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RESEARCH ARTICLE

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Association of social deprivation with cognitive status and decline in older adults

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Abstract

Objectives: Social deprivation, i.e. the relative deprivation in socioeconomic domains, is known to exacerbate disease risk. Less is known about its role in cognitive functioning and decline in older adults. This study aimed to investigate the association between social deprivation and cognitive status as well as rate of decline.

Methods: We analysed data from the nationally representative Health and Retirement study (HRS) of individuals aged 50 and older. The analysis sample contained 11,101 respondents (mean age at baseline: 69.4, SD: 8.6%, 55% female) with at least two cognitive assessments (mean follow up: 11.2, SD: 5.4). To quantify social deprivation we constructed a social deprivation index (SDI) with structural equation modelling. Multiple growth curve modelling was used to model cognitive status and decline as predicted by SDI.

Results: After adjusting for covariates, greater social deprivation was associated with poorer cognitive status ($\beta = -0.910$, $p < 0.001$; 95% CI: −0.998–0.823) and faster cognitive decline ($\beta = -0.005$, $p = 0.002$; 95% CI:−0.009–0.002). Of the covariates, depressive symptoms, chronic disease burden, belonging to a racial or ethnical minority, and male gender were also associated with poorer cognitive status. Marriage statuses other than being married or partnered had a positive association with cognitive status.

Conclusions: Our findings indicate that greater social deprivation was associated with significantly poorer cognitive status implying that preventing social deprivation can contribute to raising cognitive functioning in the older population and help reduce the incidence of dementia. Policy that facilitates early intervention in social deprivation will be key.

KEYWORDS
cognition, cognitive decline, dementia, socialdeprivation, socioeconomic

Key points

- Social deprivation is a multi-dimensional construct reflecting relative deprivation in socioeconomic domains

- Social deprivation has been established as a risk factor in physical health
- This work demonstrates that social deprivation is also associated with poorer cognitive status across older adulthood
- Early intervention in social deprivation will be essential in reducing the dementia burden in the population

1 | INTRODUCTION

After reaching its peak in early adulthood, cognitive functioning declines again, starting in middle age. This overall trend has been demonstrated reliably, however, it is notable that there is a great deal of variability in both the individual 'peak', i.e. the level of cognitive functioning that is achieved before decline occurs, and in the rate of decline that follows. At the most extreme, decline reaches pathological levels, i.e. the ageing individual develops a dementia. In the US, dementia affects around 5% of adults over the age of 71.[1] It is an open question why some individuals develop age-related cognitive decline while others do not. Age-related brain pathology alone cannot be cited as an explanation, as even individuals with comparable pathological burden show divergent cognitive functioning.[2]

One prominent theory is that some individuals may have developed or maintained an inherent cognitive reserve. It is theorised that a greater reserve enables individuals to withstand decline for longer by compensating for neuropathological burden through greater or more efficient cognitive processing resources. The Cognitive Reserve Theory refers back to educational attainment and occupation as the base for divergent life experiences that affect reserve.[3] Particularly relevant is the exposure to stressors. Depending on resources and opportunities an individual will experience more or less detrimental stressors. Stress, at least in its chronic form, is linked to poorer cognition and both non-pathological and pathological cognitive decline.[4]

Essentially, this describes the notion of variable life experiences according to social class. Social class describes a relatively stable sociocultural background that determines ones standing in society and can be passed down through the generations. Related to this idea of class, yet not identical, is the construct of socioeconomic status (SES). While class is supposed to reflect a stable background characteristic and is firmly rooted in class analytic theory, SES is a more practical operationalisation more reflective of an individual's current circumstance.[5] Yet, there is substantial overlap. Ultimately, both social class and SES reflect what resources are available to the individual.

Lacking access to resources has been termed social deprivation. British sociologist Townsend defined deprivation in this context as the lack of access to resources that are considered standard in a given society. The Townsend Deprivation Index[6] measures social deprivation on the scale of geographical areas. It combines the proportion of unemployed residents, the proportion of households with no car, the proportion of households that are not owner occupied, and the proportion of households with overcrowding (>1 person/room) in an area. Similarly, the more recent US-based Area Deprivation Index (ADI[7]) includes factors for the domains of income, education, employment, and housing quality. It reflects the proportion of households in each neighbourhood that are deprived.

Social deprivation measures, both on the individual level (i.e. SES or class) and on the area level, have been found to be related to the incidence of a range of diseases (e.g. heart disease, cancer).[8] It is generally assumed that disease risk accumulates in this way, which in turn can be expected to increases the risk of dementia.[9] Indeed, initial research suggests that cognitive functioning seems to be affected by social deprivation just as physical health is. For instance, a survey of French older adults (>60 years old) showed that individual social deprivation, measured by a questionnaire–containing items on e.g. health insurance coverage and financial difficulties–was associated with self-reported cognitive decline.[10] Area-level deprivation has also been found to be associated with poorer cognitive functioning in an adult US sample.[11]

However, accumulated disease risk does not fully explain the association between social deprivation and cognitive health, as studies show that the effects of educational and occupational attainment are not fully accounted for by health determinants.[12] The association between social deprivation and cognitive reserve may be a crucial additional factor.

While there is thus indication of an association between social deprivation and cognitive functioning in late adulthood, the nuances of the relation remain poorly understood. For instance, educational attainment alone is a good predictor of cognitive function in adulthood but a poor predictor of cognitive decline in late adulthood.[13] Adult SES largely mediates the effect of childhood SES on both cognitive status and decline.[14] The relevance of particularly late-adulthood measures of SES was also supported by a longitudinal study showing that late life income has a strong protective effect against cognitive decline, stronger than childhood SES or years of education.[15] Therefore, we want to investigate the association between social deprivation with cognitive status and cognitive decline in older adults. We expect that social deprivation will be related to poorer cognitive function and faster cognitive decline.

2 | MATERIALS AND METHODS

2.1 | Sample

The Health and Retirement Study (HRS) is a longitudinal study of a representative sample of US residents over the age of 50 and their partners. Since the HRS commenced in 1992, respondents have been interviewed biannually, over the phone or in person. A cleaned

longitudinal data set as well as wave-wise data sets are provided by the RAND Center for the Study of Ageing. RAND provides several summary variables and imputations where data would otherwise be missing, including cognitive functioning score imputations.[16] At the time of writing, RAND data was available for the years 1992-2016. We included data from the years 1998-2016, as the cognitive assessment was kept identical across this time.[16] We included respondents who, in the year of their first cognitive test score, were at least 50 years old. This was decided because cognitive decline can be expected to emerge around that age. Moreover, respondents who had missing information on dimensions of social deprivation were excluded. We further excluded individuals who, at the baseline assessment, were institutionalised. Finally, respondents were only included if they had at least one additional cognitive test score beyond their baseline assessment. The final sample contained 11,101 respondents (see Figure 1).

2.2 | Construction of a social deprivation index (SDI)

2.2.1 | Dimensions of social deprivation

We identified relevant dimensions based on previous research on social deprivation and their availability in the HRS data sets. Included dimensions are detailed below.

Education

Education is a central determinant of the occupation an individual holds in adulthood and as such it is an important precursor of adult social status and cognitive functioning.[13] We thus include the years of education completed by the respondents (range 0–17 years, "17+ years" was coded as 17).

Job history

The current labour force status (Working full-time, Working part-time/Partly retired, Retired, Unemployed/Disabled/Not in labour force) of the respondent was recorded. However, as many enter a lesser employment status or unemployment as they age, job historical stability should give a more comprehensive reflection of deprivation stress experienced.[17] We thus also used the number of jobs the respondent reports having held (range: 0–12) and whether or not the respondent ever held a job for five or more years [responses "Never worked" and "Worked, no 5+ year jobs" were coded as No response (No = 2) "Worked, 1+ job for 5+ years" as Yes (Yes = 1); "Worked, dk (sic; short for "do not know") if any 5+ year job" and "Dk (sic) if worked" were considered missing).

Income

We use the RAND-provided measure of total income. Total income is the sum of various sources of income, including earnings and government transfers.[16] We adjusted this value for the household size by dividing by the square root of household members. The values were transformed using the inverse hyperbolic sinus (IHS) transformation. The IHS transformation has the advantage of approximating the values of the commonly used log transformation while also allowing for the transformation of negative and null values.

Wealth

Wealth expresses accumulated resources, which are increasingly depended on by adults transitioning into retirement and relevant to

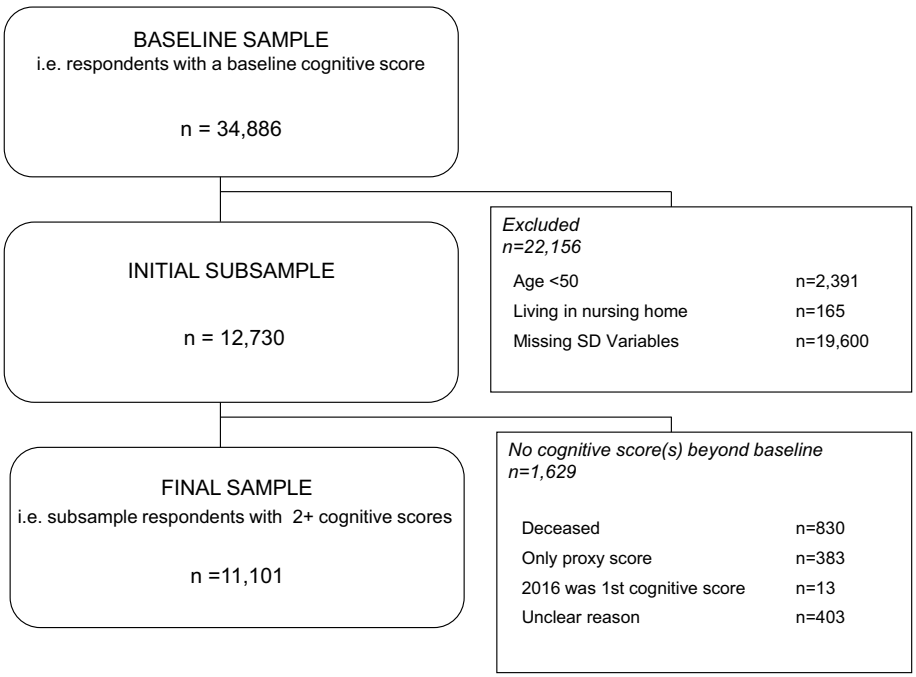

FIGURE 1 Flow chart representing the selection of the final analysis sample. Abbreviation: SD, Social Deprivation

cognitive functioning of older adults. In the present work, we use the total wealth variable provided by RAND. It is the sum of all wealth components (excluding the primary residence) less all debt components.[16] We adjusted for household size by dividing by the square root of the number of household members and IHS-transformed the values.

Housing tenure

Housing tenure, i.e. whether respondents live in an owned property (1 = owned, 2 = not owned), is another aspect of accumulated resources. Generally, ownership is associated with better health outcomes, presumably, as it affords greater control and quality.[18]

Housing condition

Previous studies show a relationship between housing condition and health outcomes, including cognitive outcomes.[19] The HRS includes a measure of subjective housing satisfaction: "How about the physical condition of your home, would you say it is in excellent, very good, good, fair, or poor condition?", scored between 1 and 5, 5 being poor condition. Subjective housing satisfaction is known to be strongly reflective of basic functionality and maintenance issues. Housing in poor repair is unsafe and causes severe psychological stress.[19]

Perceived neighbourhood safety

We use a subjective safety assessment. i.e., the safety score is defined by this question: "Would you say the safety of your neighbourhood is excellent, very good, good, fair or poor?", scored between 1 and 5, 5 being poor safety. Subjective evaluation of the neighbourhood as unsafe is a strong predictor of cognitive function, stronger even than objective measurements of neighbourhood safety.[20]

Health insurance

Health insurance coverage directly reflects access to medical care and as such is reliably linked to better health outcomes.[21] We recorded whether or not the respondent reported having (a) No health insurance; (b) Medicare only (i.e. basic health cost overage for US citizens >65 years old); (c) Employer-based or own-business-based health insurance; (d) Other health insurance (No = 0, Medicare = 1, Other = 2, Employer/Business-Based = 3). The latter category includes individuals who receive military or veteran health benefits, who receive Medicare (coverage for low-earners), or who purchased private insurance.

2.2.2 | Index building

We used structural equation modelling (SEM) to build the Social Deprivation Index (SDI). SEM was conducted using lavaan in R.[22] The social deprivation domains described above were used. Reverse scoring was applied to the variables that would otherwise indicate lower rather than higher social deprivation (years of education, income, wealth, number of jobs held, and health insurance). We used the Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR) to judge fit. A CFI >0.95 is commonly considered a goof fit, while the RMSEA is generally required to be <0.06 and SRMR <0.05 is considered good.[23] Adjustments were made until satisfactory fit was reached and all variables showed significant loadings >0.4 onto the SDI (see Table 1).

2.3 | Modelling of cognitive status

2.3.1 | Social deprivation index

The latent social deprivation score for each participant was predicted using the final SEM (SEM 4, Table 1) and appended to the data set. Higher SDI values indicated greater social deprivation.

2.3.2 | Covariates

Invariant covariates used were race (White/Caucasian, Black/African American, Other) and gender (Women, Men). In addition, covariates recorded in the year of the respondents first available cognitive function score were: the number of chronic health conditions respondents had ever been diagnosed with (range: 0-8), their marital status (Married/Partnered, Widowed, Divorced/Separated, Never married), and the Center for Epidemiologic Studies Depression (CESD) Scale score (range: 0-8). For any given covariate, less than 0.001% of respondents have missing covariate data; no respondents were excluded based on missing covariates.

2.3.3 | Outcome measure

Cognitive testing in the HRS is adapted from the modified Telephone Interview of Cognitive Status.[24] A higher total cognition score (range: 0–35) reflects better cognitive performance. In the word recall task, respondents were asked to reproduce a list of 10 words, both immediately and after a 5 min delay. Each correctly recalled word was worth one point at each instance (range: 0–20). In the serial 7s test, respondents were asked to subtract 7s from 100 in five consecutive steps. Each correct step was awarded one point (range: 0–5). In the counting backwards task, respondents were asked to count backwards from 20 to 10. Respondents were given a score of two or one if they managed upon first or second try, respectively (range: 0–2). The naming task respondents were given two descriptions of objects and gained points for each correctly named object (range: 0–2). In addition, they were asked for the date (scored 0–4, one point each for correct day of the week, month, day, and year), and the President/Vice-President (one point for each correct last name, range: 0–2).

TABLE 1 Results from structural equation models (SEM) estimating the loading of social deprivation variables on a single social deprivation construct

Social deprivation variable	St.Est.	CFI	RMSEA	SRMR	Adjustment decision
SEM 1		*0.92*	*0.20*	*0.14*	
Years of education (rev)	0.58***				SEM 1 strongly underestimated the correlation between *no. of jobs* and *ever held a job for 5+ years*. A high modification index also flagged this association. The former has low face value as job stability indicator and was excluded.
Income (rev)	0.68***				
Wealth (rev)	0.59***				
Neighbourhood safety	0.52***				
Housing condition	0.53***				
Housing tenure	0.70***				
Health insurance (rev)	0.43***				
No. of jobs (rev)	0.51***				
Ever held a job for 5+ years	0.68***				
Current labour force status	0.55***				
SEM 2		*0.96*	*0.15*	*0.11*	
Years of education (rev)	0.58***				SEM 2 notably underestimated the correlations between a) *housing tenure* and *wealth*, b) *housing condition* and *neighbourhood safety*, and c) *current labour force status* and *ever held a job for 5+ years*. Regressions accounting for these relationships were added.
Income (rev)	0.73***				
Wealth (rev)	0.62***				
Neighbourhood safety	0.51***				
Housing condition	0.52***				
Housing tenure	0.67***				
Health insurance (rev)	0.43***				
Ever held a job for 5+ years	0.52***				
Current labour force status	0.52***				
SEM 3		*0.99*	*0.06*	*0.05*	
Years of education (rev)	0.56***				In SEM 3 *housing condition*, *housing tenure*, and *current labour force status* had loadings <.4 onto the social deprivation construct; these were excluded.
Income (rev)	0.87***				
Wealth (rev)	0.49***				
Neighbourhood safety	0.42***				
Housing condition	0.27***				
Housing tenure	0.29***				
Health insurance (rev)	0.40***				
Ever held a job for 5+ years	0.43***				
Current labour force status	0.31***				
SEM 4		*1.0*	*0.04*	*0.03*	
Years of education (rev)	0.59***				
Income (rev)	0.80***				
Wealth (rev)	0.52***				
Neighbourhood safety	0.46***				

(Continues)

TABLE 1 (Continued)

Social deprivation variable	St.Est.	CFI	RMSEA	SRMR	Adjustment decision
Health insurance (rev)	0.42***				
Ever held a job for 5+ years	0.47***				

Abbreviations: CFI, Comparative fit index; RMSEA, Root mean square error of approximation; SRMR, Standardized Root Mean Square Residual; St Est, Standardised Estimate; rev, reverse scored variable.

***$p < 0.001$.

2.4 | Statistical analyses

2.4.1 | Descriptive analyses

We calculated the mean and standard deviation (SD) of participant demographics at baseline: age, number of chronic conditions, CESD score, and baseline cognitive score. We also calculated the mean (SD) duration of follow up, the mean (SD) last cognitive score on record, and the median (interquartile range) for wealth and income.

2.4.2 | Growth curve modelling

We conducted growth curve modelling using the nlme package in R.[25] All models include a random intercept and a random slope allowing for the initial cognitive status and the association between time and cognitive score to vary randomly. Age was used as the time variable and re-centred at 50. We used the modelled coefficients of an unconditional means model to calculate the Intraclass Correlation Coefficient (ICC). An ICC >0.25 indicates high between-person variability, and thus implies that multilevel modelling is indeed appropriate.[26] The unconditional growth model was fit to assess whether there is sufficient variation in cognition across ages. A model containing a quadratic age term was employed to assess whether the relationship can indeed be assumed to be linear. Model fit was judged by Akaike Information Criteria (AIC) and the Bayesian Information Criteria (BIC). Since we saw only a marginal improvement, we decided on the most parsimonious approach and included the squared age term but only investigated the linear interaction with SDI in an unadjusted conditional model. We then added in all covariates into a second conditional model to determine whether any association between SDI and cognitive scores would survive adjustment for these.

2.4.3 | Effect estimation

We used the parameters of the adjusted conditional model to calculate the predicted cognitive scores at ages 60 and 80 for individuals with a score marking the bottom or top 20% of SDI values, respectively. In this we kept categorical variables at reference level (Gender: Female; Race: White/Caucasian; Marriage Status: Married/Partnered) and used the average values for number of chronic conditions and CESD score (see Table 2).

3 | RESULTS

3.1 | Descriptive analyses

At baseline, respondents had an average age of 69.4 years (SD: 8.6). The average baseline cognitive score was 22.9 (SD: 5.0) and the cognitive follow-up lasted on average 11.2 (SD: 5.4) years. The average last cognitive score on record was 18.8 (SD: 6.16). For more descriptive statistics see Table 2.

3.2 | Growth curve modelling

Table 3 presents the results of growth curve models investigating the association between the social deprivation index (SDI) and cognitive scores. Model 1 presents the unconditional means model, it shows that there is significant variation in cognitive scores (ICC = 0.44). The unconditional growth model (Model 2) showed that cognitive scores changed significantly over time. Model 3, including the quadratic age term, showed a significant quadratic association between age and cognitive score and AIC and BIC indicate an improved fit. The conditional model shows that a greater SDI values were associated with poorer cognition as well as a faster cognitive.

These associations survived adjustment for covariates. In Model 5, a unit increase in SDI was associated with a cognitive score 0.910 points smaller ($\beta = -0.910$, $p < 0.001$) and a cognitive decline 0.005 points per year faster ($\beta = -0.005$, $p = 0.00$). Further, there was a negative association between male rather than female gender and cognitive score and between racial minority status and cognitive score compared to White/Caucasian race. Compared to be Married/Partnered all other types of marriage status had a positive association with cognition. Both the number of chronic conditions and the CESD score reported were negatively associated with cognitive score.

3.3 | Effect estimation

We found that the expected cognitive score for someone with a SDI score at the lower 20% mark was 26.50 at 60 years old and 22.14 at 80 years old, meaning that the expected decline in those 20 years was 4.36 points. Conversely, for someone with a SDI score at the higher 20% mark the predicted scores were 24.03 and 19.40 at 80,

TABLE 2 Sample demographics. Descriptive statistics of baseline covariates, cognitive testing results, and social deprivation variables

Total N =	**11,101**
Age	
Mean (SD)	69.4 (8.6)
Range	50-106
Baseline covariates	
Gender	
Male: Female	4967 : 6134
Race	
White/Caucasian	9,164
Black/African-American	1,590
Other	351
Marriage Status	
Married/Partnered	7,275
Widowed	2,396
Separated/Divorced	1,118
Never married	339
Chronic conditions	
Mean (SD)	1.6 (1.3)
Range	0-7
CESD Score	
Mean (SD)	1.5 (1.9)
Range	0-8
Cognitive testing	
Baseline Cognitive Score	
Mean (SD)	22.9 (5.0)
Range	1-35
Cognitive follow-up	
Mean (SD)	11.2 (5.4)
Range	2-18
Final Cognitive Score	
Mean (SD)	18.8 (6.2)
Range	0-35
SDI variables	
Education	
Years of education	
Mean (SD)	12.2 (3.4)
Income	
Median (IQR)	31,620 (41,096)
Range	0-7,302,072
Wealth	
Median (IQR)	152,000 (327,800)
Range	−846,850-23,154,807
Health insurance	
Uninsured	191
Medicare only	4978
Employer-/Own-Business-Based	977
Other	4,955
Ever held a job for 5+ years	
Yes	10,125
No	976
Neighbourhood Safety	
Excellent	3,697
Very good	3,728
Good	2,629
Fair	858
Poor	189

Abbreviation: SD, standard deviations.
One Values in US Dollars.

respectively, so that the expected decline was 4.63 points in this period. Figure 2 illustrates the cognitive decline in those extreme SDI groups compared to respondents with moderate SDI across the ages from 50 to 90.

4 | DISCUSSION

In this study, we found that greater social deprivation–as measured by a social deprivation index (SDI) summarising years of education, wealth, income, health insurance status, neighbourhood safety, and job stability–predicted both significantly worse cognitive status and a significantly faster rate of decline across late adulthood, even when adjusting for a comprehensive range of covariates. Effect estimation demonstrated a less pronounced association between SDI and cognitive decline than between SDI and cognitive status.

This suggests that social deprivation overall takes its effect mostly on the "peak" of cognitive performance in adulthood. This is in line with previous evidence showing a clear effect of social deprivation variables on cognitive status but much less so on decline.[13,14] Previous findings suggest that faster decline in more deprived individuals may be attributed to statistical phenomena such as regression towards the mean and may also be the result of selective attrition.[13] However, even in the absence of a clear effect on the rate

TABLE 3 Results from linear growth models of the associations between SDI and cognitive scores

	M1	M2	M3	M4		M5	
Intercept	22.20 (0.04)***	29.14 (0.09)***	24.54 (0.12)***	24.05 (0.13)***		25.50 (0.14)***	
Age		−0.31 (0.00)***	0.11 (0.01)***	0.13 (0.01)***		0.12 (0.01)***	
Age^2			−0.01 (0.00)***	−0.01*** (0.00)		−0.01 (0.00)***	
				Cog. Score	Cog. Dec	Cog. Score	Cog. Dec
SDI				−1.09 (0.04)***	−0.00 (0.00)*	−0.91 (0.04)***	−0.01 (0.00)**
Gender: Male[a]						−1.13 (0.07)***	
Race: Black/African American[b]						−2.79 (0.10)***	
Race: Other[b]						−1.70 (0.19)***	
Marriage status: Widowed[c]						0.78 (0.09)***	
Marriage status: Divorced/ Separated[c]						0.66 (0.11)***	
Marriage status: Never married[c]						0.78 (0.20)***	
No. of chronic conditions						−0.15 (0.03)***	
CESD score						−0.26 (0.02)***	
Goodness of fit							
AIC	362,951	353,254	351,068	348,587		346,676	
BIC	362,987	353,318	351,168	348,678		346,840	

Abbreviations: Cog., Cognitive; Dec, Decline; Model 1, Unconditional means model; Model 2, Unconditional growth model; Model 3, Unconditional growth model w/age^2; Model 4, Conditional model with SDI as predictor; Model 5, Conditional model with addition of covariate.

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$.

[a]Gender: Female is the reference level.

[b]Race: White/Caucasian is the reference level.

[c]Marriage status: Married/Partnered is the reference level; Values in brackets are the standard errors (SE).

of decline, an advantage in peak functioning puts less deprived individuals in the position to reach the threshold for cognitive impairment much later, or never, depending on their survival age. This insight into cognitive ageing gives support to arguments in favour of early preventive efforts and interventions in socially deprived individuals and as such is highly relevant to policy makers.[13]

In terms of covariates, we mostly observed relationships in the expected directions. First, global health status, as indicated by number of chronic conditions, was negatively associated with cognitive performance, lending weight to existing evidence suggesting that accumulated health risk plays a role in cognitive status.[9] Second, the association between depressive symptoms was also to be expected, given the well-known association between depression and cognitive decline and dementia.[27] Third, the association between minority race/ethnic status and poorer cognitive performance is in accordance with a wider literature on the effects of systematic racism on health. The role of discrimination in chronic stress is well established and a likely key factor.[28]

Somewhat surprising was the finding that all marriage statuses other than being married/partnered had a protective effect on cognitive performance. Previous work has generally shown marriage as protective factors in global health and cognition, and cited social support among the reasons for this. One potential explanation for this result could be the sometimes reinforcing effects of partnership on unhealthy behaviours.[29] Alternatively, it may be the case that by including the SDI predictor and other covariates we accounted for mediators that, in previous work, were conflated with marriage and partnership. The negative association between male gender and cognitive status is at odds with findings such as the higher dementia prevalence in women.[30] It is conceivable that our finding is the result of sample selection, as we excluded respondents who had dementia at baseline.

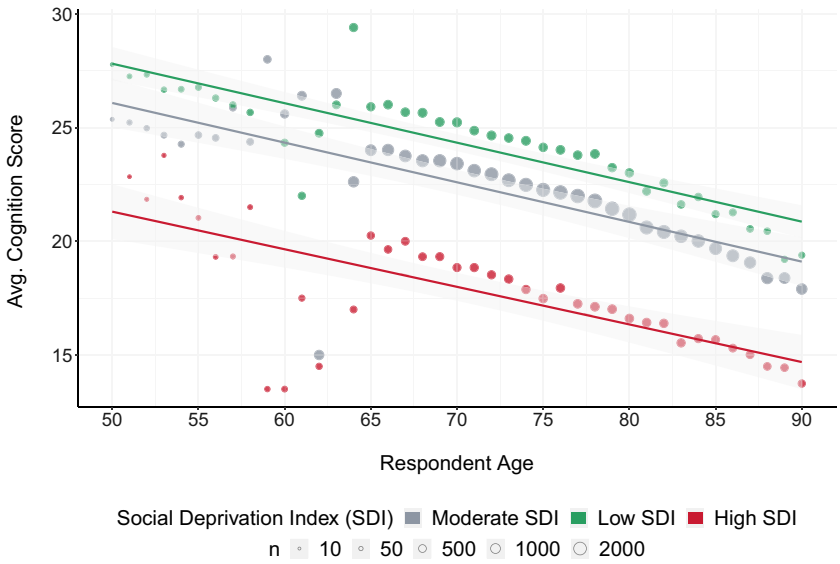

FIGURE 2 Average cognitive scores across ages 50 to 90 by SDI group. The size of the dots represent the number (n) of respondents whose scores counted towards the calculated average. Lines are the regression lines for respondents with high SDI (80% percentile of SDI scores; red) and with low SDI (20% percentile of SDI scores; green). The grey colour represents moderate SDI scorers. Light grey shading surrounding regression lines shows the 95% confidence interval [Colour figure can be viewed at wileyonlinelibrary.com]

As the present work is based exclusively on a US-sample and the social deprivation construct is explicitly context-dependent, results may not generalise to other populations. For instance, the US health care system is more heterogeneous than other health care systems, possibly creating a greater relevance of health insurance status to health outcomes than would be seen elsewhere.[31] Therefore, further research in non-US contexts is needed to establish whether the SDI domains relevant to the present sample will be replicated and whether the association with cognitive functioning is confirmed.

A notable limitation of the present work is that the global cognition score used as the outcome in the present work is not wholly independent from the SDI predictor in as far as missing scores imputed by the RAND do take socioeconomic factors into account.[24] This might have inflated the association. On the other hand, by only including non-institutionalised, non-demented individuals at baseline we likely excluded the most deprived, which would suggest that the effect of social deprivation may be underestimated in our sample. An additional concern is the high number of respondents excluded due to missing social deprivation data. Lacking information from respondents experiencing particularly high deprivation might have further contributed to an underestimation of an SDI effect.

In sum, our analyses underline the role of social deprivation in cognitive status. The fact that this association is stronger than the association between deprivation and cognitive decline may suggest that early intervention is key in raising the cognitive "peak" from which each individual enters age-related cognitive decline. This should be considered when formulating policies designed in preventing cognitive decline that reaches pathological levels.

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DATA AVAILABILITY STATEMENT

The data used in this work are publically available from Health and Retirement Study (HRS) and the RAND Center for the Study of Aging at https://hrs.isr.umich.edu/data-products.

CONFLICT OF INTEREST DISCLOSURE

The authors have no conflict of interest.

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No external sponsor had any role in the development of this work.

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