

SHORT REPORTS

Sex on the brain! Associations between sexual activity and cognitive function in older age

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Abstract

Background: the relationship between cognition and sexual activity in healthy older adults is under-researched. A limited amount of research in this area has shown that sexual activity is associated with better cognition in older men. The current study explores the possible mediating factors in this association in men and women, and attempts to provide an explanation in terms of physiological influences on cognitive function.

Methods: using newly available data from Wave 6 of the English Longitudinal Study of Ageing, the current study explored associations between sexual activity and cognition in adults aged 50–89 ($n = 6,833$). Two different tests of cognitive function were analysed: number sequencing, which broadly relates to executive function, and word recall, which broadly relates to memory.

Results: after adjusting for age, education, wealth, physical activity, depression, cohabiting, self-rated health, loneliness and quality of life, there were significant associations between sexual activity and number sequencing and recall in men. However, in women there was a significant association between sexual activity and recall, but not number sequencing.

Conclusions: possible mediators of these associations (e.g. neurotransmitters) are discussed. The cross-sectional nature of the analysis is limiting, but provides a promising avenue for future explorations and longitudinal studies. The findings have implications for the promotion of sexual counselling in healthcare settings, where maintaining a healthy sex life in older age could be instrumental in improving cognitive function and well-being.

Keywords: cognition, sexual activity, ageing, gender differences, English Longitudinal Study of Ageing (ELSA), older people

Cognitive function has been associated with a number of physical, psychological and emotional factors in older adults, such as cognitive lifestyle [1], psychological factors of quality of life [2], loneliness [3] and mood [4] and physical activity [5, 6].

Sexual activity is equivalent to mild to moderate physical activity in the range of 3–5 METS (metabolic equivalents) [7], but very little research has focussed specifically on possible associations between sexual activity and cognitive function. The limited amount of existing research focuses on of the impact of cognitive impairment or dementia on sexual relationships in older adult couples [8–10]. A recent systematic review found that those experiencing cognitive decline and dementia engaged in fewer sexual activities than their cognitively intact, non-demented counterparts [11].

There is a gender bias in research examining links between sexual activity and cognition in older age. For example, healthy older Italian men with a continued interest in sex, and those

who were sexually active, had better overall cognitive functioning [12, 13]. One explanation for the relative lack of research with women could be that females are more likely to be widowed—and hence lose their sexual partner—at an earlier age than men [14]. In addition to this gender bias, there has been little exploration of potential mediators in the relationship between sexual activity and cognitive function, particularly in women. Indeed, there are gender differences in cognitive function across the lifespan [15], which are arguably due to fundamental effects of prenatal sex hormones on brain development and structure [see Ref. 16 for review]. However, the observed gender differences in cognition scores are usually small, ranging from 0.3 to 0.9 standard deviation units [17].

The current study proposes to investigate the association between sexual activity and cognitive function in older adults in more detail, including a thorough investigation of mediating variables such as age, gender and loneliness. The English

Longitudinal Study of Ageing (ELSA) is a nationally representative panel survey that gathers data on health, lifestyle and socioeconomic variables in adults over the age of 50 years. Wave 6 of ELSA is the first wave to include questions pertaining to sexual relationships [18], and as such is ideal for the study of associations between sexual activity and cognitive function in an ageing population.

Method

Participants

Data were drawn from survey responses to Wave 6 version 1 of ELSA ($n = 10,601$). Respondents under the age of 50 years or over the age of 90 years were excluded ($n = 436$). (In ELSA, respondents who were aged 90 and above were coded with an arbitrary age of 99 years to promote anonymity, which would be an inaccurate representation of age within the oldest portion of the sample. Those under the age of 50 years (mostly comprising younger partners of invited respondents) were outside the remit of our focus on an ageing population.) Respondents who did not answer the question pertaining to sexual activity over the past 12 months ($n = 3,332$) were also removed from the analysis. The remaining sample ($n = 6,833$) comprised 3,060 men and 3,773 women between the ages of 50 and 89 years.

Design

Independent variable

The independent variable in this study was whether or not the respondent had engaged in any form of sexual activity over the previous 12 months (ELSA Wave 6 contains a rich dataset of variables pertaining to sexual activity, function and problems. We thank an anonymous reviewer for drawing our attention to these. However, for this exploratory analysis, we chose to use this variable to distinguish older adults who were sexually active from those who were not). In this case, sexual activity could include intercourse, masturbation, petting or fondling.

Dependant variables

The dependant variables were scores from cognitive tests of recall and a number sequencing. In the recall task, respondents heard a list of 10 everyday words and were asked to recall them straight away (immediate recall) and after a short delay (delayed recall; maximum score 20).

The number sequencing task required completion of a number sequence, by first determining the number pattern, and then deciding which number was missing, e.g. 1, 2, __, 4, where the correct answer would be '3'. Raw scores were converted into standardised scores and made available in the ELSA Wave 6 dataset (range 409–584).

Covariates

Model 1: Age was measured in full years (range 50–89), and education was divided into three standard categories of none,

intermediate and degree/higher. Net financial wealth was divided into quintiles (1st quintile = poorest, 5th quintile = wealthiest).

Model 2: Physical activity was predefined in ELSA as sedentary, low, moderate or high. Cohabiting was classified as the respondent living with spouse/partner or not, and self-rated health was categorised as good (comprising 'excellent', 'very good' and 'good') or poor (comprising 'fair' and 'poor').

Model 3: Depression was indicated by scoring 4 or more on the 8-item CES-D depression scale [19, 20] or a reported diagnosis of depression. Quality of life was measured by total score on the CASP19 questionnaire [21], and loneliness was calculated from total score on the three-item loneliness scale [22].

Data analysis

All data analysis was conducted using IBM SPSS Version 22.0 (IBM Corp., Armonk, NY, USA). Analysis of covariance (ANCOVA) was used to assess differences in cognitive function scores in sexually active and sexually inactive participants, with separate models for men and women, and for number sequencing and recall scores. Model 1 included standard adjustments for the mediating effects of age, education and wealth on cognitive function scores. Model 2 included all Model 1 covariates, plus adjustments for physical activity, cohabiting and self-rated health. Model 3 included all previous variables, plus depression, quality of life and loneliness. (Interactions between the independent variable (sexual activity) and each covariate were assessed separately, where any statistically significant ($P < 0.05$) interactions were included in the final models.)

Results

Table 1 shows sexually active men and women to have significantly higher scores on the number sequencing and recall tests than sexually inactive men and women (all $P < 0.001$). Additionally, sexually active men and women were more likely to have a higher level of education, be younger, wealthier, more physically active, not depressed, less lonely and have a better quality of life (all $P \leq 0.001$).

Table 2 shows the results of the ANCOVA for Models 1, 2 and 3, for men and women separately. After full adjustments in Model 3, sexually active men had significantly higher number sequencing ($F_{1, 2,128} = 5.444$, $P = 0.020$; 20.7% variance explained) and recall ($F_{1, 2,164} = 13.810$, $P < 0.001$; 24.2% variance explained) scores than sexually inactive men. For females, the significant association between sexual activity and unadjusted cognitive function scores (see Table 1) was attenuated following adjustments. There was no significant association between sexual activity and number sequencing in any of the models for women (all $P > 0.10$; see Table 2). However, there was a significant association between sexual activity and recall scores in Model 3, where sexually active women scored higher than sexually inactive women ($F_{1, 2,610} = 9.064$, $P = 0.003$; 20.9% variance explained).

Table 1. Basic characteristics of sexually active vs. sexually inactive men and women aged 50–89 in ELSA Wave 6; $n = 6,833$

Men	Sexual activity in past 12 months?		P
	Yes ($n = 2,349$)	No ($n = 711$)	
Age (years)	64.4 (7.8)	72.9 (8.5)	<0.001
Cognitive function			
Number sequencing	543.3 (25.6)	529.7 (30.5)	<0.001
Recall	11.1 (3.1)	9.0 (3.2)	<0.001
Education			
Degree/higher	51.1	32.1	<0.001
Intermediate	35.8	42.8	0.001
None	13.1	25.0	<0.001
Wealth (quintiles)			
1st (poorest)	11.3	19.0	<0.001
2nd	16.0	21.5	0.001
3rd	20.1	22.1	0.274
4th	25.1	21.4	0.053
5th (wealthiest)	27.5	16.0	<0.001
Physical activity			
Sedentary/low	18.0	34.0	<0.001
Moderate	52.1	49.3	0.201
High	29.9	16.8	<0.001
Cohabiting	84.6	73.9	<0.001
Good health	79.2	56.5	<0.001
Depression	11.3	16.1	0.001
Loneliness score	3.9 (1.4)	4.2 (1.6)	<0.001
Quality of life (CASPI9)	41.8 (8.4)	37.7 (9.5)	<0.001
Women	Yes ($n = 2,148$)	No ($n = 1,625$)	
Age (years)	62.4 (7.5)	69.6 (8.9)	<0.001
Cognitive function			
Number sequencing	536.3 (24.2)	527.3 (28.1)	<0.001
Recall	12.2 (3.2)	10.7 (3.5)	<0.001
Education			
Degree/higher	36.1	23.5	<0.001
Intermediate	47.0	44.1	0.076
None	16.9	32.4	<0.001
Wealth (quintiles)			
1st (poorest)	10.4	23.7	<0.001
2nd	16.6	22.9	<0.001
3rd	19.8	22.9	0.025
4th	24.8	17.3	<0.001
5th (wealthiest)	28.5	13.1	<0.001
Physical activity			
Sedentary/low	20.2	37.2	<0.001
Moderate	56.1	48.6	<0.001
High	23.6	14.2	<0.001
Cohabiting	85.6	47.0	<0.001
Good health	81.6	66.8	<0.001
Depression	17.2	22.6	<0.001
Loneliness score	4.1 (1.5)	4.5 (1.7)	<0.001
Quality of life (CASPI9)	42.6 (8.4)	39.0 (9.2)	<0.001

ANOVA for continuous variables, presented as mean (SD). χ^2 for categorical variables, presented as %.

Discussion

Previous research has shown that older men who are sexually active also have increased levels of general cognitive function [12, 13]. The current study supports these findings in two different cognitive tasks, namely number sequencing and recall. This association remains after adjusting for confounding variables such quality of life, loneliness, depression and

Table 2. Adjusted cognitive function scores for sexually active vs. sexually inactive men and women, with R^2 and P values for final models

	Sexual activity in past 12 months?		Model results	
	Yes	No	R^2	P
Men				
Number sequencing ^a				
Model 1	536.7 (0.6)	532.1 (1.1)	0.184	<0.001
Model 2	534.3 (0.8)	530.8 (1.2)	0.204	0.008
Model 3	536.4 (1.2)	531.4 (1.9)	0.207	0.020
Recall ^b				
Model 1	10.4 (0.1)	9.7 (0.1)	0.220	<0.001
Model 2	10.2 (0.1)	9.7 (0.1)	0.240	0.001
Model 3	10.3 (0.1)	9.5 (0.2)	0.242	<0.001
Women				
Number sequencing ^c				
Model 1	530.9 (0.6)	529.5 (0.7)	0.153	0.137
Model 2	530.0 (0.8)	528.7 (0.8)	0.165	0.216
Model 3	531.4 (0.9)	530.7 (0.9)	0.155	0.523
Recall ^d				
Model 1	11.5 (0.1)	11.2 (0.1)	0.193	0.016
Model 2	11.5 (0.1)	11.1 (0.1)	0.212	0.008
Model 3	11.7 (0.1)	11.2 (0.1)	0.209	0.003

Scores are presented as adjusted mean (SE). All variables, models and statistical analyses are described in the Method section.

^aMen, Number sequencing models: Model 1: age, education, wealth; Model 2: Model 1 plus physical activity; Model 3: Model 2 plus depression, quality of life, loneliness, sexual activity \times depression, sexual activity \times quality of life.

^bMen, Recall models: Model 1: age, education, wealth; Model 2: Model 1 plus physical activity; Model 3: Model 2 plus depression, quality of life, loneliness, sexual activity \times depression.

^cWomen, Number sequencing models: Model 1: age, education, wealth; Model 2: Model 1 plus physical activity; Model 3: Model 2 plus depression, quality of life and loneliness.

^dWomen, Recall models: Model 1: age, education, wealth, sexual activity \times age; Model 2: Model 1 plus physical activity, sexual activity \times physical activity, sexual activity \times cohabiting; Model 3: Model 2 plus depression, quality of life and loneliness.

physical activity [2–5]. This indicates an additional benefit of sexual activity on cognition in older men.

For females in the current study, after adjustments for age, education and wealth (Model 1), there was no significant difference in scores on a number sequencing task between sexually active and inactive women. Thus, initial differences were accounted for by age, education and wealth, rather than sexual activity *per se*. There was however, a significant association between sexual activity and recall scores in women, even after full adjustments (Model 3). These results show an additional benefit of sexual activity, on memory function specifically, in women.

Gender differences in cognitive function [15, 17] may be underpinned by sex differences in brain development and structure [16]. Therefore, it is possible that physiological correlates of sexual activity (e.g. testosterone, oxytocin) have different effects on the brain and hence cognitive function in men and women. Though speculative and an area for future research, the relationship between enhanced cognitive performance and higher levels of sexual activity may be explained via alterations in

neurotransmission. For example, the potential cognitive enhancing effects of dopamine, particularly at D1 and D4 receptors [23], the relationship between dopamine and sexual behaviour [24], and other biological processes such as enhanced oxytocin release [25], are all possible mediators in the observed association. Future neuroimaging and psychobiological studies could examine the influence of neurotransmitters in this association in men and women.

Strengths and limitations

This is the first study of this kind to explore the association between sexual activity and cognitive function in a large cohort of older, community-dwelling adults. We have shown associations between sexual activity and two different types of cognitive function in men and for memory specifically in women. It should be noted that the magnitude of differences in scores was small, although this is in line with general findings in the literature [17]. As this was a cross-sectional analysis, we can only speculate as to a causal relationship at this time, where prospective studies would assist with the question of causality.

Implications and conclusions

This study provides a starting point for understanding gender differences in the associations between sexual activity and cognition. The findings have important implications for the inclusion of sexual health discussions during routine health checks for over 50s and for the provision of sexual counselling in this age group. This could also provide a modest benefit to cognitive function in older adults.

Key points

- There is limited research on the possible effects of sexual activity on cognition in later life.
- Sexual activity is associated with higher scores on tests of memory and executive function, in adults aged 50–89.
- Maintaining healthy sexual relationships in later life may be associated with better cognitive function.

Conflicts of interest

None declared.

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The increase in healthcare costs associated with frailty in older people discharged to a post-acute transition care program

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Abstract

Background: older people are high users of healthcare resources. The frailty index can predict negative health outcomes; however, the amount of extra resources required has not been quantified.

Objective: to quantify the impact of frailty on healthcare expenditure and resource utilisation in a patient cohort who entered a community-based post-acute program and compare this to a cohort entering residential care.

Methods: the interRAI home care assessment was used to construct a frailty index in three frailty levels. Costs and resource use were collected alongside a prospective observational cohort study of patients. A generalized linear model was constructed to estimate the additional cost of frailty and the cost of alternative residential care for those with high frailty.

Results: participants ($n = 272$) had an average age of 79, frailty levels were low in 20%, intermediate in 50% and high in 30% of the cohort. Having an intermediate or high level of frailty increased the likelihood of re-hospitalisation and was associated with 22 and 43% higher healthcare costs over 6 months compared with low frailty. It was less costly to remain living at home than enter residential care unless >62% of subsequent hospitalisations in 6 months could be prevented.

Conclusions: the frailty index can potentially be used as a tool to estimate the increase in healthcare resources required for different levels of frailty. This information may be useful for quantifying the amount to invest in programs to reduce frailty in the community.

Keywords: cost, frailty, community care, older people