Sexual activity and cognitive decline in older age: a prospective cohort study

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**Abstract**

**Background**

To explore the association between sexual activity and change in cognitive function over four years in a representative sample of older adults in England.

**Methods**

Data were from 1,963 men and 2,513 women participating in Wave 6 (2012/13) and Wave 8 (2016/17) of the English Longitudinal Study of Ageing. Participants reported whether or not they had engaged in any sexual activity in the last year. Cognitive function was assessed with tests of immediate and delayed recall. Adjusted general linear models were used to test associations between sexual activity and changes in cognitive function.

**Results**

Men who were sexually active at baseline had better preservation in immediate (0.18 points, 95% CI 0.07 to 0.29, *p*=0.002) and delayed recall (0.19 points, 95% CI 0.08 to 0.29, *p=*0.001) over four-year follow-up. No significant associations were observed for women.

**Discussion**

Strengths of this study include the large, representative sample, longitudinal design, and adjustment for a wide range of potential confounders. The observational nature of our study means we cannot deduce the exact direction of effect of our findings. In addition, cognitive ability test scores in older people may reflect not only a possible decline, but also their peak prior cognitive ability, but we did not have any information regarding the trajectories of their cognitive function during the lifespan.

**Conclusion**

Health practitioners should be encouraged to screen older men relating to their sexual activity to identify those who may be at risk of cognitive decline. Older men will be heartened to know that sexual activity may aid in the prevention of age-related decline in cognition.

**Key words:** Sexual activity, cognitive function, older adults, ELSA

Background

Over the last century, life expectancy has risen considerably on a global scale [1]. However, with populations getting older, diseases of ageing have become increasingly prevalent. Dementia is one of the greatest health threats of old age, affecting an estimated 50 million people worldwide and forecast to increase to 132 million by 2050 [2]. Almost half of adults over the age of 85 are afflicted with Alzheimer's disease [3], one of the main causes of disability and dependency in the expanding older adult population worldwide [4].

There are currently limited treatments that effectively alter the clinical course of dementia [5]. Identifying modifiable risk factors in the precursory stages of dementia is thus a priority [6]. Cognitive decline is a key preclinical indicator of dementia [7]. Literature suggests that regular physical activity and management of cardiovascular risk factors (diabetes, obesity, smoking, and hypertension) reduce the risk of cognitive decline and subsequently the risk of dementia [8-11]. Moreover, there is sufficiently strong evidence to conclude that a healthy diet and lifelong learning/cognitive training may also reduce the risk of cognitive decline [8]. Identification of other modifiable correlates of cognitive decline is important in advancing knowledge and developing interventions and recommendations to aid in the prevention of dementia.

Sexual activity is a modifiable behaviour that has been shown to yield health benefits in older age [12-14]. Importantly, sexual inactivity is a risk factor for cardiovascular disease, which is known to be associated with dementia [15,16]. In a study with a 20-year follow-up, low frequency of sexual intercourse (less than once a month) at baseline was associated with 2.80 times higher odds of fatal coronary heart disease events relative to high frequency of intercourse (at least twice a week) over 10 years and 1.69 times higher odds over 20 years, even after adjustment for a wide range of potential confounders [14]. Therefore, sexual activity may also offer some protection against cognitive decline. Indeed, in a cross-sectional study of older English adults it was found that men, but not women, who were sexually active had better cognitive test scores [17]. In a prospective study using the same sample of older English adults it was found that sexual activity was associated with better cognition. However, this study was limited by just a 2-year follow-up and a single measure of cognition [18].

We therefore aimed to explore sex-specific associations between sexual activity and change in cognitive function, operationalised as verbal memory, over four years in a large, population-based sample of older adults in England.

Materials and Methods

## Study population

Data were from the English Longitudinal Study of Ageing (ELSA), a population-representative longitudinal panel study of men and women aged 50 and older living in England [19]. Participants take part in biennial assessments, in which they complete a computer assisted personal interview and self-completion questionnaires. Baseline data for the present analyses are from Wave 6 of ELSA (2012/13; the only wave to date that has included assessment of sexual activity) and follow-up data are from Wave 8 (2016/17; the most recent wave of data available at the time of analysis). We restricted our sample to those with complete data on sexual activity and all covariates at baseline, and cognitive function at baseline and follow-up (*n*=4,476). All participants gave written full informed consent to participate in the study, and ethical approval was obtained from the London Multi‐Centre Research Ethics Committee.

## Measures

Exposure: sexual activity

Sexual activity was assessed with the question “*Have you had any sexual activity (sexual intercourse, masturbation, petting or fondling) in the past year?*” (yes/no). This item was administered as part of a self-completion questionnaire and returned in a sealed envelope. Participants were advised that all responses would be kept anonymous.

Outcome: change in cognitive function

Cognitive function is evaluated in ELSA using a variety of tests, but these vary across data collection waves. For our research, we focused on memory as an indicator of cognitive function because this test was included in both the Wave 6 and Wave 8 assessments. Each participant was presented with a list of 10 nouns on a computer, one every two seconds. Participants were asked to recall as many words as possible immediately and again after a short delay during which they carried out other cognitive tests. To calculate the degree of cognitive change between Wave 6 and Wave 8, we carried out a linear regression analysis using the values of each test at Wave 6 as independent variables and scores of cognitive tests at Wave 8 as dependent variables, and used the standardised residual as a measure of cognitive change, as has been done in previous work in this area [20,21].

Potential confounders

Demographic information included age, sex, ethnicity (white vs. non-white), partner status (married/cohabiting, separated/divorced, widowed, or single/never married), and highest level of education (no qualifications, intermediate, higher). Socio-economic status was indexed using household non-pension wealth quintile (calculated across all ELSA Wave 6 participants), as this measure has been shown to be particularly sensitive in this age group [22]. Health-related variables included self-reported cardiovascular disease (hypertension, angina, myocardial infarction, stroke), diabetes, and limiting long-standing illness; cigarette smoking (smoker vs. non-smoker); alcohol consumption; physical activity; depressive symptoms; and impairments in activities of daily living (ADL) and instrumental activities of daily living (IADL). Frequency of alcohol intake over the past 12 months was reported on an 8-point scale from “not at all in the last 12 months” to “almost every day” and categorised as never/rarely (never – once or twice a year), regularly (once every couple of months – twice a week), or frequently (3 days a week – almost every day) [23]. Physical activity was assessed with three items that asked participants how often they took part in vigorous, moderate and low-intensity activities (more than once a week, once a week, 1-3 times a month, hardly ever/never) [20], and further categorised into three groups, as previously described: inactive (no moderate/vigorous activity on a weekly basis); moderate activity at least once a week; and vigorous activity at least once a week [24]. Depressive symptoms were assessed using the 8-item Centre of Epidemiological Studies Depression (CES-D) scale, highly validated for use in older adults [25]. ADL impairment was assessed with six questions that asked participants whether a health or memory problem caused them difficulty with the following everyday activities: dressing, walking across a room, bathing or showering, eating, getting in or out of bed, and toileting (yes/no). IADL impairment was assessed by asking whether participants had any difficulty performing seven activities because of a health or memory problem: using a map to figure out how to get around in a strange place, preparing a hot meal, shopping for groceries, making telephone calls, taking medications, doing work around the house or garden, and financial management (yes/no). These covariates were selected because they were hypothesised to be independently associated with both the exposure (sexual activity) and the outcome (change in cognitive function).

## Statistical analysis

Analyses were performed using IBM SPSS Statistics 25. Data were weighted to correct for sampling probabilities and for differential non-response and to calibrate back to the 2011 National Census population distributions for age and sex. The weights accounted for the differential probability of being included in Wave 6 of ELSA and for non-response to the questionnaire assessing sexual activity. Details can be found at <http://doc.ukdataservice.ac.uk/doc/>5050[/mrdoc/pdf/](http://mrdoc/pdf/)5050[\_elsa\_w6\_technical\_report\_v1.pdf](http://_elsa_w6_technical_report_v1.pdf/)

Analyses were performed separately for men and women. Bivariate associations between sexual activity and covariates were explored using one-way independent *t*-tests for continuous variables and chi-square tests for categorical variables. General linear models were used to test associations between sexual activity at baseline and change in (i) immediate recall and (ii) delayed recall over four-year follow-up. For each outcome, we ran two models: the first was minimally adjusted for age and number of words recalled at baseline (age adjusted model), the second was adjusted for age, number of words recalled at baseline, partner status, ethnicity, education, wealth, cardiovascular disease, diabetes, limiting long-standing illness, smoking status, physical activity, depressive symptoms, ADL impairment and IADL impairment (fully adjusted model). We report results as estimated marginal (EM) means with standard errors (SE), and adjusted betas with 95% confidence intervals (CIs). A *p*-value < 0.05 was used to indicate statistical significance.

Results

## Baseline characteristics

Table 1 shows the baseline characteristics of the male and female samples in relation to whether or not they were sexually active. The majority (79.2%) of men and just over half (54.7%) of women reported any sexual activity in the last year at baseline. These participants were on average younger (*p*<0.001), more wealthy (*p*=0.001 for men, *p*<0.001 for women) and more likely to be married or cohabiting (*p*<0.001) than those who were not sexually active. They were also less likely to report the presence of cardiovascular disease (*p*<0.001), diabetes (*p*<0.001) or a limiting long-standing illness (*p*<0.001), more likely to drink alcohol regularly or frequently (*p*<0.001) and be physically active (*p*<0.001), and reported fewer depressive symptoms (*P*=0.044 for men, *p*<0.001 for women) and fewer impairments with ADLs and IADLs (*p*<0.001). In addition, participants who were sexually active had better baseline scores for immediate and delayed recall compared with those who were not sexually active (*p*<0.001).

## Follow-up data

Tables 2 and 3 report associations between baseline sexual activity and change in cognitive function over four-year follow-up in men and women, respectively.

After adjusting for age and baseline recall score, there were significant associations between sexual activity and change in immediate recall (0.23 points, 95% CI 0.12 to 0.34) and delayed recall (0.25 points, 95% CI 0.15 to 0.36) in men. There was little change in recall ability among men who reported any sexual activity in the last year (immediate recall EM mean = 0.001, SE = 0.02; delayed recall EM mean = 0.02, SE = 0.02) versus a decline among men who were not sexually active (immediate recall EM mean = -0.23, SE = 0.05; delayed recall EM mean = -0.23, SE = 0.05). However, in women, there was no significant relationship between sexual activity and change in either immediate (0.04 points, 95% CI -0.04 to 0.12, *p*=0.394) or delayed recall (0.06 points, 95% CI -0.03 to 0.14, *p*=0.176).

After additional adjustment for partner status, ethnicity, education, wealth, cardiovascular disease, diabetes, limiting long-standing illness, smoking status, physical activity, depressive symptoms, ADL impairments and IADL impairments, associations between sexual activity and preservation of cognitive function in men remained significant for immediate (0.18 points, 95% CI 0.07 to 0.29, *p*=0.002) and delayed recall (0.19 points, 95% CI 0.08 to 0.29, *p=*0.001). Associations remained non-significant in women.

Discussion

In this large, representative sample of older English adults, the majority of men and just over half of women reported any sexual activity in the last year at baseline. In final adjusted models, sexual activity appeared to protect against cognitive decline (measured either by immediate or delayed recall) in men over four-year follow-up. However, no such association was observed in women.

Literature suggests that older men who are sexually active also have increased levels of cognitive function, while findings in women are contradictory. In the ELSA study, the same that we used for our research, a previous cross-sectional study demonstrated that men who were sexually active had better cognitive tests scores in all domains, while in women these findings were attenuated [17]. A more recent prospective study in the ELSA sample found that sexual activity was associated with better cognition, but this investigation was limited to just one cognitive test and evaluated changes over a shorter time span (two years) [18]. Our investigation expands these preliminary findings, showing that sexual activity is positively associated with several cognitive tests over a longer follow-up and, importantly, that this association is only observed among men.

We can potentially explain our findings through several mechanisms. First, the possible relationship between sexual activity and better cognitive function may be explained via alterations in neurotransmission. For example, dopamine might have cognitive enhancing effects as reported in animal and experimental models [26], and dopamine is highly involved in sexual behavior [27]. In this sense, other hormones such as oxytocin are probably involved in the association between sexual activity and cognition [28]. Low serum level of brain-derived neurotrophic factor (BDNF) may also be implicated. BDNF has previously been shown to be associated with cognitive impairments, and genetic variations in the BDNF gene have been found to protect against cognitive impairments [29,30]. BDNF is a neurotrophin secreted in response to muscle contraction [31]. Sexual intercourse can be seen as a moderate intensity (5.8 METS) activity [32] and requires significant contraction of large skeletal muscles; during such contractions BDNF is released which may aid in the prevention of cognitive decline. Another potential explanation is that engaging in sexual activity is beneficial for the circulatory system [14] and diseases of the circulatory system may adversely affect normal brain functioning, leading to cognitive decline [33].

Sex differences in cognitive function in later life are thought to be a consequence of differences in brain development and structure between men and women [34]. Recently, sex differences and response to sex hormones in brain function and regions have been identified [35]. Sex hormones affect neuronal structure and function on their own. For instance, testosterone induced spine synapses have been shown in the male rat hippocampus [36]. Sex hormones also affect brain functions interacting with stressors, although the specific mechanisms are yet to be discovered [37]. It may be the high level of testosterone released by men, not women, during sexual activity that is driving the sex-specific association with cognitive decline observed in the present study. However, previous research reported that the association between sexual activity and cognition is more evident in women than in men [38], highlighting the need for more research on this topic.

Strengths of this study include the large, representative sample, longitudinal design, and adjustment for a wide range of potential confounders. However, there were also limitations. The observational nature of our study means we cannot deduce the exact direction of effect of our findings. In addition, cognitive ability test scores in older people may reflect not only a possible decline, but also their peak prior cognitive ability [20], but we did not have any information regarding the trajectories of their cognitive function during the lifespan. The present study did not discriminate between types of sexual activity. For example, masturbation may have a different impact on cognition as to intercourse. Future studies should investigate the effect of different types of sexual activity on cognition. Finally, participants were asked to recall as many words as possible immediately and again after a short delay during which they carried out other cognitive tests. However, no set time was provided for the length of delay nor was this time recorded.

The present study has identified a novel modifiable correlate that may aid in the prevention of cognitive decline in older men. Health practitioners should be encouraged to screen older men relating to their sexual activity to identify those who may be at risk of cognitive decline. Older men will be heartened to know that participation in sexual activity may aid in the prevention of age-related decline in cognitive function and subsequent dementia.

**Conflicting Interests:** The authors declare that there is no conflict of interest.

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| **Table 1** Sample characteristics at baseline |  |  |  |  |  |
|  |  |  | **Men** |  | **Women** |
|  | **Sexually active (*n*=1,554)** | **Not sexually active (*n*=409)** | ***p*** |  | **Sexually active (*n*=1,375)** | **Not sexually active (*n*=1,138)** | ***p*** |
| Age (mean [SD] years) | 63.37 (7.97) | 72.68 (7.97) | <0.001 |  | 62.81 (7.59) | 69.49 (9.06) | <0.001 |
| White ethnicity | 95.3 | 93.0 | 0.069 |  | 97.5 | 95.7 | 0.023 |
| Partner status |  |  |  |  |  |  |  |
|  | Married/cohabiting | 75.4 | 69.4 | <0.001 |  | 76.6 | 42.2 | <0.001 |
|  | Separated/divorced | 12.0 | 8.9 | - |  | 14.3 | 20.4 | - |
|  | Widowed | 4.2 | 14.4 | - |  | 5.5 | 30.4 | - |
|  | Single/never married | 8.5 | 7.3 | - |  | 3.5 | 7.0 | - |
| Education |  |  |  |  |  |  |  |
|  | No qualifications | 14.8 | 27.7 | <0.001 |  | 20.9 | 37.7 | <0.001 |
|  | Intermediate | 39.6 | 42.5 | - |  | 48.7 | 42.8 | - |
|  | Higher | 45.6 | 27.2 | - |  | 30.4 | 19.5 | - |
| Wealth quintile |  |  |  |  |  |  |  |
|  | 1 (poorest) | 15.5 | 18.8 | 0.001 |  | 12.9 | 25.9 | <0.001 |
|  | 2 | 17.1 | 22.5 | - |  | 18.8 | 22.9 | - |
|  | 3 | 19.2 | 22.0 | - |  | 19.7 | 24.1 | - |
|  | 4 | 23.3 | 19.9 | - |  | 23.1 | 16.0 | - |
|  | 5 (richest) | 24.9 | 16.8 | - |  | 25.6 | 11.0 | - |
| Cardiovascular disease | 41.0 | 58.6 | <0.001 |  | 33.8 | 49.6 | <0.001 |
| Diabetes | 10.4 | 19.6 | <0.001 |  | 7.5 | 13.0 | <0.001 |
| Limiting long-standing illness | 26.1 | 45.2 | <0.001 |  | 29.7 | 42.8 | <0.001 |
| Current smoker | 13.4 | 12.3 | 0.565 |  | 11.9 | 13.5 | 0.282 |
| Alcohol intake¹ |  |  |  |  |  |  |  |
|  | Never/rarely | 10.5 | 28.0 | <0.001 |  | 21.2 | 39.7 | <0.001 |
|  | Regularly | 43.2 | 42.4 | - |  | 48.1 | 41.1 | - |
|  | Frequently | 46.2 | 29.6 | - |  | 30.7 | 19.2 | - |
| Physical activity |  |  |  |  |  |  |  |
|  | Inactive | 13.7 | 28.2 | <0.001 |  | 16.4 | 31.1 | <0.001 |
|  | Moderate at least once a week | 44.4 | 49.3 | - |  | 49.7 | 49.5 | - |
|  | Vigorous at least once a week | 41.9 | 22.5 | - |  | 33.8 | 19.4 | - |
| Depressive symptoms (0-8) (mean [SD]) | 0.98 (1.67) | 1.16 (1.74) | 0.044 |  | 1.30 (1.79) | 1.71 (2.09) | <0.001 |
| ADL impairment (0-6) (mean [SD]) | 0.22 (0.70) | 0.46 (0.99) | <0.001 |  | 0.23 (0.73) | 0.43 (1.01) | <0.001 |
| IADL impairment (0-7) (mean [SD]) | 0.15 (0.56) | 0.36 (0.83) | <0.001 |  | 0.20 (0.62) | 0.46 (1.00) | <0.001 |
| Immediate recall (0-10) (mean [SD]) | 6.23 (1.52) | 5.29 (1.51) | <0.001 |  | 6.58 (1.57) | 5.97 (1.64) | <0.001 |
| Delayed recall (0-10) (mean [SD]) | 5.03 (1.77) | 4.14 (1.72) | <0.001 |  | 5.53 (1.87) | 4.84 (1.97) | <0.001 |
|  | Values are percentages unless otherwise stated. All figures are weighted for sampling probabilities and differential non-response.SD = standard deviation, ADL = activities of daily living, IADL = instrumental activities of daily living.¹ Never/rarely = never – once or twice a year; regularly = once every couple of months – twice a week; frequently = 3 days a week – almost every day. |  |

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| **Table 2** Associations between sexual activity at baseline and change in cognitive function over four-year follow-up in men |
|  |  | **Age-adjusted model** |  | **Fully adjusted model** |
|  |  | **EM mean (SE) sexually active** | **EM mean (SE)** **not sexually active** | **Beta [95% CI]** | ***p*** |  | **EM mean (SE) sexually active** | **EM mean (SE)** **not sexually active** | **Beta [95% CI]** | ***p*** |
| Immediate recall | 0.001 (0.02) | -0.23 (0.05) | 0.23 [0.12; 0.34] | <0.001 |  | -0.01 (0.02) | -0.19 (0.05) | 0.18 [0.07; 0.29] | 0.002 |
| Delayed recall | 0.02 (0.02) | -0.23 (0.05) | 0.25 [0.15; 0.36] | <0.001 |  | 0.01 (0.02) | -0.17 (0.05) | 0.19 [0.08; 0.29] | 0.001 |
| In both models, those who reported no sexual activity in the last year were taken as the reference group.The age adjusted model is adjusted for age and recall at baseline.The fully adjusted model is adjusted for age, recall at baseline, partner status, ethnicity, education, wealth, cardiovascular disease, diabetes, limiting long-standing illness, smoking status, physical activity, depressive symptoms, activities of daily living and instrumental activities of daily living.All figures are weighted for sampling probabilities and differential non-response.CI = confidence interval. EM = estimated marginal. SE = standard error. |

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| **Table 3** Associations between sexual activity at baseline and change in cognitive function over four-year follow-up in women |
|  |  | **Age-adjusted model** |  | **Fully adjusted model** |
|  |  | **EM mean (SE) sexually active** | **EM mean (SE)** **not sexually active** | **Beta [95% CI]** | ***p*** |  | **EM mean (SE) sexually active** | **EM mean (SE)** **not sexually active** | **Beta [95% CI]** | ***p*** |
| Immediate recall | 0.01 (0.03) | -0.02 (0.03) | 0.04 [-0.04; 0.12] | 0.394 |  | -0.03 (0.03) | 0.03 (0.03) | -0.06 [-0.15; 0.03] | 0.177 |
| Delayed recall | 0.05 (0.03) | -0.01 (0.03) | 0.06 [-0.03; 0.14] | 0.176 |  | -0.01 (0.03) | 0.07 (0.03) | -0.07 [-0.16; 0.02] | 0.104 |
| In both models, those who reported no sexual activity in the last year were taken as the reference group.The age adjusted model is adjusted for age and recall at baseline.The fully adjusted model is adjusted for age, recall at baseline, partner status, ethnicity, education, wealth, cardiovascular disease, diabetes, limiting long-standing illness, smoking status, physical activity, depressive symptoms, activities of daily living and instrumental activities of daily living.All figures are weighted for sampling probabilities and differential non-response.CI = confidence interval. EM = estimated marginal. SE = standard error. |