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Prosocial Intentions and Subsequent Cognitive Health: A Prospective Cohort Study

Justin G Farmer, SM¹; Lucía Macchia, PhD²; Feifei Bu, PhD³; Jessica Gong, PhD^{4,5}; Andrew Steptoe, PhD³; Panayotes Demakakos, PhD⁴; Laura D. Kubzansky, PhD⁶

1. Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, MA, USA
2. School of Health and Psychological Sciences, City, University of London, London, United Kingdom
3. Department of Behavioural Science and Health, University College London, London, United Kingdom
4. Department of Epidemiology and Public Health, University College London, London, United Kingdom
5. George Institute for Global Health, Imperial College London, London, UK
6. Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, Boston, MA, USA

*Address correspondence to: Justin G. Farmer, SM. E-mail: jfarmer@hsph.harvard.edu

Abstract

Objectives: Prosociality, defined as positive other-regarding intentions and behaviors, is a modifiable factor demonstrated to be associated with better mental, physical, and cognitive health in older adults. Prior studies have largely focused on individual prosocial behaviors, especially volunteering. This study examines whether prosocial intentions are associated with maintaining cognitive health over time.

Methods: Data are from 7,844 adults aged 50 or older in the English Longitudinal Study of Ageing. A 9-item prosocial intentions scale was derived from self-reported items assessing altruism and collectivism. Cognitive health was assessed via biennial completion of tasks related to executive function and verbal memory and incident dementia diagnosis over 11 years. Linear mixed-effects models examined relationships between prosocial intentions and changes in executive function and verbal memory. Cox proportional hazards models assessed risk of developing dementia. A broad array of demographic, socioeconomic, and health-related covariates were also considered.

Results: Results from mixed-effects analyses suggest higher prosocial intentions are associated with better cognitive health maintenance after controlling for sociodemographics and baseline health characteristics including depressive symptoms. Participants with high versus low prosocial intentions had 24% slower decline in verbal memory and 55% slower decline in executive function. Similarly, higher prosocial intentions were associated with a 35% reduced hazard of dementia during this same period in fully adjusted models.

Discussion: These results suggest aspects of prosociality beyond formal volunteering facilitate maintaining cognitive health among older adults and may provide novel targets for future interventions to enhance healthy aging.

Key Words: Prosociality, Dementia, psychological assets

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Introduction

Recent global estimates suggest that by the year 2050, the number of individuals with dementia will nearly triple to 150 million people (Nichols et al., 2022). While the age-specific incidence of late onset dementia (hereafter dementia) has declined in the prior two decades (Wolters et al., 2020), recent work suggests these improvements have slowed or even reversed (Chen et al., 2023). Dementia takes a toll on the physical, mental, and economic health not only of those living with the condition, but also of their families, and their communities. Furthermore, dementia currently has no known cure with recently developed anti-amyloid treatments showing only modest effects in slowing cognitive decline (Shi et al., 2022). Thus, identifying novel factors that can improve capacity to maintain cognitive health throughout later adulthood is an urgent priority. Prosociality may be one such factor given recent work suggesting it is modifiable (Bailey et al., 2021; Luberto et al., 2018), a key determinant of population health (Kubzansky et al., 2023; Sachs et al., 2022), and relevant for cognitive health (Guiney & Machado, 2018). However, empirical work is limited, and direct tests of this hypothesis are needed.

A recent Lancet Commission recognized prosociality, defined as “the orientation of individuals and government regulations to the needs of society as a whole, rather than to narrow individual interests,” as critical for re-orienting our societies in ways that will promote greater societal health in the wake of the COVID-19 pandemic (Sachs et al., 2022). However, the health benefits of prosociality likely extend well-beyond quelling the spread of infectious disease during times of crisis, given the growing literature linking it to a range of physical and mental health conditions (Hui et al., 2020; Macchia et al., 2023). Prosociality may be particularly relevant for cognitive health, given its role in fostering social engagement, which has demonstrated cognitive benefits in older adults (Duffner et al., 2022; Evans et al., 2019). Prior research has found evidence for the health benefits of specific prosocial behaviors with most studies focusing on formal volunteering, which has consistently been associated with a 25% decrease in mortality (Okun et al., 2013; O’Reilly et al., 2017), as well as with reduced cognitive decline (Gupta, 2018), a lower risk of dementia (Griep et al., 2017), and improvements in cortical and hippocampal

volume (Carlson et al., 2009, 2015). While some of the observed cognitive benefits could be due to reverse causation, whereby prodromal declines in cognition cause changes in prosocial behaviors, findings not only from well controlled observational studies but also from experimental studies suggest this cannot account for the full relationship (Carlson et al., 2015; Kail & Carr, 2020).

While a substantial literature documents salutogenic effects of volunteering and other prosocial behaviors such as donating to charity and informal helping (Corrêa et al., 2019; Macchia et al., 2023; Okun et al., 2013), less is known about how prosocial intentions, the underlying emotional and motivational components of prosociality that may precede the enactment of prosocial behaviors, relate to physical health. Older adults appear to be more amenable to enhancing their prosociality compared to the general population (Bailey et al., 2021), but they may have more limited opportunities for participation in organized prosocial activities such as formal volunteering (Bhatta et al., 2021). Thus, whether increasing other aspects of prosociality beyond the behaviors assessed to date could be health beneficial remains unknown. The limited work on prosocial intentions to date is promising: a few studies found higher levels of self-reported compassion, altruism, and empathy were associated with healthier levels of inflammation and blood pressure (Hui et al., 2020), both implicated in the development of dementia. Studies examining personality traits relevant to, though distinct from, prosocial intentions such as agreeableness and conscientiousness have found both traits are associated with slower rates of cognitive decline and reduced risk of dementia (Aschwanden et al., 2021; Habashi et al., 2016). While these findings are suggestive, we know of no epidemiologic work directly examining the cognitive health effects of prosocial intentions *per se*.

In addition to understanding the potential role of prosocial intentions in maintaining cognitive health for the overall population, it is important to identify whether the magnitude of the association varies across subgroups because the burden of dementia is not equitably shared within and across populations. For instance, those with fewer socioeconomic resources are at higher risk of developing dementia within their lifetimes (Rajan et al., 2021; Samuel et al., 2020). Additionally, prior work suggests

the health benefits of prosociality vary by age and sex, with those above 65 especially benefitting and those who are female benefitting more than male (Hui et al., 2020). Less work has considered whether and how health effects of prosociality may be modified by socioeconomic factors such as personal wealth or educational attainment. Importantly, it is possible the health benefits of prosociality may also be confounded by socioeconomic status, whereby more affluent individuals simply have more time and flexibility to engage in both other-oriented behaviors and unrelated salutogenic practices. Considering the social contexts in which prosocial intentions occur may add insight for understanding whether and for whom prosociality influences health.

Using data from a nationally representative sample of older adults in England, this study tests the hypothesis that individuals reporting higher vs. lower prosocial intentions will demonstrate better maintenance of cognitive health. We further hypothesize that these associations will be especially strong in adults 65 years or older and those who are female (Hui et al., 2020). With additional analyses we also evaluate potential modifying effects of the socioeconomic status as measured by personal wealth and educational attainment.

Methods

Sample and Study Design. Data are from the English Longitudinal Study of Ageing (ELSA) core sample, a nationally representative panel study of English adults aged 50 and over living in private households (Stephens et al., 2013). Collection of ELSA data has occurred biennially since 2002 with participants providing information on health and well-being, social activities, and economic resources through computer-assisted personal interviews. The study sample is periodically replenished to ensure the full age range is represented. Prosocial intentions were assessed during Wave 4 (2008-2009), which serves as our study's baseline. Among 9,886 Wave 4 participants, our analytic sample excludes those with prevalent dementia ($n = 211$), who lacked prosocial intentions data ($n = 1,415$) or had incomplete outcome or covariate data ($n = 416$; see Supplementary Material Section A), yielding a sample of 7,844 participants. Cognitive outcome data is collected at every data collection wave through Wave 9 (2018-

2019), for up to 11-years of total possible follow-up time. All ELSA participants provide written informed consent, and the study was approved by the UK National Research Ethics Service. Researchers may request all ELSA data through the UK Data Service (<https://ukdataservice.ac.uk/use-data.aspx>).

Prosocial Intentions. Prosocial intentions on an individual level can be defined as positive other-regarding beliefs and motivations, encompassing a range of facets such as altruism, trust, reciprocity, compassion, and empathy (Kubzansky et al., 2023). To capture the multifaceted nature of this construct, we derived a 9-item scale using items from well-validated self-report measures of altruism and collectivism administered in ELSA at Wave 4 only (Johnson et al., 1989; Singelis, 1994). These items were previously selected and modified for the ELSA population based on face-validity. Items related to altruism included questions such as “Please say how often you would be willing to do the following: Help a stranger in the street” with response options on a Likert scale ranging from “Never” to “Very Often”. Items related to collectivism included statements such as “If a relative were in financial difficulty I would help within my means.” with response options asking participants to rate the extent to which they agreed with each statement on a Likert scale “Strongly Disagree” to “Strongly Agree.” For all items, see Supplementary Material Section B. Following prior work, individuals missing $\geq 50\%$ of items were excluded, while participants missing $<50\%$ of the items (8.9%) had missing values imputed with the individual’s mean score (Bell et al., 2016). We then derived an overall score summing the 9 items, with higher scores reflecting higher prosocial intentions (score range 0-36). The derived prosocial intentions scale demonstrated strong internal consistency reliability ($\alpha = 0.80$) and good validity based on correlations in expected direction with relevant other psychosocial factors. That is, the measure correlated positively with personality traits such as agreeableness ($\rho = 0.27$) and conscientiousness ($\rho = 0.16$), as well as religiosity ($\rho = 0.13$), and quality of life ($\rho = 0.15$) (Bhatta et al., 2021; Habashi et al., 2016). For more details on these measures and associations see Supplementary Material Section C. We standardized the prosocial intentions measure for all main and sensitivity analyses where we separately examined

prosocial intentions as a continuous or categorical measure, with tertiles based on the distribution of scores in the sample.

Cognitive Health. We examined three cognitive health outcomes based on performance on each of two tasks or receiving a dementia diagnosis. One task assessed verbal memory through a word-list learning test on which participants were asked to remember 10 common words and were then tested immediately and again after a delay. The final verbal memory score was the sum of the number of words recalled across the two time points (Phillips et al., 2014). Executive function was measured by participants listing as many animals as they could generate in one minute (Huppert et al., 2004; Phillips et al., 2014). Both tasks were assessed at each wave, excluding the executive function task at Wave 6. The median number of assessments for each task was 5 (Supplementary Material Section D). Dementia diagnoses were identified through an algorithmic approach, with case status ascertained using information from the National Health System Hospital Episode Statistics and Office for National Statistics and Mortality Statistics based on ICD Codes (Supplementary Material Section E). Additional cases were identified through self-reported physician diagnosis and scores on the caregiver completed Informant Questionnaire on Cognitive Decline in the Elderly during all study waves (with 3.38 cut-off), as well as medication use for dementia (Donepezil hydrochloride, Galantamine, Memantine hydrochloride, and Rivastigmine) collected during nurse visits in Wave 6 and 8/9. Date of diagnosis was taken as the earliest report of dementia referenced in hospital, mortality, self, proxy reports, or medication use.

Covariates. Baseline covariates (Wave 4) for the main analyses, selected based on a review of literature, were limited to factors that could be associated with both prosocial intentions and cognitive health, but which were unlikely to be on the causal pathway between them. These include self-reported demographic factors age, sex, race (characterized by ELSA as White and non-White), marital status (married, single, divorced, widowed), and socioeconomic factors characterized by educational attainment, work status, income, and wealth. Educational attainment was categorized according to number of years of formal

education as follows: 1) lacked formal qualifications (4 years); 2) completed education to School Certificate level only (8 years); 3) completed A levels or equivalent (12 years); 4) obtained a university degree or higher (15 years). Work status was categorized as employed, retired, or out of the work force. Wealth was derived by summing up the value of reported possessions and assets and subtracting reported open mortgages and payments. Both wealth and income were then divided into deciles for interpretability.

While health factors may confound or mediate the associations of interest, we added baseline health factors to the main models to mitigate concerns about confounding. These include functional limitations (classified as health problems that limit one's; coded Yes/No), continuous depressive symptoms as measured by the Center for Epidemiological Studies—Depression Scale (Lewinsohn et al., 1997), and self-reported physician diagnosis of any cardiometabolic disease including diabetes, angina, heart attack, and stroke, previously demonstrated to be valid measures compared to medical records (Stoye & Zaranko, 2020).

Other covariates more likely to be downstream of prosocial intentions than prior causes or were available only in a subset of the sample were considered in additional models. For detailed description, see Supplementary Material Section C. Briefly, health behaviors relevant for dementia and prosocial behaviors were assessed at baseline, including current smoking, physical activity, alcohol use, healthy eating, and whether participants volunteered, donated money, provided caregiving, or provided unpaid help. Covariates available only on a subset of our sample include personality traits, religiosity, and quality of life (all measured only in Wave 5), as well as nurse-assessed baseline health characteristics such as hypertension based on standard guidelines (Deckers et al., 2015; Duffner et al., 2022).

Statistical Analysis. Descriptive analyses compared covariates across tertiles of prosocial intentions. We also evaluated the association of mean prosocial intention scores with number of self-reported prosocial behaviors in Wave 4 using ANOVA (Supplementary Material Section C). Analyses examining prosocial intentions in relation to trajectories of cognitive health measured by executive function or verbal memory used linear mixed-effects models (LMMs) with random intercepts and unstructured covariance. Potential

confounders were sequentially added to models in sets related to demographics, socioeconomics, and baseline health characteristics: model 1 was unadjusted; model 2 adjusted for age, sex, race, and marital status; model 3 (our main model) additionally adjusted for educational attainment, work status, income, and wealth. Model 4 additionally adjusted for health characteristics and behaviors that could either confound or mediate the prosocial intentions—cognitive health relationship such as depressive symptoms, cardiovascular disease, and current smoking. In sensitivity analyses, additional health characteristics (hypertension status, hypercholesterolemia status) and other psychosocial factors (volunteering behavior; personality traits including agreeableness, neuroticism, conscientiousness, extraversion, and openness; religiosity; quality of life) reliably linked with both prosociality and health in prior work were also added to models 3 and 4 respectively among participants for whom relevant covariates were available (Aschwanden et al., 2021; Habashi et al., 2016; Okun et al., 2013; Penner & Finkelstein, 1998).

To address concerns about potential selection bias at baseline due to differential completion of the prosocial intentions measure, we used inverse probability weights (IPW), derived by logistic regression (Cole & Hernán, 2008). Additionally, to account for possible differential loss to follow-up based on prosocial intentions, we also created wave-specific IPWs. Composite weights were created by multiplying wave-specific and weights and applied to all mixed-effects models. Models for these weights are included in Supplementary Material Section F.

We conducted Cox proportional hazard analyses to compare the hazard of developing dementia based on level of prosocial intentions at baseline. Follow up time was defined as the amount of time from Wave 4 survey until dementia diagnosis, death, or the date of the most recently completed ELSA survey. Separate models included prosocial intentions as either a continuous variable or tertiled to assess possible discontinuity of effects. To account for the well-documented effects of prosociality as protective against mortality (Okun et al., 2013), death was considered a competing risk and treated as a censoring event. We added covariates in increasingly adjusted models as described above. To reduce concerns about reverse causality, in an additional sensitivity analysis we re-ran all models excluding the first five years of follow-up.

Finally, we evaluated potential effect modification by age, sex, personal wealth, and educational attainment using interaction terms in models adjusted for covariates in our core model. Because we may be underpowered to detect significant differences in the interaction term models, we examined analyses stratified by these potential effect modifiers for both LMMs and survival models.

Results

A total of 7,844 participants were included in descriptive, LMMs, and survival analyses. The sample was majority female (55.2%), white (98.0%), and had a mean age of 66.0 years at baseline (SD = 9.4). Descriptive statistics show individuals with higher vs. lower prosocial intentions were more likely to be female, were younger, and were more likely to be married or divorced rather than single or widowed, as well as being more highly educated, more likely to be employed, and having higher baseline incomes and total wealth (Table 1). However, levels of functional limitations and depressive symptoms did not differ significantly across level of prosocial intentions. Moreover, prosocial intentions were strongly associated with engaging in prosocial behaviors (Supplementary Material Section C; ANOVA p-value <0.01).

Longitudinal Changes in Cognitive Function

The average change in verbal memory score for the overall sample was -0.22 per 2-year wave, while the average change in executive function score was -0.15 per wave. Figure 1 illustrates predicted changes in each cognitive performance task over time across high, medium, and low levels of prosocial intentions and shows higher prosocial intentions are associated with less decline. In all analytic models for each cognitive performance task, higher prosocial intentions were consistently associated with slower rate of cognitive decline over the 11-year study period (see Table 2; Supplementary Material Section G). For example, in our core model considering continuous prosocial intentions, each 1 SD increase in prosocial intentions was associated with a 0.02 unit slower decline in verbal memory (95% Confidence Interval [CI]: 0.01-0.04) and a 0.07 unit slower decline in executive function (95% CI: 0.04-0.10) per wave, after controlling for age, sex, race, marital status, education, work status, income, and wealth. In the verbal memory model with tertiled prosocial intentions, participants with high vs. low prosocial

intentions had 0.42 unit higher memory score at baseline (95% CI: 0.26, 0.57) and a 0.06 (95% CI: 0.02, 0.09) unit slower decline in performance per wave. For executive function, those with high vs. low prosocial intentions had a 0.51 unit higher baseline score on average and a 0.15 unit slower decline per wave (95% CI: 0.08, 0.22). Associations of prosocial intentions with each performance task over time remained evident when restricting analyses to participants with >1 cognitive measure. Further adjusting for depressive symptoms, cardiovascular disease, functional limitations and baseline health behaviors did not change any estimates (Table 2, Supplementary Material Section G).

Dementia Status

A total of 533 incident dementia cases were identified during the 11 years of follow-up (median = 9.8 years) among participants who were dementia-free at study baseline. 228 cases were identified through medical or mortality records, while 305 were identified through self-report or proxy assessment. Estimates from Cox models are depicted in Figure 2 and presented in Table 3 (see also Supplementary Material Section H). The crude (Model 1) hazard ratio (HR) of dementia comparing high vs. low prosocial intentions is 0.51 (95% CI: 0.41,0.62). Adjusting for age, sex, race, educational attainment, current work status, wealth, and income attenuated this effect, but an association remained evident with a 35% reduced hazard of dementia (95% CI: 0.53, 0.81). Estimates for associations of prosocial intentions with incident dementia risk were similar after excluding those who developed dementia within 5 years of study baseline (n = 213).

Additional Analyses:

Results remained largely robust across several sensitivity analyses (Supplementary Material Sections I and J). In the subset of participants with relevant covariates measured, for verbal memory analyses, separately adjusting for nurse-measured baseline health characteristics or relevant psychosocial factors did not materially alter the estimates for longitudinal change in this outcome. For executive function, adjusting for the nurse-assessed health characteristics did not alter any baseline estimates or most longitudinal estimates; however, it attenuated longitudinal estimates for the medium vs. low

prosocial intentions group. Adjusting for other relevant psychosocial factors, including formal volunteering, also attenuated the baseline effects of prosocial intentions to the null, but longitudinal associations remained evident. Adjusting for these psychosocial factors also attenuated the results for dementia risk to the null for both the medium vs. low and high vs. low groups. However, adjusting for nurse-assessed health characteristics did not substantially alter dementia risk estimates.

In models including interaction terms we did not find significant effect modification by age (below 65 vs. 65+), sex (female vs. male), or education (A-level vs. no A-level) for associations of prosocial intentions with decline in either verbal memory or executive function or time to dementia diagnosis (Supplementary Material Section K). However, effects of prosocial intentions on executive function appeared to be larger in those with higher vs. lower wealth ($\beta_{\text{prosocial*time*wealth}} = 0.07$; 95% CI: 0.01-0.13). While the direction of effects was similar across all subgroups, stratified analyses hinted the associations of prosocial intentions with change in verbal memory and executive function may be slightly stronger for those 65 years and above, those with at least median wealth, and those without an A-level degree. For instance, a 1 SD increase in prosocial intentions was associated with a 0.07 (95% CI: 0.02-0.11) unit slower decline in executive function for those 65 years and above, while the same increase was associated with a 0.03 unit slower decline for those below 65 years. Stratified survival analyses also hinted at some differences in effect sizes for dementia with female vs. male participants, those younger vs. older than 65, and those with less vs. more wealth benefitting more (Supplementary Material Section K).

Discussion

This study examined associations between prosocial intentions and cognitive health outcomes including rate of cognitive change and risk of dementia over 11 years of follow-up. Results from linear mixed-effects and survival analyses suggest higher prosocial intentions were associated with maintaining better cognitive health over time. Even after accounting for baseline health status and sociodemographic characteristics, individuals with higher prosocial intentions demonstrated better maintenance in both

executive function and verbal memory, as well as a lower risk of developing dementia. Comparing across tertiles, participants with high vs. low prosocial intentions had baseline verbal memory scores equivalent to being 2.63 years younger and experienced a 24% slower decline in verbal memory per wave. Results for executive function are even more striking, suggesting a 55% slower decline per wave. Intriguingly, our results hold even after adjusting for depressive symptoms, suggesting the salutogenic benefits from the presence of prosocial intentions is not simply due to the absence of being socially withdrawn or having negative cognitions.

Findings regarding associations of prosocial intentions with risk of dementia show similar trends, affirming the observed differences in maintenance of cognitive health over time are substantial and clinically meaningful. Those with high vs. low prosocial intentions had a 35% reduced risk of developing dementia during the study period. Based on the 2020 Lancet Commission on dementia prevention, this difference is similar in size to the individual effects of education, hypertension in midlife, and smoking (Livingston et al., 2020). These estimates were attenuated after accounting for personality traits and other psychosocial factors such as formal volunteering in a smaller subset of participants; however, results still suggest a protective effect and lack of significance could be explained by a lack of power in our models due to having a significant fraction of participants, including a quarter of the dementia cases, who were missing personality data.

While this is the first study to examine associations of prosocial intentions with cognitive health in older adults, our results are similar to those found in studies assessing specific prosocial behaviors such as volunteering or prosociality-related personality traits (e.g., agreeableness) in relation to cognitive decline and dementia (Aschwanden et al., 2021; Griep et al., 2017; Grodstein et al., 2022; Gupta, 2018). For example, research has shown that individuals who volunteer their time have slower cognitive decline and a lower risk of dementia compared to non-volunteers (Gupta, 2018). Experimental findings show volunteering behavior causally contributes to improved cognitive health. In a study that randomized older adults to volunteer or not in local schools, volunteers vs. controls demonstrated short-term benefits in

executive function, especially among those with lower cognitive function at baseline (Carlson et al., 2009). Repeated imaging on these participants suggested engaging in the program slowed, and in men, even reversed declines in brain volume related to dementia (Carlson et al., 2015). Some limited other work has suggested engaging in formal volunteering may not be the only aspect of prosociality that is health beneficial, with one small observational study finding that engaging in more altruistic behaviors contributed to better cognitive health independent of volunteering (Corrêa et al., 2019). Our findings are in line with these results. However, our measure relates specifically to one's intentions or willingness to engage in range of prosocial behaviors beyond volunteering, rather than assessing enacted behaviors. As a result, our findings are novel in that they suggest having a general motivational-emotional orientation toward prosociality may also be health-enhancing. It also identifies an additional point of intervention for improving population cognitive health and potentially widens the range of older adults who can benefit from initiative to increase prosociality beyond those physically able to participate in formal volunteering or other prosocial behaviors. More work is needed to disentangle whether observed cognitive benefits from prosociality stem primarily from the enactment of specific behaviors or may also be due to the cognitive and emotional components underlying prosociality.

Findings for each outcome were largely consistent across several potential effect modifiers. This was true when considering difference by age, sex, and educational attainment. There was a hint that associations of prosocial intentions with maintaining executive functioning depended somewhat on wealth, with wealthier people getting more benefit; however, these differential effects were not found in relation to dementia risk. In fact, individuals with less wealth appeared to benefit more (i.e., had an even lower dementia risk) from having more prosocial intentions compared to those with more wealth. While seemingly contradictory, these results could be attributed to differences in outcome assessment since executive function was measured by the repeated completion of a task, while dementia was based on a clinical diagnosis, but further work is needed to confirm the reliability of this difference. While estimates in stratified analyses hinted those who are female and above 65 might benefit more from prosocial

intentions, aligning with our hypothesis, all estimates had overlapping confidence intervals across strata, suggesting findings should be viewed cautiously. Taken together, our results suggest greater prosociality may provide health benefits in populations ranging in age and socioeconomic status. Whether our findings among individuals in a high income Western country will generalize to other settings will need to be further assessed.

Several theories and frameworks have been proposed to explain linkages between prosociality and health for older adults and more generally (Bailey et al., 2021; Kubzansky et al., 2023). These largely center on aspects related to self-determination and role theory, whereby more prosocial individuals are better able to envision and achieve a sense of purpose in their lives, which in turn has been linked with a lower risk of dementia (Sutin et al., 2021). Most work linking prosociality to better health and well-being has focused on effects of prosocial behaviors per se. Our findings suggest that such theoretical frameworks may need to be expanded, whereby not only prosocial acts, but also being motivated to engage in prosocial behavior may, in and of itself, also be health beneficial. Such motivation may also foster greater social connectedness, lower loneliness, or otherwise increase well-being by conferring a sense of purpose, all of which in turn have been linked with slower cognitive decline and reduced risk of dementia (Evans et al., 2019; Willroth et al., 2023). Individuals oriented to be more prosocial may also engage in more positive and fewer negative health behaviors, which are known risk factors for cognitive decline and dementia (Livingston et al., 2020). Of note, recent work on prosociality has emphasized the importance of considering both the upstream factors that drive the distribution of prosociality, as well as downstream health effects. Our current analysis confirmed the relevance of considering upstream factors with findings suggesting associations were not confounded by two socioeconomic factors, wealth and education, but hinting that prosociality may confer greater benefits for cognitive health among individuals with less versus more wealth (Kubzansky et al., 2023). While the results of our sensitivity analyses suggest the observed effects of prosocial intentions could be, at least partially, due to effects on

subsequent health and psychosocial factors as evidenced by the attenuation of effect estimates, a formal causal mediation is necessary to evaluate these potential pathways.

On a population level, prosociality is most relevant for health if it is modifiable. Decades of research suggests prosociality is influenced by the social environment on multiple levels, with individuals of higher socioeconomic status and larger social networks engaging in more prosocial behaviors (Niebuur et al., 2018; Penner & Finkelstein, 1998). Other work suggests prosocial intentions are influenced by socialization (including peer factors and social norms), modeling, and other community or individual level practices throughout life and are therefore still amenable at older ages (Bailey et al., 2021; Eisenberg et al., 2014). For example, engaging in meditation can increase prosociality with prior research demonstrating it can increase not only an individual's engagement in prosocial behaviors but also the underlying emotional components of prosociality examined in this study (Luberto et al., 2018).

Some limitations should be noted. First, prosocial intentions were measured using a set of questions developed specifically for ELSA. It is possible the items did not fully capture the true range of prosocial intentions in the sample. However, this would likely bias associations toward the null unless there were sizable differences based on future dementia status. Additionally, we only have a measure of prosocial intentions at one point in time, making it difficult to disentangle mediators from confounders and when in the life-course these effects are most potent (Gilsanz et al., 2022). Another issue is our results could be somewhat driven by reverse causation whereby those already experiencing cognitive decline are less likely to report high prosocial intentions due to feeling less capable of actually enacting such intentions. Concerns about the lack of specificity of our exposure and reverse causation are both mitigated by our rigorous analytic approach including accounting for baseline cognition and other health concerns, as well as finding that our results remain robust to excluding the first five years of follow-up. Another limitation of our study is our case ascertainment does not include primary care linkage and therefore our dementia results may be an underestimate. Finally, as with all observational studies, unmeasured confounding is a concern. Results however were strikingly robust to additional adjustment

for several known health related risk and protective factors for dementia. While results were not uniformly robust to adjustments for personality and other relevant psychosocial factors in terms of statistical significance in the smaller subsample with appropriate covariates, estimates remain substantial especially with regard to associations with change over time, suggesting a protective effect of prosocial intentions independent of closely linked personality traits and the actual enactment of behavior.

Our study has a number of strengths. First, we used a large, well-characterized, and nationally representative sample richly characterized facilitating inclusion of many potential confounders. Second, we used IPW to account for selective attrition, which not only improves validity of our results but also allows us to generalize results to those individuals who remained alive during the study period. Finally, we had objective measures of cognitive health including two well-validated task performance measures rather than self-reported measures. Our comprehensive definition of dementia diagnoses includes the use of hospital and mortality records.

Reducing the burden of dementia and later life cognitive decline is necessary for the well-being of individuals and our societies. This challenge must be met with a comprehensive tool kit that includes intervening upon psychological and social factors including prosociality. Our results strongly suggest higher prosocial intentions may be protective for cognitive health even among older adults, regardless of sex, age, and educational attainment, and wealth. Taken together, our findings suggest that prosociality, beyond formal volunteering, is a potentially important modifiable risk factor for improving later life cognitive function on an individual and population level and should therefore be further examined.

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Conflict of Interest

None.

Data Availability

Researchers may request all ELSA data through the UK Data Service (<https://ukdataservice.ac.uk/use-data.aspx>). All code will be made available by request to the corresponding author. This study was not preregistered.

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Table 1. Descriptive Statistics by Tertile of Prosocial Intentions

Characteristic	Tertile		
	Low	Medium	High
n	2644	2477	2723
Raw Prosocial Intentions [Range] ***	16.48 [0,20]	22.58 [20.25, 24.75]	27.79 [25,36]
Standardized Prosocial Intentions [Range] ***	-1.09 [-4.15, -0.43]	0.05 [-.39, 0.45]	1.01 [0.50, 2.54]
Sociodemographics			
Sex (%)***			
Female	1339 (50.6)	1368 (55.2)	1623 (59.6)
Male	1305 (49.4)	1109 (44.8)	1100 (40.4)
Age ***	67.05 (9.64)	65.93 (9.25)	65.07 (9.14)
White (%)	2590 (98.0)	2425 (97.9)	2676 (98.3)
Marital Status (%) **			
Married	1783 (67.4)	1690 (68.2)	1888 (69.3)
Divorced	273 (10.3)	270 (10.9)	319 (11.7)
Single	184 (7.0)	144 (5.8)	116 (4.3)
Widowed	404 (15.3)	373 (15.1)	400 (14.7)
Educational Attainment (%) ***			
4 years	837 (31.7)	612 (24.7)	610 (22.4)
8 years	641 (24.2)	604 (24.4)	620 (22.8)
12 years	554 (21.0)	586 (23.7)	724 (26.6)
15 years	612 (23.1)	675 (27.3)	769 (28.2)
Wealth***	289,688.84 (368,465.81)	348,812.46 (484,215.83)	379,226.50 (786,966.86)
Income***	434.85 (338.77)	485.77 (400.40)	521.22 (440.26)
Work Status (%) ***			
Employed	781 (29.5)	849 (34.3)	1001 (36.8)
Out of Work Force	323 (12.2)	271 (10.9)	293 (10.8)
Retired	1540 (58.2)	1357 (54.8)	1429 (52.5)
Health Factors			
Any Heart Problem (%) ***	442 (16.7)	355 (14.3)	334 (12.3)
Diabetes (%) ***	215 (8.1)	169 (6.8)	140 (5.1)
Angina (%) **	206 (7.8)	138 (5.6)	153 (5.6)
Heart Attack (%) **	193 (7.3)	130 (5.2)	143 (5.3)
Stroke (%)	84 (3.2)	61 (2.5)	66 (2.4)
Functional Limitations (%)	47 (1.8)	37 (1.5)	63 (2.3)
Depressive Symptoms (%)	2.99 (1.37)	2.93 (1.33)	2.95 (1.31)
Current Smoker (%) **	319 (12.1)	287 (11.6)	391 (14.4)
Healthy Diet (%) ***	804 (30.4)	894 (36.1)	1011 (37.1)
Moderate Alcohol (%)*	1352 (51.1)	1367 (55.2)	1470 (54.0)
Physical Inactivity (%) ***	828 (31.3)	658 (26.6)	697 (25.6)

Note. * p < 0.05, ** p < 0.01, *** p < 0.001

Table 2. Longitudinal Associations between Prosocial Intentions and Cognitive Decline (n = 7,844)

Variable	Model 1		Model 2		Model 3		Model 4	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Verbal Memory								
Intercept	10.66 ***	10.59, 10.74	19.97 ***	19.36, 20.57	16.93 ***	16.27, 17.59	17.53 ***	16.85, 18.22
Prosocial Intentions	0.52 ***	0.44, 0.59	0.33 ***	0.27, 0.40	0.21 ***	0.15, 0.28	0.21 ***	0.14, 0.27
Time	-0.21 ***	-0.23, -0.20	-0.22 ***	-0.24, -0.21	-0.23 ***	-0.24, -0.21	-0.23 ***	-0.25, -0.22
Prosocial Intentions * Time	0.02 *	0.00, 0.03	0.02 *	0.00, 0.03	0.02 **	0.01, 0.04	0.02 **	0.01, 0.04
Executive Function								
Intercept	21.01 ***	20.86, 21.15	33.03 ***	31.79, 34.27	27.26 ***	25.88, 28.64	28.16 ***	26.71, 29.60
Prosocial Intentions	0.66 ***	0.51, 0.80	0.42 ***	0.28, 0.55	0.21 **	0.08, 0.34	0.20 **	0.07, 0.33
Time	-0.16 ***	-0.19, -0.13	-0.18 ***	-0.21, -0.15	-0.19 ***	-0.22, -0.16	-0.19 ***	-0.22, -0.16
Prosocial Intentions * Time	0.06 ***	0.03, 0.09	0.07 ***	0.04, 0.10	0.07 ***	0.04, 0.10	0.07 ***	0.04, 0.10

Note. Estimates are shown for baseline effects of prosocial intentions, effects of time, and effects of prosocial intentions on change over time. Full model output can be found in Supplementary Material Section G. Model 1 is a crude model. Model 2 adjusts for age, sex, and race. Model 3 is Model 2 + educational attainment, current work status, wealth, and income. Model 4 is Model 3 + cardiovascular disease, depressive symptoms, functional limitations, diet, alcohol consumption, physical activity, and current smoking.

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

Table 3. Prosocial Intentions and Time to Dementia Diagnosis

Prosocial Intentions	Cases / person-years	Model 1	Model 2	Model 3	Model 4
Continuous	533/69,674	0.71 (0.66, 0.77)	0.78 (0.72, 0.84)	0.80 (0.73, 0.86)	0.80 (0.74, 0.87)
Low	244/22,825	Ref	Ref	Ref	Ref
Medium	155/22,215	0.65 (0.53, 0.79)	0.72 (0.59, 0.89)	0.74 (0.60, 0.91)	0.75 (0.61, 0.92)
High	134/24,634	0.51 (0.41, 0.62)	0.63 (0.51, 0.78)	0.65 (0.53, 0.81)	0.66 (0.54, 0.82)

Note. Estimates are Hazards Ratios (95% CI). The continuous exposure measure estimate is per 1 SD change in prosocial intentions. Model 1 is a crude model. Model 2 adjusts for age, sex, and race. Model 3 is Model 2 + educational attainment, current work status, wealth, and income. Model 4 is Model 3 + cardiovascular disease, depressive symptoms, functional limitations, diet, alcohol consumption, physical activity, and current smoking. All results reached statistical significance at the 0.05 level. Full model output can be found in Supplementary Material Section H.

Figures

Figure 1. Predicted Cognitive Function Score by Level of Prosocial Intentions

Note. Cognitive Trajectories predicted for white female participants who are married, currently working, who have the lowest education, are free from baseline health concerns, and are at the mean age, income decile, and wealth decile of the sample at baseline.

Alt Text: Two line graphs depicting the trajectories of verbal memory and executive function from baseline through the end of the study. Each graph contains a line for each tertile of prosocial intentions (High, Medium, Low) and shows that individuals with higher prosocial intentions exhibit higher verbal memory and executive function at baseline and slower declines in both domains.

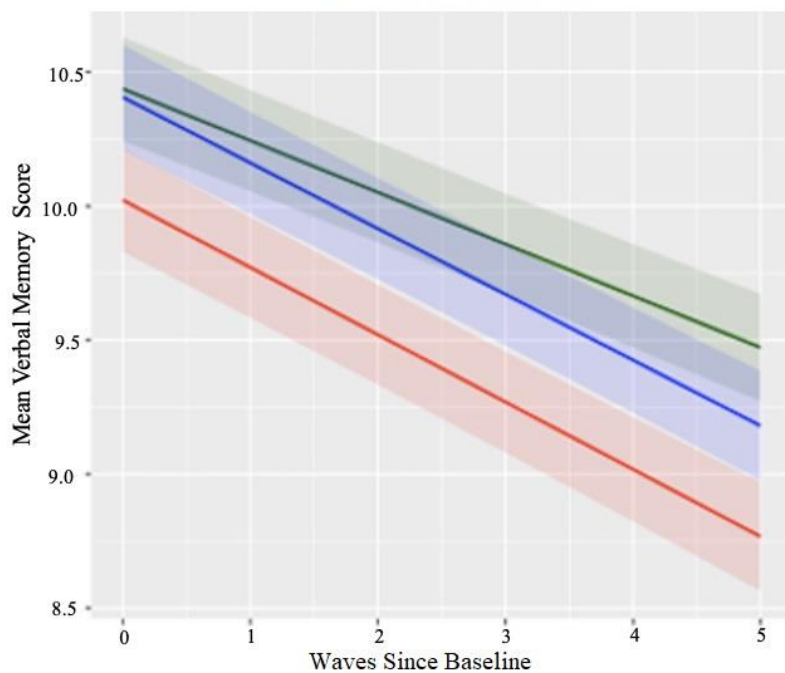
Figure 2. Probability of Remaining Dementia Free by Prosocial Intention Level.

Note. Individuals with higher prosocial intentions have a significantly lower risk of dementia over 11-years of follow-up. Curves are unadjusted for covariates. High Prosocial Intentions (n = 2,723, cases = 134) correspond to scores of 25 to 36. Medium Prosocial Intentions (n = 2,477, cases = 155) correspond to scores of 20.25 to 24.75. Low Prosocial Intentions (n = 2,644, cases = 244) correspond to scores of 0 to 20.

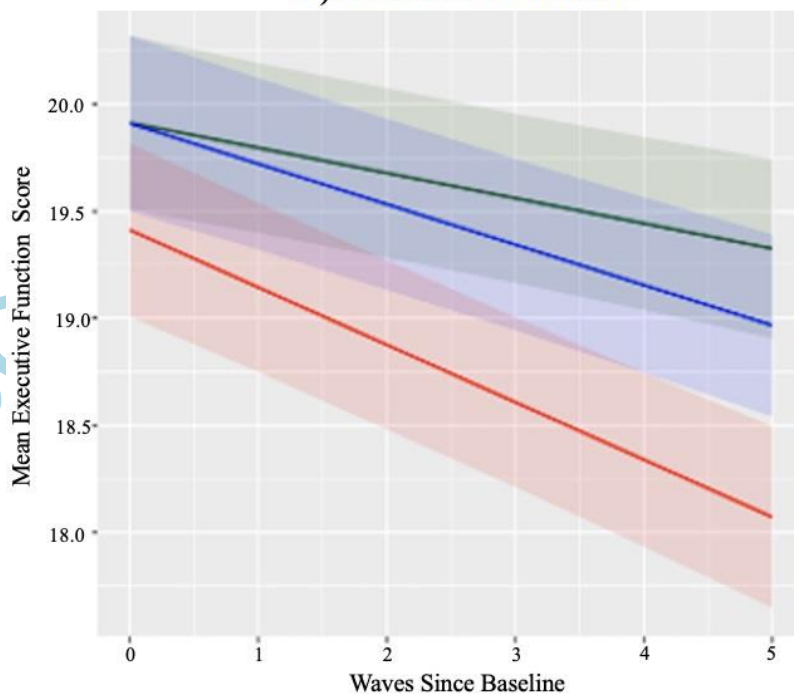
Alt Text: A line graph depicting the probability of remaining dementia free over time. The graph contains three lines, one for each tertile of prosocial intentions (High, Medium, Low) and shows that individuals with higher prosocial intentions exhibit a lower risk of developing dementia over time.

Figure 1

A) Verbal Memory



B) Executive Function



Prosocial Intentions



High



Medium

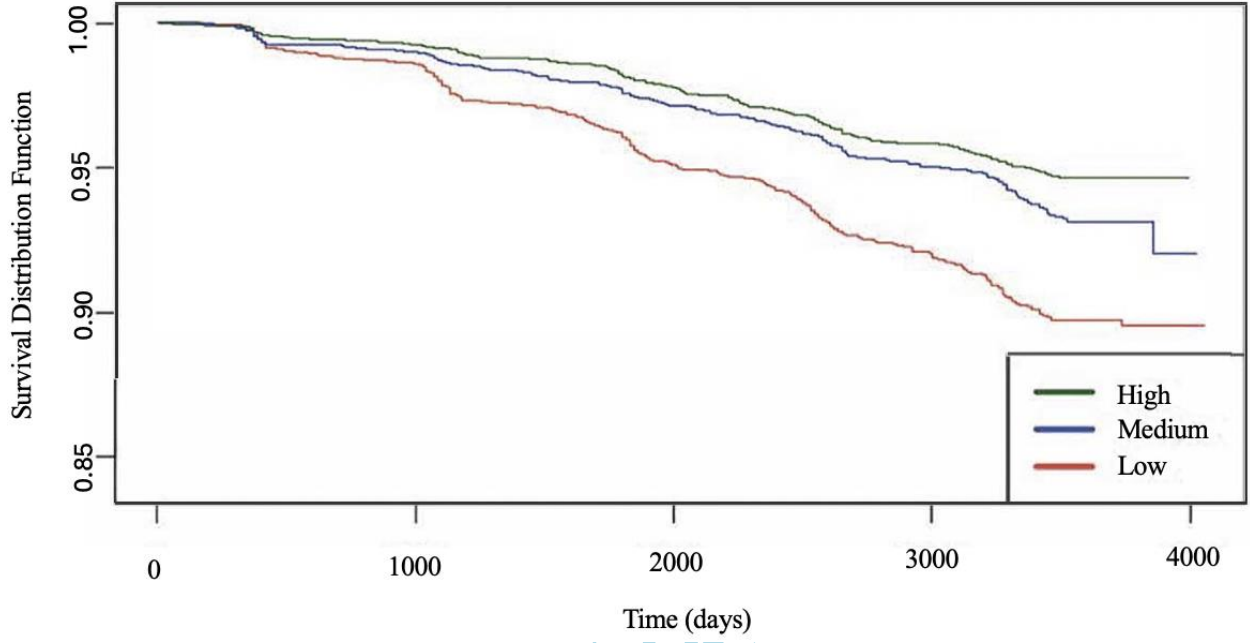


Low

ACF

nt

Figure 2



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