s predictive algorithm to estimate the probably of dementia for those in the HRS sample in 2016 and extended the prediction to the ELSA sample. The algorithm predicts the probability of dementia in the following year; therefore, we predicted dementia prevalence in 2017. Hurd *et al*'s predictive algorithm has been shown to have an accuracy (percentage correctly classified as demented or non-demented) of 94%, sensitivity of 65% and a specificity of 98% in the estimation sample.[16] An in-depth discussion of the predictive algorithm procedure can be found in the online supplemental appendix.

Non-response for people unable or unwilling to participate in the survey is important when attempting to estimate dementia prevalence across the population. While

attrition exists in both surveys, it is unlikely to significantly affect our estimates since among older ELSA and HRS respondents, there is no statistically significant correlation between attrition and prior health or the SES indicators of education, income and wealth.[18]

Measures of socioeconomic status

We considered four measures of SES: income; education; wealth and non-housing wealth. Income is measured as current household income from all sources. For education, we used total years of schooling. Wealth is measured as the sum of all household reported savings, stocks, bonds, business wealth, other assets and the value of housing assets (eg, properties) after financial debt and mortgage debt has been subtracted. Non-housing wealth is the same measure as wealth but excludes housing assets and mortgage debt and therefore measures wealth that can be more easily converted to cash. Wealth and non-housing wealth are both measured from 4 years prior to minimise reverse causality, as medical expenses associated with dementia are high and may run down wealth.[4] For each measure, we created a SES gradient by ranking individuals based on that measure. For income, wealth and non-housing wealth, we assigned everyone to a decile in their respective country. For education, we ranked individuals according to their number of years of schooling.

Statistical analysis

We created a pooled dataset of the two surveys. In our statistical analysis, we used HRS and ELSA sampling weights to adjust for non-response and for the sampling design of the surveys. To make both within country estimates along the SES gradient and cross-country estimates directly comparable, estimates were age-gender standardised to the English population aged over 70 in 2016 using direct standardisation, categorising the population into 10 groups: five age bands (70–74; 75–79; 80–84; 85–89 and 90+) by gender. We estimated the prevalence of dementia in each country, their difference and compared the prevalence along the four SES gradients. For each estimate presented, we computed the corresponding 95% CI, and for any differences we computed the corresponding p values. For each SES factor, as well as estimating the age-gender standardised prevalence along the gradient, we calculated the Relative Index of Inequality (RII) and Slope Index of Inequality (SII) using generalised linear models (log binomial regression) with logarithmic and identity link functions, respectively. The RII can be interpreted as the relative likelihood of dementia prevalence of those in the lowest SES group compared with those in the highest, and the SII can be interpreted as the absolute effect on dementia probability of moving from the lowest SES group to the highest.[19] To assess whether any observed differences could be explained by disparities in past health risk factors across countries, we conditioned on a variety of risk factors and assessed how our estimates changed. Where possible, when conditioning on these factors, we used past health instead of current health to address the problem of reverse causality: that is, the problem that dementia may cause health problems such as low weight. Statistical analyses were performed using STATA software.

RESULTS

Table 1 shows the age-gender standardised prevalence of dementia for the aged over 70 white non-Hispanic population in both England and the USA. Dementia prevalence is lower in England at 9.7% (95% CI 8.9% to 10.6%) than the USA at 11.2% (95% CI 10.6% to 11.8), a difference of 1.4 percentage points (pp) that is highly statistically significant (p=0.0055).

Table 1 also shows dementia prevalence for different SES groups, in terms of income, education, wealth and non-housing wealth. Regardless of the measure of the SES, there is a clear gradient in dementia prevalence, with the most disadvantaged groups in both England and the USA having higher dementia prevalence. The gradient is steeper in the USA and is driven by significantly higher dementia prevalence for those at the very bottom of the distribution. In the USA, those in the lowest income decile have a dementia prevalence of 18.7% (95% CI 16.6% to 20.8%), which is considerably higher than in England, with a prevalence among those in the lowest decile of 11.4% (95% CI 8.9% to 13.9%). The difference is highly statistically significant (p<0.0001). For income deciles above the lowest, the difference across the two countries is much smaller and not statistically significant. This same general pattern is evident across the other measures of SES that we consider, although when using wealth, the difference between those in the bottom decile is not statistically significant.

Figure 1 presents the same dementia prevalence information shown in table 1, but in graphical format. It also reports the SII for the four different measures of the SES for both countries. In both the USA and England, dementia is more prevalent among the more disadvantaged. The gradient tends to be steeper in the USA, corresponding to a larger (in absolute value) SII in the USA for each SES measure. For income, the SII is −0.062 (95% CI −0.097 to −0.028) and −0.085 (95% CI −0.114 to −0.057) for England and the USA, respectively. The SIIs are not statistically different. If the lowest income decile is excluded, the SII for England becomes slightly steeper (−0.067 (95% CI −0.107 to −0.027)) whereas the SII for the USA becomes less steep than England (−0.060 (95% CI −0.093 to −0.027)).

Next, we attempted to understand the potential drivers of these gradients and the differences in the gradients across countries. We extended the analysis to account for cardiometabolic diseases (ie, diabetes, heart disease and stroke) and behaviours (ie, smoking and body mass index) as dementia risk factors.[1 20] Previous research showed these factors to be more prevalent in the USA than England, especially among the most disadvantaged.[5] Table 2 displays the percentage point difference

Table 1 Prevalence of dementia, USA versus England, 2017

	England	USA		
	Age-gender standardised prevalence (95% CI)	Age-gender standardised prevalence (95% CI)	Difference	P value
All	0.097 (0.089 to 0.106)	0.112 (0.106 to 0.118)	0.014	0.0055
Household income decile				
1 (lowest)	0.114 (0.089 to 0.139)	0.187 (0.166 to 0.208)	0.073	<0.0001
2	0.113 (0.090 to 0.136)	0.141 (0.119 to 0.163)	0.028	0.090
3	0.124 (0.097 to 0.151)	0.111 (0.095 to 0.127)	−0.013	0.42
4	0.099 (0.071 to 0.126)	0.118 (0.099 to 0.137)	0.019	0.26
5	0.094 (0.072 to 0.116)	0.086 (0.069 to 0.102)	−0.008	0.56
6	0.098 (0.070 to 0.127)	0.108 (0.088 to 0.128)	0.010	0.59
7	0.068 (0.042 to 0.093)	0.100 (0.078 to 0.122)	0.032	0.060
8	0.083 (0.053 to 0.114)	0.082 (0.066 to 0.097)	−0.002	0.92
9	0.082 (0.041 to 0.122)	0.093 (0.071 to 0.116)	0.012	0.62
10 (highest)	0.059 (0.035 to 0.083)	0.077 (0.052 to 0.103)	0.019	0.30
Years of schooling				
9 or fewer	0.128 (0.101 to 0.154)	0.190 (0.162 to 0.218)	0.062	0.0015
10	0.095 (0.074 to 0.116)	0.137 (0.109 to 0.165)	0.042	0.018
11	0.096 (0.077 to 0.115)	0.109 (0.080 to 0.139)	0.013	0.471
12	0.071 (0.042 to 0.100)	0.124 (0.114 to 0.133)	0.053	0.0006
13	0.061 (0.038 to 0.083)	0.116 (0.090 to 0.141)	0.055	0.0013
14 or more	0.056 (0.039 to 0.073)	0.085 (0.076 to 0.093)	0.029	0.0031
Household wealth decile				
1 (lowest)	0.165 (0.132 to 0.198)	0.187 (0.162 to 0.211)	0.022	0.31
2	0.117 (0.092 to 0.143)	0.149 (0.129 to 0.169)	0.031	0.061
3	0.100 (0.073 to 0.127)	0.107 (0.091 to 0.122)	0.006	0.68
4	0.093 (0.071 to 0.115)	0.115 (0.098 to 0.132)	0.022	0.12
5	0.110 (0.085 to 0.134)	0.091 (0.077 to 0.106)	−0.018	0.21
6	0.080 (0.057 to 0.103)	0.089 (0.074 to 0.103)	0.008	0.55
7	0.070 (0.046 to 0.094)	0.103 (0.084 to 0.123)	0.034	0.034
8	0.092 (0.066 to 0.118)	0.089 (0.072 to 0.106)	−0.003	0.85
9	0.082 (0.048 to 0.116)	0.103 (0.084 to 0.123)	0.021	0.28
10 (highest)	0.060 (0.038 to 0.081)	0.067 (0.051 to 0.084)	0.008	0.58
Household non-housing wealth decile				
1 (lowest)	0.136 (0.103 to 0.168)	0.201 (0.176 to 0.226)	0.065	0.0019
2	0.109 (0.084 to 0.134)	0.137 (0.119 to 0.156)	0.029	0.074
3	0.123 (0.095 to 0.151)	0.131 (0.111 to 0.150)	0.008	0.66
4	0.096 (0.073 to 0.118)	0.101 (0.085 to 0.116)	0.005	0.71
5	0.108 (0.082 to 0.134)	0.107 (0.091 to 0.123)	−0.001	0.95
6	0.093 (0.067 to 0.119)	0.086 (0.070 to 0.101)	−0.007	0.64
7	0.099 (0.072 to 0.125)	0.086 (0.070 to 0.102)	−0.013	0.42
8	0.078 (0.051 to 0.105)	0.090 (0.073 to 0.106)	0.011	0.49
9	0.058 (0.036 to 0.081)	0.092 (0.074 to 0.111)	0.034	0.024
10 (highest)	0.063 (0.043 to 0.084)	0.079 (0.062 to 0.095)	0.015	0.26

Sample includes non-Hispanic white population aged 70+ only. The sample size is 3147 participants in England and 5330 participants in the USA. All estimates are age-gender standardised to the overall 2016 aged 70+ white population in England. The difference is calculated as the prevalence in the USA minus prevalence in England. All deciles are calculated within country.
Overall prevalence and prevalence according to four measures of socioeconomic status.

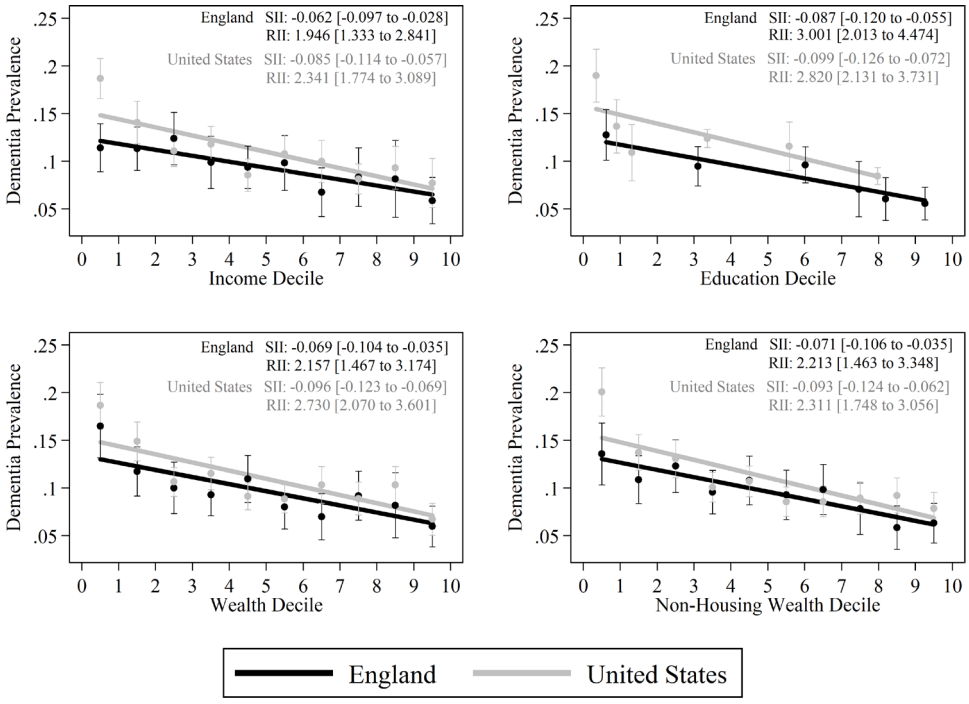

Figure 1 SES Gradient of Dementia, USA versus England, 2017, according to four measures of SES. Absolute and relative inequality shown with 95% CI. The points in this figure represent the mean age-gender standardised dementia prevalence for each country by SES, along with 95% CI for these predictions. The solid lines represent the fitted Slope Index of Inequality (SII: absolute inequality) for each country. The values of the SII and the corresponding Relative Index of Inequality (RII: relative inequality) are listed in the top right of each figure, with 95% CI in brackets. For education, individuals are ranked based on their years of schooling within each country, and as the USA has higher educational attainment, individuals with 14+ years of schooling are the 80th percentile of the US education distribution, but at the 90th percentile of the English educational distribution. SES, socioeconomic status.

in dementia prevalence after we controlled for various measures of past health and behaviours. The results are split into three panels: the whole sample; the whole sample excluding those in the lowest income decile and the lowest income decile. As was shown in table 1, the difference in the prevalence of dementia between England and the USA was 1.43 pp (p=0.0055). Table 2 shows this difference declined to 0.894 pp (p=0.11) when we excluded the lowest income decile. Controlling for past health and behaviours modestly reduced this cross-country difference further: the difference declined by a maximum of 19%. For the lowest income decile, controlling for past health and behaviour reduced the cross-country difference of 7.27 pp (p<0.0001) by a more substantial 33%.

In the online supplemental tables A6–A8, we investigated whether past health and behaviour explained the SES gradient within each country. We found that in England and the USA these factors accounted for most of the SES gradient, as shown in online supplemental figure A1. However, in the USA, prevalence in the lowest income decile remained disproportionately high.

Education has also been shown to be a risk factor for dementia. Table 1 shows that in both the USA and England, the less educated have higher dementia prevalence. Controlling for education increased the estimated difference across countries, from 1.43 pp to 2.82 pp, as can be seen in the online supplemental table A7. Education cannot explain these differences since the English have lower educational attainment.

In our main analysis, we exclude ethnic minorities, who have higher dementia prevalence and comprise a larger share of the USA than the English population. Including minorities increased the estimated difference across countries, from 1.43 pp to 2.42 pp, as can be seen in the online supplemental tables A9 and A10. This is largely caused by the high prevalence of dementia among minorities in the USA as displayed in online supplemental table A11.

DISCUSSION

Main findings

Using nationally representative samples of older individuals from England and the USA and applying the same algorithmic procedure to predict dementia in both samples, we showed that in both the USA and England dementia is more prevalent among the disadvantaged, and the SES gradient of dementia is steeper in the USA. The steeper gradient in the USA is largely driven by those in the lowest decile. In both countries, most of the SES gradient disappeared when we controlled for past health related factors, although prevalence for those in lowest income decile in the USA remained disproportionately high. If the lowest income decile is excluded from our sample the difference in dementia prevalence across the

Table 2 Difference in prevalence of dementia, USA vs England, 2017

Whole sample					
Percentage point difference	1.43	1.34	1.15	1.21	1.18
p value	0.0055	0.0091	0.025	0.020	0.034
% Difference from baseline	–	–6%	–19%	–16%	–17%
Excluding lowest income decile					
Percentage point difference	0.89	0.88	0.74	0.75	0.81
p value	0.11	0.11	0.18	0.18	0.18
% difference from baseline	–	–2%	–17%	–16%	–10%
Lowest income decile					
Percentage point difference	7.27	6.14	5.45	5.93	4.85
p value	<0.0001	0.0003	0.002	0.0011	0.012
% difference from baseline	–	–15%	–25%	–18%	–33%
Control for					
Past cardiometabolic diseases		✓	✓	✓	✓
Past psychiatric conditions			✓	✓	✓
Ever smoked				✓	✓
Past BMI					✓

Sample includes non-Hispanic white population aged 70+ only. The sample size is 3147 participants in England and 5330 participants in the USA. All estimates are age-gender standardised to the overall 2016 aged 70+ white population in England. The difference is calculated as the prevalence in the USA minus prevalence in England. Differences are displayed as percentage points. 'Past Cardiometabolic Diseases' and 'Past Psychiatric Conditions' control for whether an individual says they had the conditions 4 years prior. 'Cardiometabolic Diseases' include diabetes, heart disease and stroke. 'Smoking' controls for whether an individual has ever smoked. 'Past BMI' includes dummy variables to control for whether an individual is classed as underweight, *overweight* or *obese*. BMI values are based on when an individual first entered the survey, which is at least 10 years prior.
Estimates of the between-country difference taking account of antecedent health status, smoking and degree of adiposity.
BMI, body mass index.

countries is statistically insignificant, and the remaining SES gradient of dementia is remarkably similar across countries.

While poorer individuals face a higher burden of dementia in both England and the USA, the extremely poor in the USA face a disproportionately high burden of dementia. Controlling for past health-related factors can explain some, but not all, of the cross-country difference. It can explain up to around one third of the difference for those in the lowest income decile. While past health factors such as adiposity and smoking are correlated with dementia, those in the lowest income decile in the USA do not smoke more or have higher body mass indexes (BMIs) than their English counterparts. Therefore, this cannot explain their disproportionately higher prevalence of dementia. Education also cannot explain the difference, as the US population is more educated at every income decile, and in fact the educational difference masks some of the underlying dementia risk difference between countries.

Adding minorities increased estimated dementia prevalence, especially in the USA, because dementia prevalence is higher among minorities, who comprise a higher share of the USA than the English population. This fits with prior research which showed dementia prevalence is higher for non-whites and Hispanics.[20 21] We did not observe higher dementia prevalence among Hispanics and non-whites in the USA for those in relatively high socioeconomic groups.

Comparison with previous studies and how findings are an advance on current literature

Previous studies have shown cross-country variation in dementia prevalence. However, substantial heterogeneity in case-ascertainment methods across countries and studies makes interpreting any observed differences difficult. We believe this is the first study to compare dementia prevalence in England and the USA using the exact same measure of dementia, thus overcoming previous difficulties in making comparisons across the two countries due differences in diagnostic practices and case definitions. We also compared the SES gradient of dementia in both countries. While some studies have shown in both England and the USA those with lower education and less wealth have been found to have higher rates of dementia,[4 9 11 22 23] there are no systematic comparative studies. We compared prevalence along the SES gradient using almost identical measures of income, wealth and education. Further, we standardised the cross-country comparison for age and gender, using the English over 70 population as the standard population. We found that dementia prevalence is higher and more concentrated

among the poorest in the USA than England. Detailed disaggregation according to SES measures shows the true extent of the excess burden of dementia in the very poorest group in the USA.

We showed that risk factors for dementia such as cardiometabolic diseases, psychiatric conditions, high BMI, smoking have similar affects across countries. Accounting for these risk factors removes most of the SES gradient for both countries, but disproportionately high prevalence remains for the most disadvantaged in the USA.

Implications (wider interpretation)

Much research has shown that low-income Americans are more likely to be in poor health and die younger than their high-income counterparts.[24] We show that these health differences also extend to dementia prevalence.

While risk factors contribute to higher prevalence among those who are more disadvantaged, those in the USA appear to have an undue burden that is caused by risk factors for which we cannot account. One possible explanation is differential access to healthcare. The NHS provides broadly equitable care according to education in the older population after accounting for health status.[25] In the USA, the poor often go uninsured, and although virtually every American aged 65 or older is eligible for Medicare, around 20% of Medicare beneficiaries healthcare must be financed out of pocket.[26] The extent to which healthcare provision below and above aged 65 may account for the relative excess dementia burden in the USA is unclear.

The implications of our results are that interventions designed to attempt to prevent dementia should be targeted towards the most disadvantaged. This is especially true in the USA. As yet, we are unable to advocate specific measures as we do not yet understand the specific nature of disadvantage in respect to dementia risk.

Strengths and weaknesses of analysis

This study has a strong design. Results are directly comparable across England and the USA. The same predictive algorithm was applied to both countries, addressing the problem of heterogeneity in case ascertainment which has affected the literature.[1 13] Further, because ELSA and HRS share sample selection and questionnaire design, any differences in overall prevalence and SES gradients in prevalence across the two countries should represent true differences. In contrast to the Global Burden Disease study, we find higher dementia prevalence in the USA. Furthermore, we measured the SES gradient of dementia across four different measures of SES, with consistent results. Our work also highlights the usefulness of the standardised measure of dementia to allow for meaningful comparisons across countries.

This study had three limitations. First, we do not ascertain dementia directly, but predict cases using a common battery of measures in ELSA and HRS. Importantly, Hurd's prediction algorithm has high accuracy and although our case definition lacks a clinical point of reference in England, it is based on a detailed clinical substudy in the USA.[16] Further, cross-cultural subjectivities in reporting of impairment severity are likely to be similar in the USA and England (see online supplemental table A5). It would be of great value for future work to use the Harmonized Cognitive Assessment Protocol data to provide a standard clinical point of reference to validate and verify the cross-country dementia prevalence estimates.[27] Second, education is one of the factors in the predictive algorithm for dementia and also one of our measures of SES. The dementia algorithm takes account of the well-documented correlation between education level and cognitive function in adult life. Nevertheless, we found substantial absolute and relative inequalities in dementia prevalence according to education level in the USA and UK. Education may be a successful approach for reducing dementia risk.[28] Third, while we show risk factors explain a large proportion of the differences in dementia between the England and the USA—although cannot account for the difference in the lowest income decile—there are likely other unmeasured confounding factors that impact dementia prevalence which we do not observe.

CONCLUSION

Given the large social and economic costs of dementia, there is great value in understanding the scope and burden of dementia in the population along the SES gradient. This study indicates that more disadvantaged individuals face a higher burden of dementia and that the poorest individuals in the USA face a disproportionately high burden. The high burden faced by these individuals can be partly but not fully explained by past health factors. We lacked data on other important possible contributing factors such as habitual drug use. Further research is needed to fully understand this issue using data from multiple sources.

Contributors All authors made a substantial contribution to study conception and design. EF and JM developed the original idea. JM and KA prepared and analysed the data, with inputs from EF and EB. All authors contributed to interpreting the results and drafting the manuscript. JM and KA serve as guarantors and affirm that the manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained. All authors had full access to all of the data (including statistical reports and tables) in the study and take responsibility for the integrity of the data and accuracy of the data analysis. criteria and that no others meeting the criteria have been omitted.

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Competing interests None declared.

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REFERENCES

1 GBD 2016 Dementia Collaborators. Global, regional, and national burden of Alzheimer's disease and other dementias, 1990-2016: a systematic analysis for the global burden of disease study 2016. *Lancet Neurol* 2019;18:88–106.
2 Kuo C-L, Pilling LC, Atkins JL. Apoe e4e4 genotype and mortality with COVID-19 in UK Biobank. *medRxiv* 2020.
3 Hurd MD, Martorell P, Delavande A, *et al*. Monetary costs of dementia in the United States. *N Engl J Med* 2013;368:1326–34.
4 Hudomiet P, Hurd MD, Rohwedder S. The relationship between lifetime out-of-pocket medical expenditures, dementia, and socioeconomic status in the U.S. *J Econ Ageing* 2019;14:100181.
5 Banks J, Marmot M, Oldfield Z, *et al*. Disease and disadvantage in the United States and in England. *JAMA* 2006;295:2037–45.
6 Marmot MG. Status syndrome: a challenge to medicine. *JAMA* 2006;295:1304–7.
7 Brunner EJ. Social factors and cardiovascular morbidity. *Neurosci Biobehav Rev* 2017;74:260–8.
8 Marmot M. Health equity in England: the marmot review 10 years on. *BMJ* 2020;368:m693.
9 Rusmaully J, Dugravot A, Moatti J-P, *et al*. Contribution of cognitive performance and cognitive decline to associations between socioeconomic factors and dementia: a cohort study. *PLoS Med* 2017;14:e1002334.
10 George KM, Lutsey PL, Kucharska-Newton A, *et al*. Life-course individual and neighborhood socioeconomic status and risk of dementia in the Atherosclerosis risk in communities neurocognitive study. *Am J Epidemiol* 2020;189:1134–42.
11 Cadar D, Lassale C, Davies H, *et al*. Individual and area-based socioeconomic factors associated with dementia incidence in England: evidence from a 12-year follow-up in the English longitudinal study of ageing. *JAMA Psychiatry* 2018;75:723–32.
12 Global Burden of Disease. Global burden of disease. GBD compare. IHME viz hub. GBD COMP. viz hub. Available: https://vizhub.healthdata.org/gbd-compare/ [Accessed 18 Jul 2020].
13 Launer LJ. Statistics on the burden of dementia: need for stronger data. *Lancet Neurol* 2019;18:25–7.
14 Sonnega A, Faul JD, Ofstedal MB, *et al*. Cohort profile: the health and retirement study (HRS). *Int J Epidemiol* 2014;43:576–85.
15 Steptoe A, Breeze E, Banks J, *et al*. Cohort profile: the English longitudinal study of ageing. *Int J Epidemiol* 2013;42:1640–8.
16 Gianattasio KZ, Wu Q, Glymour MM, *et al*. Comparison of methods for algorithmic classification of dementia status in the health and retirement study. *Epidemiology* 2019;30:291–302.
17 Jorm AF, Christensen H, Korten AE, *et al*. Informant ratings of cognitive decline in old age: validation against change on cognitive tests over 7 to 8 years. *Psychol Med* 2000;30:981–5.
18 Banks J, Muriel A, Smith JP. Attrition and health in ageing studies: evidence from ELSA and Hrs. *Longit Life Course Stud* 2011;2:101–26.
19 Wagstaff A, Paci P, van Doorslaer E. On the measurement of inequalities in health. *Soc Sci Med* 1991;33:545–57.
20 Yaffe K, Falvey C, Harris TB, *et al*. Effect of socioeconomic disparities on incidence of dementia among biracial older adults: prospective study. *BMJ* 2013;347:f7051.
21 Vega IE, Cabrera LY, Wygant CM, *et al*. Alzheimer's disease in the latino community: intersection of genetics and social determinants of health. *J Alzheimers Dis* 2017;58:979–92.
22 Langa KM, Larson EB, Crimmins EM, *et al*. A comparison of the prevalence of dementia in the United States in 2000 and 2012. *JAMA Intern Med* 2017;177:51–8.
23 Rocca WA, Petersen RC, Knopman DS, *et al*. Trends in the incidence and prevalence of Alzheimer's disease, dementia, and cognitive impairment in the United States. *Alzheimers Dement* 2011;7:80–93.
24 Chetty R, Stepner M, Abraham S, *et al*. The association between income and life expectancy in the United States, 2001-2014. *JAMA* 2016;315:1750–66.
25 Stoye G, Zaranko B, Shipley M, *et al*. Educational inequalities in hospital use among older adults in England, 2004-2015. *Milbank Q* 2020;98:1134–70.
26 De Nardi M, French E, Jones JB, *et al*. Medical spending of the US elderly. *Fisc Stud* 2016;37:717–47.
27 Langa KM, Ryan LH, McCammon RJ, *et al*. The health and retirement study harmonized cognitive assessment protocol project: study design and methods. *Neuroepidemiology* 2020;54:64–74.
28 Nguyen TT, Tchetgen Tchetgen EJ, Kawachi I, *et al*. Instrumental variable approaches to identifying the causal effect of educational attainment on dementia risk. *Ann Epidemiol* 2016;26:71–6.

Supplementary Appendix (For Online Publication)

Research in context

We reviewed existing evidence in July 2020, searching PubMed database for any studies looking at cross-country comparisons of dementia using the same standard measures and diagnostic practices.

("Dementia"[mesh]) AND ("Prevalence"[mesh])

AND

("Survey"[tw]) AND ("Population"[tw]) AND ("Representative"[tw])

AND

("Cross-Country"[ti] OR "Comparison"[ti])

This search yielded no results. The only relevant project we could find relating to our research was regarding the Health and Retirement Study Harmonized Cognitive Assessment Protocol (HCAP) Project. [1] This is an international research collaboration funded by the National Institute on Aging to better measure and identify cognitive impairment and dementia in longitudinal studies of countries around the world. However, this project has not yet released any international comparisons.

We also reviewed existing evidence in the PubMed database for any studies looking at how dementia prevalence varies by socioeconomic status (SES) in either England or the US. The search terms used were the following:

("Dementia"[mesh]) AND

("Prevalence"[tw]) AND ("Socioeconomic"[ti] OR "Socioeconomic"[tw] OR "SES"[tw]) AND

("United Kingdom"[mesh] OR "United Kingdom"[tw] OR "England"[tw] OR "UK"[tw] OR "United Kingdom"[tw] "Britain"[tw] OR "United States"[mesh] OR "United States"[tw] OR "US"[tw] OR "America"[tw])

This search yielded 50 results. Papers which were not relevant were manually removed. We also excluded papers that did not use nationally representative samples. We performed additional searches using lists of references retrieved from relevant papers. Relevant papers found in the search can be found in Table A1 below.

Table A1: Studies on Dementia Prevalence by Socioeconomic Status (SES)

Authors	Country	Socioeconomic Indicator	Years	Findings
Langa et al. (2017)[1]	United States	Education	2000 and 2012	Link between education and dementia risk
Hudomiet et al, (2019)[2]	United States	Education and Social Security Benefits	1998 to 2014	Link between education and dementia risk
Rusmaully et al, (2017)[3]	United Kingdom	Education, height, occupational position	Various years between 1985 and 2015	High cognitive reserve associated with lower risk for dementia
Cadar et al, (2018)[4]	United Kingdom	Education, wealth and the index of multiple deprivation	2002 to 2015	Lower wealth in but not education associated with increased risk for dementia
Rocca et al,(2011)[5]	United States	Education, net worth	1993 and 2002	Higher education, higher net worth protected against cognitive impairment.
Basu (2013)[6]	United States	Education	2000 - 2002	Education has causal effect on dementia risk
Nguyen et al, (2016)[7]	United States	Education	1998 to 2010	Education protective against dementia risk
Crimmins et al, (2018)[8]	United States	Education	2000 and 2010	More education linked to lower dementia prevalence
Garcia et al, (2018)[9]	United States	Race, ethnicity, nativity, and education	2012	Education reduces the odds for CIND
Weden et al, (2018)[10]	United States	Race, ethnicity, total number of children, marital status, highest educational attainment, and net total assets in 2000	2000 and 2010	Strong protective role of educational attainment and persisting rural disadvantages for dementia

Data Appendix

HRS Data

The Health and Retirement Study (HRS) is a nationally representative, biennial longitudinal survey of adults in the United States.[11] It started in 1992 and since it collects a wide range of questions on income, wealth, employment, health, cognition, and demographics. It utilises a steady-state sampling design, with a new cohort aged 51-56 entering every 6 years. In total, 43,478 individuals have been interviewed to date. We used data from the 2016 and earlier waves to predict dementia and focused on the over the age of 70 years old that live in the community or in nursing homes in 2016. This left a sample of 7,165 individuals. We restricted our attention to non-Hispanic whites for comparability with ELSA. These restrictions generated a main study sample of 5,330 participants with 4,932 being self-respondents, and 398 proxy interviews.

ELSA Data

The English Longitudinal Study of Ageing (ELSA) is a biennial longitudinal survey of adults in England, developed as a companion study to the HRS.[12] ELSA was also designed to be nationally representative of the non-institutionalised population. Respondents remain the study if they become institutionalised. While it is has been shown to be representative of the English population in terms of sociodemographic characteristics, the proportion of non-white people in the survey is very small.[12] We used data from the 2016 and earlier waves and focused on the aged over 70 years old that live in the community or in nursing homes in 2016. This left a sample of 3,224 individuals. We restricted our attention to non-Hispanic whites for comparability. These restrictions generated a study sample of 3,147 participants with 3,007 being self-respondents, and 140 proxy interviews.

Harmonised Variables HRS and ELSA

We use the same set of cognitive and demographic variables available in both the HRS and ELSA.

For cognitive and demographic measures, we used the same questions as Hurd et al.[13] Specifically, we used variables on demographics, difficulties respondents have with Activities of Daily Living (ADLs), Instrumental Activities of Daily Living (IADLs), and a range of cognitive function tests adapted from the Telephone Interview for Cognitive Status (TICS) and their change across waves. For Proxy respondents we also used the shortened 16 question form of IQCODE.

We used four variables to measure socioeconomic status (SES). These are household income, education, total household wealth, and total household non-housing wealth. For the HRS we used variables from HRS RAND dataset. To establish each respondent's SES in terms of income, wealth, and non-housing wealth, we assigned everyone to a decile rank for each variable in their respective country. For education, we ranked respondents according to their number of years of schooling. We used respondents' reported wealth and non-housing wealth from 4 years prior. If a respondent had a missing value of income, wealth, or non-housing wealth we used the most recent non-missing observation from previous waves. All amounts of income, wealth and non-housing wealth were deflated to 2016 GBPs, and USD amounts were converted to GBPs using 1 USD = 0.75 GBP.

Finally, in our analysis, we investigated how variables that have been associated with dementia affect our results. These include Body Mass Index (BMI), past smoking behaviour, past stroke. Respondents are asked whether they have any health conditions, of which we use whether they had any cardiometabolic diseases (diabetes, heart disease, and stroke) and/or psychiatric conditions 4 years prior. BMI is collected by a nurse for every ELSA respondent when they first enter the survey, which for everyone over 70 in the 2016 survey means their BMI was collected over 10 years prior. BMI is recorded in each wave of HRS based on self-reported height and weight. To make the BMI measures in HRS comparable with ELSA, we used respondents first ever recorded BMI in HRS, which for our sample was at least 10 years prior.

Hurd et al. Dementia Prediction Algorithm

To estimate the probability of dementia for each individual present in our pooled data we follow the method of Hurd et al. that is based on the HRS supplement Aging, Demographics and Memory Study (ADAMS).[13] It is a representative subsample of HRS members aged over 70 that received a detailed in-home assessment of their cognitive status by experienced teams at the Duke University Dementia Epidemiology

Research Center.[14] Consensus conferences were used to establish a final diagnosis of dementia or a cognitive impairment with no dementia (CIND) for each participant. Hurd et al. applied separate ordered probit models to self- and proxy-respondents to generate a predictive algorithm, based on the ADAMS diagnoses, for the whole HRS sample, using a range of variables including demographic information, ADLs, IADLs, the TICS questionnaire, IQCODE, lagged variables and differences in variables between waves. The algorithm predicts the probability of dementia in the following year.

Most of the coefficients used in the predictive algorithm can be found in the online appendix of the Hurd et al. paper. To account for the small number of missing variables in HRS and ELSA we either used coefficients provided by the authors or estimated them by a conditional minimum distance estimator using the publicly available HRS data and the predicted values of the researcher contribution Dementia Predicted Probability Files (DPPF), that follows the method of Hurd et al. To verify our predictions in HRS, we compared our predictions with the DPPF data available on the HRS website for the year 2008 and found that we accurately matched predicted dementia.

Hurd et al's predictive algorithm has been shown to have high specificity and accuracy, and generally performs well in terms of sensitivity compared to other predictive algorithms for dementia.[15]

Table A2: HRS and ELSA Response Rates

Year	2010	2012	2014	2016
HRS				
Wave	10	11	12	13
Response rate (%)	81.0	89.1	87.1	84.3
ELSA				
Wave	5	6	7	8
Fieldwork response rate (%)	79.1	80.2	80.1	82.4

Notes: The response rates are calculated differently in HRS and ELSA. For the HRS, the response rate includes all individuals who were determined to be eligible for HRS who completed a baseline interview.[16] For ELSA, the fieldwork response rate is the proportion of eligible survey units who participate in the research study, where 'eligible' means not having been found to be ineligible through death or moving out of Great Britain.[17]

Table A3: Summary Statistics, Raw Sample, England vs United States

	Raw Full Sample		With Population Weights	
	Non-Standardized Mean		Non-Standardized Mean	
	England	United States	England	United States
Total Sample Size	3,147	5,330	3,147	5,330
Proxy Respondents (%)	0.044	0.075	0.050	0.072
Age	78.8	80.5	79.5	79.7
Female	0.551	0.590	0.553	0.561
Married	0.580	0.517	0.584	0.536
Current Income and Wealth (£)				
Income	21,070	28,800	20,215	30,240
Wealth	280,000	210,000	270,000	230,000
Non-Housing Wealth	40,000	88,275	36,000	96,150
Wealth 4 Years Prior (£)				
Wealth	270,000	220,000	250,000	230,000
Non-Housing Wealth	42,300	96,800	35,727	100,000
Education				
Less than High School	0.362	0.174	0.424	0.161
High-school or Some College	0.473	0.573	0.444	0.560
College	0.165	0.253	0.132	0.279
Current Health				
ADLs (Out of 6)	0.510	0.583	0.561	0.548
IADLs (Out of 5)	0.348	0.513	0.411	0.482
Arthritis	0.569	0.728	0.578	0.715
Cancer	0.190	0.251	0.189	0.244
Lung disease	0.117	0.135	0.118	0.127
Diabetes	0.162	0.246	0.166	0.240
Heart Disease	0.390	0.383	0.396	0.365
High Blood Pressure	0.576	0.684	0.583	0.671
Psychiatric Condition	0.134	0.171	0.132	0.175
Stroke	0.092	0.103	0.096	0.095
Health 4 Years Prior				
ADLs	0.346	0.274	0.381	0.267
IADLs	0.159	0.228	0.185	0.219
Diabetes	0.131	0.215	0.135	0.212
Heart Disease	0.309	0.316	0.312	0.303
High Blood Pressure	0.513	0.653	0.519	0.643
Psychiatric Condition	0.120	0.157	0.118	0.162
Stroke	0.063	0.074	0.065	0.067
Other Health Factors				
Ever Smoked	0.660	0.553	0.674	0.561
BMI: <20 (Underweight)	0.016	0.038	0.015	0.036
BMI: 20-24.9 (Normal Weight)	0.266	0.352	0.262	0.343
BMI: 25-29.9 (Overweight)	0.461	0.405	0.461	0.410
BMI: 30+ (Obese)	0.256	0.205	0.262	0.211

Notes: Sample includes non-Hispanic white population aged 70+ only. The sample size is participants in England and participants in the United States. The mean is presented for each variable, apart from income and wealth variables where medians values are displayed. All amounts deflated to 2016 £s. Dollar amounts converted to £ using 1 $ = 0.75 £. Age is top coded at 99.

Table A4: Summary Statistics, Age-Gender Standardized, England vs United States

	Full Sample		Lowest Income Decile	
	Age-Gender Standardized Mean		Age-Gender Standardized Mean	
	England	United States	England	United States
Age	79.5	79.3	79.7	79.7
Female	0.553	0.553	0.553	0.553
Married	0.584	0.547	0.148	0.170
Current Income and Wealth (£)				
Income	20,547	31,927	8,247	8,645
Wealth	271,511	236,431	120,261	46,762
Non-Housing Wealth	38,715	100,996	7,778	5,509
Wealth 4 Years Prior (£)				
Wealth	257,459	242,655	111,830	55,953
Non-Housing Wealth	40,604	110,530	6,476	13,724
Education				
Less than High School	0.424	0.160	0.619	0.323
High-school or Some College	0.444	0.559	0.318	0.556
College	0.132	0.281	0.063	0.122
Current Health				
ADLs (Out of 6)	0.561	0.523	0.559	0.827
IADLs (Out of 5)	0.411	0.457	0.421	0.679
Arthritis	0.578	0.715	0.617	0.750
Cancer	0.189	0.244	0.157	0.196
Lung disease	0.118	0.127	0.137	0.217
Diabetes	0.166	0.242	0.157	0.283
Heart Disease	0.396	0.364	0.402	0.427
High Blood Pressure	0.583	0.671	0.619	0.703
Psychiatric Condition	0.132	0.174	0.158	0.262
Stroke	0.096	0.094	0.111	0.135
Health 4 Years Prior				
ADLs	0.381	0.255	0.424	0.546
IADLs	0.185	0.205	0.218	0.393
Diabetes	0.135	0.214	0.131	0.254
Heart Disease	0.312	0.302	0.345	0.352
High Blood Pressure	0.519	0.640	0.559	0.662
Psychiatric Condition	0.118	0.162	0.142	0.271
Stroke	0.065	0.066	0.064	0.099
Other Health Factors				
Ever Smoked	0.674	0.565	0.741	0.594
BMI: <20 (Underweight)	0.015	0.036	0.025	0.032
BMI: 20-24.9 (Normal Weight)	0.261	0.342	0.361	0.364
BMI: 25-29.9 (Overweight)	0.461	0.410	0.397	0.339
BMI: 30+ (Obese)	0.262	0.212	0.216	0.265

Notes: Sample includes non-Hispanic white population aged 70+ only. The sample size is 3,147 participants in England and 5,330 participants in the United States. The age-gender standardized mean is presented for each variable, apart from income and wealth variables where age-gender standardised medians values are displayed. The standard population is the overall age 70+ population in England in 2016. All amounts deflated to 2016 £s. Dollar amounts converted to £ using 1 $ = 0.75 £. Age is top coded at 99.

Table A5: Summary Statistics for Predictor Variables, England vs United States

	Full Sample		Lowest Income Decile	
	Age-Gender- Standardized Mean		Age-Gender-Standardized Mean	
	England	United States	England	United States
Cognitive Scores				
Dates (Out of 4)	3.663	3.387	3.573	3.198
Backward counting 20	0.912	0.875	0.935	0.830
Serial 7 (Out of 5)	3.787	3.364	3.667	2.580
Scissor	0.978	0.920	0.993	0.912
Cactus	0.915	0.891	0.913	0.842
PM/Vice-President	0.846	0.900	0.828	0.854
Immediate recall (Out of 10)	5.318	4.631	5.010	3.972
Delayed recall (Out of 10)	3.797	3.684	3.185	2.894
Limitations				
ADLs (Out of 6)	0.561	0.523	0.559	0.827
IADLs (Out of 5)	0.411	0.457	0.421	0.679
Proxy Respondent	0.050	0.068	0.038	0.075

Notes: Sample includes non-Hispanic white population aged 70+ only. The sample size is 3,147 participants in England and 5,330 participants in the United States. The Cognitive Scores are from a range of tests adapted from Telephone Interview for Cognitive Status (TICS). Only non-proxy respondents answered the TICS questions. ADL and IADLs are Activities of Daily Living and Instrumental Activities of Daily Living, respectively.

Table A6: Indexes of Inequality

	Slope Index of Inequality (SII)			Relative Index of Inequality (RII)		
	England	United States	Difference	England	United States	Difference
Income	-0.062	-0.085	-0.023	1.946	2.341	1.203
	[-0.097 to -0.028]	[-0.114 to -0.057]	(0.31)	[1.333 to 2.841]	[1.774 to 3.089]	(0.44)
Education	-0.087	-0.099	-0.011	3.001	2.820	0.940
	[-0.120 to -0.055]	[-0.126 to -0.072]	(0.56)	[2.013 to 4.474]	[2.131 to 3.731]	(0.80)
Wealth	-0.069	-0.096	-0.026	2.157	2.730	1.265
	[-0.104 to -0.035]	[-0.123 to -0.069]	(0.24)	[1.467 to 3.174]	[2.070 to 3.601]	(0.33)
NH Wealth	-0.071	-0.093	-0.022	2.213	2.311	1.044
	[-0.106 to -0.035]	[-0.124 to -0.062]	(0.36)	[1.463 to 3.348]	[1.748 to 3.056]	(0.87)
Excluding Most Disadvantaged Group						
Income	-0.067	-0.060	0.007	2.104	1.833	0.871
	[-0.107 to -0.027]	[-0.093 to -0.027]	(0.79)	[1.343 to 3.296]	[1.313 to 2.560]	(0.63)
Education	-0.070	-0.062	0.008	2.509	1.932	0.770
	[-0.107 to -0.032]	[-0.094 to -0.030]	(0.76)	[1.548 to 4.065]	[1.378 to 2.708]	(0.39)
Wealth	-0.065	-0.059	0.005	2.092	1.887	0.902
	[-0.104 to -0.025]	[-0.091 to -0.028]	(0.84)	[1.319 to 3.317]	[1.349 to 2.639]	(0.72)
NH Wealth	-0.064	-0.075	-0.012	2.077	1.981	0.954
	[-0.107 to -0.020]	[-0.110 to -0.040]	(0.69)	[1.217 to 3.544]	[1.433 to 2.740]	(0.88)
Full Sample with Controls						
Income	-0.040	-0.051	-0.011	1.499	1.698	1.133
	[-0.075 to -0.004]	[-0.079 to -0.023]	(0.63)	[1.028 to 2.187]	[1.275 to 2.263]	(0.61)
Education	-0.0336	-0.056	-0.022	1.308	1.742	1.332
	[-0.0754 to 0.008]	[-0.086 to -0.026]	(0.40)	[0.899 to 1.903]	[1.306 to 2.324]	(0.24)
Wealth	-0.060	-0.045	0.015	1.777	1.483	0.834
	[-0.097 to -0.023]	[-0.074 to -0.015]	(0.53)	[1.224 to 2.582]	[1.131 to 1.945]	(0.44)
NH Wealth	-0.050	-0.051	-0.002	1.562	1.614	1.033
	[-0.087 to -0.012]	[-0.080 to -0.023]	(0.94)	[1.078 to 2.262]	[1.231 to 2.116]	(0.89)

Notes: This table shows the Slope Index of Inequality (SII) and Relative Index of Inequality (RII), calculated using generalized linear models (log binomial regression) with identity and logarithmic link functions, respectively. The SIIs are displayed graphically in Figure 1. The estimates of RII are risk ratios. P-values are displayed in parentheses under differences. The panel 'Excluding Most Disadvantaged Group' excludes individuals in the bottom income decile. The panel 'Full Sample with Controls' controls for whether an individual had any cardiometabolic diseases (diabetes, heart disease, and stroke) and/or psychiatric conditions 4 years prior, whether an individual has ever smoked, and Body Mass Index (BMI) from at least 10 years prior.

Table A7: Difference in Prevalence of Dementia with Controls, United States vs England, 2017

Whole Sample:					
England Prevalence	0.097	0.088	0.086	0.089	0.092
	(0.089 to 0.106)	(0.078 to 0.098)	(0.073 to 0.099)	(0.072 to 0.106)	(0.072 to 0.111)
United States	0.112	0.100	0.098	0.101	0.120
	(0.106 to 0.118)	(0.092 to 0.108)	(0.087 to 0.109)	(0.087 to 0.114)	(0.104 to 0.135)
Percentage Point Difference	1.43	1.15	1.21	1.18	2.82
p-value	0.0055	0.025	0.020	0.034	<0.0001
Excluding Lowest Income Decile:					
England Prevalence	0.094	0.086	0.086	0.090	0.094
	(0.085 to 0.103)	(0.076 to 0.096)	(0.073 to 0.1)	(0.073 to 0.108)	(0.074 to 0.114)
United States	0.103	0.093	0.094	0.098	0.115
	(0.097 to 0.109)	(0.085 to 0.102)	(0.083 to 0.105)	(0.084 to 0.113)	(0.099 to 0.131)
Percentage Point Difference	0.89	0.74	0.75	0.81	2.09
p-value	0.11	0.18	0.18	0.18	0.0021
Lowest Income Decile:					
England Prevalence	0.114	0.107	0.088	0.082	0.095
	(0.089 to 0.139)	(0.074 to 0.14)	(0.036 to 0.14)	(0.021 to 0.144)	(0.025 to 0.164)
United States	0.187	0.162	0.148	0.131	0.163
	(0.166 to 0.208)	(0.129 to 0.195)	(0.103 to 0.192)	(0.078 to 0.184)	(0.103 to 0.223)
Percentage Point Difference	7.27	5.45	5.93	4.85	6.85
p-value	<0.0001	0.0020	0.0011	0.012	0.0015
Control for:					
Past Health Conditions		✓	✓	✓	✓
Ever Smoked			✓	✓	✓
Past BMI				✓	✓
Education					✓

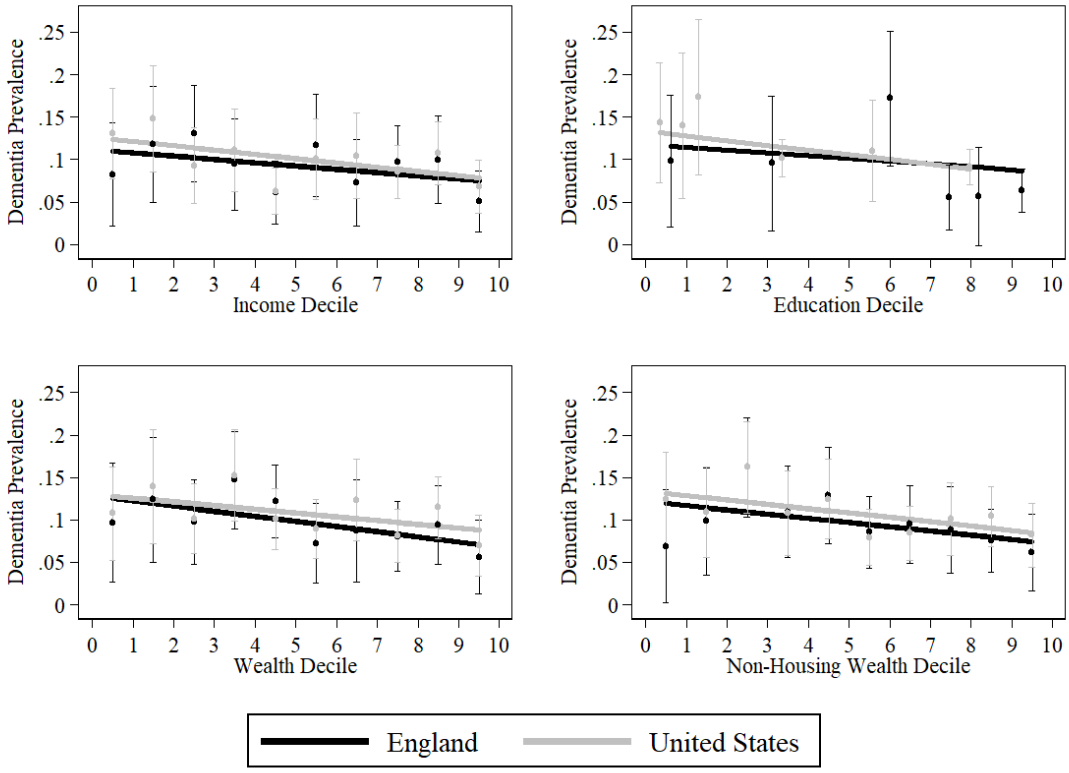
Notes: Sample includes non-Hispanic white population aged 70+ only. The sample size is 3,147 participants in England and 5,330 participants in the United States. All estimates are age-gender standardized to the overall 2016 aged 70+ white population in England. The difference is calculated as the prevalence in the US minus prevalence in England. Differences are displayed as percentage points. 'Past Health Conditions' controls for whether an individual had any cardiometabolic diseases (diabetes, heart disease, and stroke) and/or psychiatric conditions 4 years prior. 'Ever Smoked' controls for whether an individual has ever smoked. BMI stands for Body Mass Index. 'Past BMI' includes dummy variables to control for whether an individual is classed as underweight, normal weight, *overweight* or *obese*. BMI measurements are based on when an individual first entered the survey, which is at least 10 years prior. We assume the effect of each control is constant across countries and age/gender groups. The reference groups are: No past health conditions; never smoked; normal weight; and high-school education.

Table A8: Difference in Prevalence of Dementia with Controls, United States vs England, 2017

	England			United States		
Whole Sample:						
Prevalence	0.097	0.092	0.089	0.112	0.105	0.101
CI	(0.089 to 0.106)	(0.082 to 0.102)	(0.072 to 0.106)	(0.106 to 0.118)	(0.098 to 0.113)	(0.087 to 0.114)
Income Decile:						
1 *Prevalence*	0.114	0.112	0.082	0.187	0.173	0.131
CI	(0.089 to 0.139)	(0.079 to 0.144)	(0.021 to 0.144)	(0.166 to 0.208)	(0.142 to 0.205)	(0.078 to 0.184)
2 *Prevalence*	0.113	0.119	0.118	0.141	0.145	0.148
CI	(0.09 to 0.136)	(0.088 to 0.149)	(0.05 to 0.187)	(0.119 to 0.163)	(0.113 to 0.176)	(0.086 to 0.21)
3 *Prevalence*	0.124	0.107	0.130	0.111	0.089	0.093
CI	(0.097 to 0.151)	(0.074 to 0.139)	(0.073 to 0.187)	(0.095 to 0.127)	(0.067 to 0.11)	(0.048 to 0.137)
4 *Prevalence*	0.099	0.095	0.094	0.118	0.114	0.111
CI	(0.071 to 0.126)	(0.065 to 0.126)	(0.041 to 0.148)	(0.099 to 0.137)	(0.088 to 0.14)	(0.062 to 0.16)
5 *Prevalence*	0.094	0.087	0.061	0.086	0.084	0.063
CI	(0.072 to 0.116)	(0.062 to 0.112)	(0.024 to 0.098)	(0.069 to 0.102)	(0.063 to 0.104)	(0.035 to 0.09)
6 *Prevalence*	0.098	0.097	0.116	0.108	0.107	0.100
CI	(0.07 to 0.127)	(0.064 to 0.131)	(0.056 to 0.177)	(0.088 to 0.128)	(0.081 to 0.134)	(0.053 to 0.148)
7 *Prevalence*	0.068	0.066	0.073	0.100	0.101	0.104
CI	(0.042 to 0.093)	(0.038 to 0.094)	(0.021 to 0.124)	(0.078 to 0.122)	(0.073 to 0.129)	(0.054 to 0.154)
8 *Prevalence*	0.083	0.084	0.097	0.082	0.078	0.085
CI	(0.053 to 0.114)	(0.051 to 0.117)	(0.054 to 0.14)	(0.066 to 0.097)	(0.058 to 0.098)	(0.054 to 0.117)
9 *Prevalence*	0.082	0.076	0.100	0.093	0.085	0.107
CI	(0.041 to 0.122)	(0.034 to 0.118)	(0.048 to 0.151)	(0.071 to 0.116)	(0.06 to 0.111)	(0.07 to 0.145)
10 *Prevalence*	0.059	0.058	0.051	0.077	0.077	0.068
CI	(0.034 to 0.083)	(0.029 to 0.087)	(0.015 to 0.087)	(0.052 to 0.103)	(0.051 to 0.103)	(0.036 to 0.1)
Control for:						
Past Health Conditions		✓	✓		✓	✓
Ever Smoked			✓			✓
Past BMI			✓			✓

Notes: Sample includes non-Hispanic white population aged 70+ only. The sample size is 3,147 participants in England and 5,330 participants in the United States. All estimates are age-gender standardized to the overall 2016 aged 70+ white population in England. 'Past Health Conditions' controls for whether an individual had any cardiometabolic diseases (diabetes, heart disease, and stroke) and/or psychiatric conditions 4 years prior. 'Ever Smoked' controls for whether an individual has ever smoked. BMI stands for Body Mass Index. 'Past BMI' includes dummy variables to control for whether an individual is classed as underweight, normal weight, *overweight* or *obese*. BMI measurements are based on when an individual first entered the survey, which is at least 10 years prior. We assume the effect of each control is constant across countries and age/gender groups. The reference groups are: No past health conditions; never smoked; and normal weight.

Figure A1: SES Gradient of Dementia, US vs England, Controlling for Past Health



Notes: The points in this figure represent the mean age-gender standardized dementia prevalence for each country by socioeconomic status (SES) after controlling for past health and behaviour, along with 95% confidence interval for these predictions. The solid lines represent the fitted Socioeconomic Index of Inequality (SII) for each country. The values of the SII and the corresponding Relative Index of Inequality (RII) are listed in Table A4.

Table A9: Prevalence of Dementia, United States vs. England, Full-Sample

	England		United States			
	Age-Gender Standardized Prevalence [95% CI]		Age-Gender Standardized Prevalence [95% CI]		Difference	p-value
All	0.099	[0.091,0.108]	0.124	[0.118,0.129]	0.024	<0.0001
Household Income Decile						
1 (Lowest)	0.116	[0.091,0.140]	0.211	[0.192,0.230]	0.095	<0.0001
2	0.126	[0.101,0.152]	0.161	[0.144,0.178]	0.035	0.025
3	0.124	[0.098,0.150]	0.141	[0.120,0.162]	0.017	0.32
4	0.100	[0.072,0.127]	0.143	[0.124,0.162]	0.044	0.0094
5	0.101	[0.078,0.124]	0.097	[0.082,0.111]	-0.004	0.76
6	0.102	[0.072,0.131]	0.104	[0.086,0.121]	0.002	0.91
7	0.061	[0.043,0.079]	0.108	[0.088,0.127]	0.047	0.0006
8	0.088	[0.057,0.118]	0.085	[0.069,0.102]	-0.002	0.91
9	0.081	[0.041,0.122]	0.089	[0.070,0.108]	0.008	0.74
10 (Highest)	0.057	[0.034,0.080]	0.076	[0.055,0.098]	0.020	0.22
Years of Schooling						
9 or less	0.128	[0.103,0.153]	0.212	[0.195,0.230]	0.084	<0.0001
10	0.099	[0.078,0.119]	0.143	[0.118,0.167]	0.044	0.0072
11	0.097	[0.079,0.116]	0.119	[0.093,0.144]	0.021	0.19
12	0.069	[0.041,0.097]	0.134	[0.124,0.143]	0.064	<0.0001
13	0.063	[0.040,0.085]	0.118	[0.095,0.141]	0.055	0.00071
14 or more	0.055	[0.039,0.071]	0.086	[0.078,0.094]	0.031	0.00071
Household Wealth Decile						
1 (Lowest)	0.172	[0.136,0.207]	0.219	[0.198,0.241]	0.047	0.024
2	0.118	[0.093,0.144]	0.169	[0.151,0.188]	0.051	0.0014
3	0.105	[0.078,0.132]	0.138	[0.120,0.155]	0.032	0.049
4	0.090	[0.068,0.111]	0.120	[0.105,0.135]	0.030	0.023
5	0.118	[0.093,0.143]	0.116	[0.100,0.132]	-0.002	0.89
6	0.077	[0.056,0.099]	0.097	[0.084,0.110]	0.020	0.13
7	0.073	[0.047,0.098]	0.092	[0.076,0.107]	0.019	0.21
8	0.093	[0.067,0.118]	0.103	[0.086,0.120]	0.010	0.52
9	0.080	[0.047,0.113]	0.101	[0.084,0.118]	0.021	0.27
10 (Highest)	0.060	[0.040,0.081]	0.074	[0.058,0.089]	0.013	0.30
Household Non-Housing Wealth Decile						
1 (Lowest)	0.147	[0.113,0.180]	0.215	[0.195,0.235]	0.068	0.00055
2	0.114	[0.089,0.140]	0.184	[0.165,0.203]	0.070	<0.0001
3	0.121	[0.095,0.148]	0.148	[0.129,0.168]	0.027	0.11
4	0.100	[0.076,0.125]	0.129	[0.112,0.147]	0.029	0.054
5	0.110	[0.084,0.135]	0.104	[0.088,0.119]	-0.006	0.70
6	0.093	[0.067,0.118]	0.099	[0.085,0.113]	0.006	0.66
7	0.098	[0.072,0.124]	0.085	[0.071,0.098]	-0.013	0.37
8	0.079	[0.052,0.106]	0.090	[0.075,0.105]	0.011	0.48
9	0.057	[0.035,0.078]	0.094	[0.077,0.110]	0.037	0.0076
10 (Highest)	0.065	[0.045,0.085]	0.083	[0.067,0.099]	0.018	0.15

Notes: This table presents the estimates as Table 1 for the full sample aged 70+, including non-whites. The US sample includes 5,330 non-Hispanic white participants and 1,835 non-white participants. The England sample includes 3,147 non-Hispanic white participants and 77 non-white participants. All estimates are age-gender standardized to the overall 2016 aged 70+ white population in England. The difference is calculated as the prevalence in the US minus prevalence in England.

Table A10: Difference in Prevalence of Dementia with Controls, Full Sample

Whole Sample:					
England Prevalence	0.099	0.088	0.088	0.084	0.085
	[0.091 to 0.108]	[0.079 to 0.098]	[0.076 to 0.1]	[0.068 to 0.1]	[0.068 to 0.103]
United States	0.124	0.107	0.107	0.105	0.123
	[0.118 to 0.129]	[0.1 to 0.114]	[0.097 to 0.117]	[0.093 to 0.118]	[0.109 to 0.137]
Percentage Point Difference	2.44	1.87	1.90	2.14	3.80
p-value	<0.0001	<0.0001	0.00015	0.00011	<0.0001
Excluding Lowest Income Decile:					
England Prevalence	0.096	0.086	0.086	0.087	0.090
	[0.087 to 0.105]	[0.076 to 0.096]	[0.073 to 0.099]	[0.071 to 0.103]	[0.072 to 0.108]
United States	0.113	0.098	0.099	0.100	0.117
	[0.107 to 0.118]	[0.091 to 0.106]	[0.089 to 0.108]	[0.086 to 0.113]	[0.103 to 0.132]
Percentage Point Difference	1.64	1.25	1.27	1.24	2.70
p-value	0.0024	0.020	0.019	0.030	<0.0001
Lowest Income Decile:					
England Prevalence	0.116	0.107	0.106	0.078	0.099
	[0.091 to 0.140]	[0.077 to 0.138]	[0.062 to 0.15]	[0.026 to 0.13]	[0.036 to 0.162]
United States	0.211	0.187	0.186	0.161	0.195
	[0.192 to 0.230]	[0.16 to 0.214]	[0.149 to 0.223]	[0.117 to 0.206]	[0.138 to 0.252]
Percentage Point Difference	9.54	7.93	7.96	8.37	9.60
p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Control for:					
Past Health Conditions		✓	✓	✓	✓
Ever Smoked			✓	✓	✓
Past BMI				✓	✓
Education					✓

Notes: Full sample, population aged 70+, including minorities. The sample sizes are 3,224 participants in England, and 7,165 participants in the United States. All estimates are age-gender standardized to the overall 2016 aged 70+ white population in England. The difference is calculated as the prevalence in the US minus prevalence in England. Differences are displayed as percentage points. 'Past Health Conditions' controls for whether an individual had any cardiometabolic diseases (diabetes, heart disease, and stroke) and/or psychiatric conditions 4 years prior. 'Ever Smoked' controls for whether an individual has ever smoked. BMI stands for Body Mass Index. 'Past BMI' includes dummy variables to control for whether an individual is classed as underweight, normal weight, *overweight* or *obese*. BMI measurements are based on when an individual first entered the survey, which is at least 10 years prior. We assume the effect of each control is constant across countries and age/gender groups. The reference groups are: No past health conditions; never smoked; normal weight; and high-school education.

Table A11: Prevalence of Dementia in United States, Whites versus Non-whites

	US Non-White and Hispanic		US Non-Hispanic White			
	Age-Gender Standardized Prevalence [95% CI]		Age-Gender Standardized Prevalence [95% CI]		Difference	p-value
All	0.182	[0.169 to 0.195]	0.112	[0.106 to 0.118]	-0.070	<0.0001
Household Income Decile						
1 (Lowest)	0.224	[0.199 to 0.249]	0.204	[0.178 to 0.231]	-0.020	0.28
2	0.211	[0.180 to 0.243]	0.143	[0.123 to 0.163]	-0.068	0.00034
3	0.220	[0.158 to 0.282]	0.121	[0.102 to 0.140]	-0.099	0.0023
4	0.202	[0.165 to 0.240]	0.133	[0.111 to 0.155]	-0.069	0.0018
5	0.116	[0.076 to 0.156]	0.094	[0.079 to 0.109]	-0.022	0.31
6	0.164	[0.097 to 0.230]	0.098	[0.081 to 0.116]	-0.065	0.065
7	0.129	[0.080 to 0.178]	0.107	[0.086 to 0.128]	-0.022	0.42
8	0.107	[0.047 to 0.166]	0.084	[0.067 to 0.101]	-0.023	0.47
9	0.072	[0.026 to 0.118]	0.090	[0.069 to 0.110]	0.017	0.50
10 (Highest)	0.084	[0.038 to 0.129]	0.077	[0.055 to 0.099]	-0.006	0.81
Years of Schooling						
9 or less	0.235	[0.212 to 0.258]	0.190	[0.162 to 0.218]	-0.045	0.015
10	0.172	[0.127 to 0.218]	0.137	[0.109 to 0.165]	-0.035	0.19
11	0.144	[0.109 to 0.179]	0.109	[0.080 to 0.139]	-0.035	0.14
12	0.198	[0.170 to 0.227]	0.124	[0.114 to 0.133]	-0.074	<0.0001
13	0.159	[0.101 to 0.218]	0.116	[0.090 to 0.141]	-0.043	0.18
14 or more	0.099	[0.079 to 0.119]	0.085	[0.076 to 0.093]	-0.015	0.20
Household Wealth Decile						
1 (Lowest)	0.228	[0.201 to 0.255]	0.208	[0.176 to 0.240]	-0.020	0.36
2	0.208	[0.179 to 0.237]	0.154	[0.131 to 0.177]	-0.054	0.0043
3	0.184	[0.142 to 0.227]	0.120	[0.102 to 0.138]	-0.064	0.0063
4	0.142	[0.111 to 0.174]	0.115	[0.098 to 0.132]	-0.027	0.13
5	0.159	[0.117 to 0.202]	0.108	[0.092 to 0.124]	-0.051	0.027
6	0.120	[0.084 to 0.155]	0.093	[0.080 to 0.107]	-0.026	0.18
7	0.156	[0.086 to 0.226]	0.088	[0.072 to 0.103]	-0.068	0.063
8	0.197	[0.134 to 0.259]	0.099	[0.081 to 0.116]	-0.098	0.0031
9	0.122	[0.065 to 0.178]	0.099	[0.082 to 0.117]	-0.022	0.46
10 (Highest)	0.045	[0.018 to 0.073]	0.075	[0.059 to 0.090]	0.029	0.071
Household Non-Housing Wealth Decile						
1 (Lowest)	0.231	[0.207 to 0.256]	0.197	[0.167 to 0.227]	-0.034	0.085
2	0.204	[0.177 to 0.231]	0.177	[0.151 to 0.203]	-0.027	0.16
3	0.187	[0.142 to 0.232]	0.135	[0.114 to 0.155]	-0.052	0.036
4	0.158	[0.128 to 0.188]	0.123	[0.104 to 0.143]	-0.034	0.059
5	0.106	[0.069 to 0.143]	0.102	[0.086 to 0.118]	-0.004	0.85
6	0.099	[0.063 to 0.134]	0.098	[0.084 to 0.113]	0.000	0.99
7	0.124	[0.066 to 0.182]	0.083	[0.069 to 0.097]	-0.040	0.18
8	0.140	[0.069 to 0.210]	0.088	[0.073 to 0.103]	-0.051	0.16
9	0.127	[0.054 to 0.201]	0.092	[0.075 to 0.108]	-0.035	0.36
10 (Highest)	0.069	[0.050 to 0.088]	0.084	[0.068 to 0.101]	0.016	0.23

Notes: The sample includes 5,330 non-Hispanic white participants and 1,835 non-white and Hispanic participants. All estimates are age-gender standardized to the overall 2016 aged 70+ white population in England. The difference is calculated as the non-white and Hispanic prevalence in the US minus the non-Hispanic white prevalence in the US.

Appendix References

1 Langa KM, Larson EB, Crimmins EM, *et al.* A comparison of the prevalence of dementia in the United States in 2000 and 2012. *JAMA Intern Med* 2017;**177**:51–8.

2 Hudomiet P, Hurd MD, Rohwedder S. The relationship between lifetime out-of-pocket medical expenditures, dementia, and socioeconomic status in the US. *J Econ Ageing* 2019;**14**:100181.

3 Rusmaully J, Dugravot A, Moatti J-P, *et al.* Contribution of cognitive performance and cognitive decline to associations between socioeconomic factors and dementia: A cohort study. *PLoS Med* 2017;**14**:e1002334.

4 Cadar D, Lassale C, Davies H, *et al.* Individual and area-based socioeconomic factors associated with dementia incidence in England: evidence from a 12-year follow-up in the English longitudinal study of ageing. *JAMA Psychiatry* 2018;**75**:723–32.

5 Rocca WA, Petersen RC, Knopman DS, *et al.* Trends in the incidence and prevalence of Alzheimer's disease, dementia, and cognitive impairment in the United States. *Alzheimers Dement* 2011;**7**:80–93.

6 Basu R. Education and dementia risk: results from the Aging Demographics and Memory Study. *Res Aging* 2013;**35**:7–31.

7 Nguyen TT, Tchetgen EJT, Kawachi I, *et al.* Instrumental variable approaches to identifying the causal effect of educational attainment on dementia risk. *Ann Epidemiol* 2016;**26**:71–6.

8 Crimmins EM, Kim JK, Langa KM, *et al.* Assessment of cognition using surveys and neuropsychological assessment: the Health and Retirement Study and the Aging, Demographics, and Memory Study. *J Gerontol B Psychol Sci Soc Sci* 2011;**66**:i162–71.

9 Garcia MA, Saenz J, Downer B, *et al.* The role of education in the association between race/ethnicity/nativity, cognitive impairment, and dementia among older adults in the United States. *Demogr Res* 2018;**38**:155.

10 Weden MM, Shih RA, Kabeto MU, *et al.* Secular trends in dementia and cognitive impairment of US rural and urban older adults. *Am J Prev Med* 2018;**54**:164–72.

11 Sonnega A, Faul JD, Ofstedal MB, *et al.* Cohort profile: the health and retirement study (HRS). *Int J Epidemiol* 2014;**43**:576–85.

12 Steptoe A, Breeze E, Banks J, *et al.* Cohort profile: the English longitudinal study of ageing. *Int J Epidemiol* 2013;**42**:1640–8.

13 Hurd MD, Martorell P, Delavande A, *et al.* Monetary costs of dementia in the United States. *N Engl J Med* 2013;**368**:1326–34.

14 Langa KM, Plassman BL, Wallace RB, *et al.* The Aging, Demographics, and Memory Study: study design and methods. *Neuroepidemiology* 2005;**25**:181–91.

15 Gianattasio KZ, Wu Q, Glymour MM, *et al.* Comparison of methods for algorithmic classification of dementia status in the health and retirement study. *Epidemiol Camb Mass* 2019;**30**:291.

16 Staff H. Sample sizes and response rates. *Ann Arbor MI Surv Res Cent Inst Soc Res Univ Mich Online Verfügbar Unter Httpshrs Isr Umich Edusitesdefaultf IlesbiblioResponseRates2017 Pdf Zugriff Am* 2017;**28**.

17 Banks J, Nazroo J, Steptoe A. Wave 6. *Inst Fisc Stud* 2014.