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Subjective memory impairment, objective cognitive functioning and social activity in French older people: Findings from the 3C study

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Abstract

Objectives: To investigate the association between subjective memory impairment (SMI) and objective cognitive impairment in later life, and to ascertain whether this is modified by level of social activity, education or living alone.

Design and Setting: Data were analysed from three French community surveys carried out in Bordeaux, Dijon and Montpellier.

Participants: Representative samples of 9294 residents aged 65 years and over.

Measurements: SMI was ascertained and investigated in relation to performance on the Benton Visual Retention Test (BVRT), the Isaac Set Test (IST) and Trail Making Test B (TMT). Adjustments were made for age, sex, education, depressive symptoms (CES-D), site and living alone. Stratified analyses investigated modification by high or low social activity, education or living arrangement.

Results: SMI was reported by 21.9% of the sample and was significantly associated with lower scores on BVRT and TMT after adjustment for age, sex, education, depressive symptoms, site and living alone. These associations were not significantly modified by social activity, education or living alone.

Conclusions: Worse subjective memory was associated independently with worse performance on two tests of cognitive function but, in these cohorts, no evidence was found for modification of associations by social activity/support or education.

Introduction

Subjective memory impairment (SMI) is one of the core components of the diagnostic criteria for Mild Cognitive Impairment (MCI) and a key potential presenting symptom stimulating referral to secondary assessment services such as memory clinics.[1, 2] Subjective memory complaint concerns an individual's awareness, self-appraisal and beliefs about their everyday memory competence. Reported common concerns have included misplacing items and forgetting new information.[3-5] A number of studies have found a higher prevalence of SMI among populations over the age of 65.[6,7] However, associations with objective cognitive impairment have been somewhat inconsistent,[8] with some studies,[7-9] but not others,[10] finding associations with impaired performance. Depression, on the other hand, is almost invariably strongly associated with SMI.[6,11]

The influence of social activity and environmental cognitive demands on the association between SMI and objective cognitive functioning is less clear, although it has been reported that increased social activity slows cognitive decline and is associated with cognitive plasticity in later life.[12] Activities such as learning languages, playing games or a musical instrument provide substantial cognitive stimulation, which is enhanced by social environment.[11,12] As well as potentially buffering against cognitive decline, more demanding environments may also increase the likelihood of someone noticing early cognitive deficits – i.e. can be hypothesised to modify (strengthen) the association between subjective and objective memory impairment. Supporting this, in one community study a stronger association was found between SMI and objective cognitive impairment

in older people living in an urban compared to a rural area, and this association was strongest of all in elders who had migrated from a rural to an urban area compared to those with lifelong urban residence. [13] Furthermore, within an urban sample, the strength of association between SMI and objective cognitive impairment was higher in individuals with higher levels of social support – again, potentially a marker of a more cognitively demanding lifestyle. [14]

Through an analysis of data from a large community study of French older people, we sought to investigate the association between SMI and objective cognitive impairment, and the extent to which this was modified by three pre-identified factors: living alone, level of education and level of social activity.

Methods

Setting and sample

The 3-Cities (3C) study is a multi-centre population-based cohort study of community residents aged 65 and older, conducted in the three French cities of Montpellier (South East), Dijon (North East) and Bordeaux (South West). At baseline in 1999–2000, the recruited cohort included 9,294 participants (3,718 men and 5,576 women; 2,104 in Bordeaux, 4,931 in Dijon, and 2,259 in Montpellier), taking into account participants who refused to partake in the baseline medical interview (n=392, 4%), who were excluded from all analyses. The Ethics Committee of the University Hospital of Kremlin-Bicêtre, France approved the 3C study. The study protocol has been described in detail in previous publications. [3,15,16]

Measures

The following socio-demographic data were considered as covariates in this analysis: age, sex, education level (2 categories of duration of formal education: <5 years or 5+ years), living alone or not, and case-level depressive symptoms defined by the Centre for Epidemiological Depression (CES-D) scale (applying the standard score cut-off of 16 and above to denote the presence of case level depressive symptoms). [17]

Subjective memory impairment, the principal dependent variable, was assessed using a self-report questionnaire applied to all 3C study participants. [3] Participants were asked about habitual forgetfulness during daily activities, and

about difficulties remembering new information. Participants who responded positively to both these questions were categorised as having SMI and compared with the remainder of the sample. This definition of SMI has been applied in previous research. [16]

The following measures of cognitive function were treated as the principal independent variables: a) Benton Visual Retention Test (BVRT), which tests immediate visual recall [18,19] b) the Isaac Set Test (IST), which tests cued semantic access [20] and c) The Trail Making Test (TMT), part B – a test of attention and task shifting, requiring the participant to connect a series of alternative numbers and letters. [21,22] For this analysis, the three measures were re-categorised into binary variables, relative impairment being defined using standard cut-offs for the BVRT and IST (<13 and <25 respectively) and 75th percentile or above for time taken to complete the TMT. These definitions have been applied in previous research, [16] and the instruments had been previously validated for use with a community population and translated in a number of languages, including French. [18,22,23]

Social activity was measured at baseline using a self-report frequency activities questionnaire and its second section which focuses on activities that are more often carried out with other people rather than in isolation. [3,24] Questions included items asking about social contact with other people, such as friends and family members, and whether participants had pursued any leisure, social or cultural activities. For the purpose of this analysis from a scale with a total maximum score of 33, high/low social activity was re-categorised into a binary

variable based on scores above or below the median score of 14. This measure was investigated as a potential effect modifier in this analysis.

Statistical analysis

SPSS version 15.0 was used. [25] SMI was modelled as the principal (binary) dependent variable and descriptive data were generated on its prevalence and unadjusted associations with potential covariates. SPSS syntax commands were compiled in manner to facilitate the exclusion of cases with a diagnosis of dementia, since the objective of the analysis was to examine cognitively healthy individuals, residing in the community. Logistic regression models were used to sequentially adjust for age, gender, education, case-level depressive symptoms, city, and living alone. Associations were finally stratified by the three proposed effect modifiers: living alone or not, above/below median social activity and high/low education, using Mantel-Haenszel procedures [26] with tests of homogeneity to investigate modification.

Results

The analysed baseline sample consisted of 9,294 participants. The mean age was 74.3; 60.7% were female and 26.1% had low education. The observed prevalence of SMI was 21.9%. As displayed in Table 1, SMI was significantly associated with older age, female sex, lower education, social activity and case-level depressive symptoms.

Associations between covariates and cognitive impairment on the three tests are summarised in Table 2. Increased age was associated with impairment on the BVRT but not on the other two tests. Impairment on the IST was more common in men but impairment on the other two tests was more common in women. Impairment on all three tests was more common in participants with lower education, in those who were widowed, and in those with case-level depression. Although significant differences were found between sites for all three impairment definitions, these did not follow a consistent pattern; neither did associations with living alone or not. Impairment on all three tests was significantly more likely in participants reporting SMI.

In logistic regression analyses (Table 3), SMI remained significantly associated with impairment on the BVRT and TMT after sequential adjustment by all covariates. The association between SMI and impairment on the IST remained significant after adjustment for age, sex and education level, but was reduced substantially in strength after adjustment for depressive symptoms. Education and depressive symptoms were the strongest potential confounders with largest

effects of adjustment on the associations of interest. In stratified analyses, the associations of interest did not differ substantially, consistently or significantly between social activity, living status or education groups (Table 3).

Discussion

The principal findings from this secondary analysis were strong cross-sectional associations between SMI and objective cognitive impairment in tests of delayed recall (BVRT) and executive function / psychomotor speed (TMT). These associations persisted after adjustment for potential confounding factors but, contrary to expectations, were not modified by social activity, education or whether participants were living alone. Associations between subjective and objective cognitive impairment are consistent with findings from some previous research. [7,16] Education level and depressive symptoms showed the greatest potential confounding effects and the latter had a pronounced impact on the association between SMI and verbal fluency (IST) impairment. These findings are in keeping with other studies which highlighted the importance of depressive symptoms and education level as potential confounding factors, [7,27] although these did not fully account for the associations between SMI and the two other measures of cognitive impairment.

There was no evidence in this sample of effect modification by social activity, living circumstances or education, hypothesised to reflect cognitive activity in these samples. This finding is not therefore consistent with the effect modification described for social support with respect to inner London older residents, [14] or urban environment for Korean elders. [13] More research is required to investigate this issue as it is reasonable to suppose that an individual's recognition of early cognitive dysfunction is likely to be influenced at least to some extent by their environmental context and that people in circumstances presenting higher levels

of cognitive challenge may notice dysfunction at an earlier stage. The associations between cognitive impairment and SMI in this sample suggest that individuals both notice and are willing to report cognitive difficulties. One possibility for the lack of effect modification may be that the measures chosen in this sample did not sufficiently reflect environmental cognitive challenge, which may vary between settings and cultures.[28]

An interesting finding was that SMI was associated with impairment not only on a test of recall (BVRT) but also on Trail Making Test B which principally tests psychomotor speed and executive function. Although impairment in executive functioning is associated with onset of dementia, it is less often considered in the routine clinical appraisal of age-related cognitive functioning. Deficits in executive functioning and attentional mechanisms may be appraised as forgetfulness by older people, because memory lapses are considered to be part of normal age related cognitive change, or it may simply reflect the lack of an alternative word to reflect the experience of impairment in other domains. [11]
Difficulties with attention give rise to memory difficulties through failure to allocate attentional resources to relevant stimuli. This may also reflect the role of executive functioning in memory for everyday tasks – particularly, the ability to switch tasks or 'multi-task' and with learning. [22]

In terms of methodological considerations, the 3C study dataset presented a valuable opportunity for investigating these research questions, involving community-based samples with sufficient statistical power to detect a range of associations. [3] The findings on the association between SMI and objective

cognitive impairment therefore add to the existing literature. [7,11,14,29,30] Although it is likely that objective cognitive impairment plays a causal role in the likelihood of someone reporting SMI, the cross-sectional nature of the study does not allow this inference to be drawn. There were some limitations in the relatively brief measures of SMI and a construct such as social activity. Cognitive assessment in the samples was also limited to the three tests presented here and did not include, for example, any assessment of verbal memory.

SMI and its association with objective cognitive impairment have been evaluated previously. [8,16] The relationship between SMI and objective memory impairment in older adults is likely to reflect a complex interaction of bio-psychosocial factors. [3,14,16] Findings of associations between the two have implications at clinical, service and policy levels. Given the increasing prevalence of dementia with population aging, memory clinics for detection, prevention and intervention programmes are being prioritised in France. [31] Since SMI is one of the few means by which early cognitive dysfunction may come to the attention of such services, further research is required to examine the meaning and implications of the construct, as well as devising better ways to define it. [2]

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Table 1: *Associations between sample characteristics and subjective memory impairment (SMI)*

Covariates	Number of participants	% SMI (N)	χ^2 Value (df)† Pearson Chi-Square, degrees of Freedom p-value
Age			
<75 years	5026	19.6 (984)	35.15 (1) p<0.001
>75 years	4069	24.7 (1007)	
Sex			
Male	3579	19.9 (712)	13.80 (1) p<0.001
Female	5516	23.2 (1279)	
Education duration			
Less than 5 years	5588	24.7 (1378)	65.12 (1) p<0.001
5 years or more	3488	17.5 (609)	
Depressive symptoms*			
Non-case (CES-D <16)	7720	19.5 (1508)	154.90 (1) p<0.001
Case (CES-D 16+)	1244	35.2 (438)	
City			
Bordeaux	2093	15.1 (317)	347.13 (2) p<0.001
Dijon	4859	29.3 (1426)	
Montpellier	2143	11.6 (248)	
Living Alone			
Yes	3247	23.2 (753)	5.02 (1) p=0.01
No	5827	21.2 (1233)	

†Pearson Chi-square, (degrees of freedom)

*CES-D=Centre for Epidemiologic Studies Depression Scale

Table 2: *Unadjusted associations between covariates and objective cognitive impairment*

Covariates	**Proportion with cognitive impairment**		
	% Isaac Set Test (N)	**% Benton Visual Retention Rest** (N)	**% Trail Making test B** (N)
Age			
<75 years	27.8 (1395)	33.5 (1297)	24.9 (1208)
>75 years	29.1 (1137)	36.5 (1839)	25.1 (908)
Chi-square (df), p-value	1.64 (1) p=0.200	8.42 (1) p=0.004	0.03 (1) p=0.855
Sex			
Male	30.8 (1080)	30.4 (1064)	23.6 (788)
Female	26.8 (1452)	38.3 (2072)	25.9 (1328)
Chi-square (df), p-value	17.30 (1) p<0.001	58.40 (1) p<0.001	5.90 (1) p=0.015
Education duration			
Less than 5 years	31.2 (1708)	40.7 (2219)	29.0 (1478)
5 years or more	23.7 (816)	26.4 (909)	18.8 (632)
Chi-square (df), p-value	59.92 (1) p<0.001	190.59 (1) p<0.001	112.84 (1) p<0.001
Depressive symptoms*			
Non-case (CES-D <16)	27.0 (2056)	34.2 (2595)	24.1 (1752)
Case (CES-D 16+)	35.4 (430)	40.7 (490)	29.7 (332)
Chi-square (df), p-value	35.90 (1) p<0.001	19.49 (1) p<0.001	16.10 (1) p<0.001
City			
Bordeaux	37.6 (740)	35.6 (697)	32.4 (571)
Dijon	20.8 (1002)	38.0 (1817)	25.0 (1159)
Montpellier	37.0 (790)	28.7 (622)	18.7 (386)
Chi-square (df), p-value	298.73 (2) p<0.001	57.15 (2) p<0.001	95.95 (2) p<0.001

Living Alone			
Yes	28.2 (1612)	33.8 (1929)	26.4 (783)
No	28.8 (918)	37.8 (1198)	24.2 (1328)
Chi-square (df), p-value	0.33 (1) p=0.567	14.30 (1) p<0.001	4.87 (1) p=0.027
Social Activity			
High	16.6 (175)	27.1 (286)	14.5 (151)
Low	25.8 (1217)	35.2 (1658)	23.1 (1049)
Chi-square (df), p-value	40.48 (1) p<0.001	25.29 (1) p<0.001	37.68 (1) p<0.001
SMI			
Present	30.8 (577)	40.1 (751)	30.9 (548)
Not Present	27.7 (1902)	33.9 (2324)	23.3 (1521)
Chi-square (df), p-value	7.06 (1) p=0.008	25.06 (1) p<0.001	42.93 (1) p<0.001

*CES-D=Centre for Epidemiologic Studies Depression Scale

Table 3: *Logistic regression analysis of the association (odds ratio) between subjective memory impairment (SMI) and cognitive impairment on the three component tests*

Logistic regression model	Association between test-specific cognitive impairment and SMI (odds ratio, 95% CI)		
	Isaac test	Benton test	Trail B test
1. Unadjusted	1.16 (1.04-1.30)	1.31 (1.17-1.45)	1.47 (1.31-1.65)
2. Adjusted for age	1.15 (1.04-1.30)	1.32 (1.20-1.47)	1.47 (1.31-1.65)
3. Model 2 plus sex	1.16 (1.04-1.31)	1.30 (1.17-1.45)	1.46 (1.30-1.65)
4. Model 3 plus education	1.14 (1.02-1.27)	1.25 (1.12-1.39)	1.42 (1.26-1.60)
5. Model 4 plus depressive symptoms	1.08 (0.96- 1.21)	1.22 (1.09-1.36)	1.40 (1.24-1.57)
6. Model 5 plus city	1.08 (0.96- 1.21)	1.21 (1.08-1.35)	1.37 (1.22-1.54)
7. Model 6 plus living alone	1.08 (0.96-1.21)	1.22 (1.09-1.36)	1.37 (1.22-1.55)
Stratified analyses*			
Social activity			
High	0.92 (0.60-1.43)	1.19 (0.84-1.69)	1.91 (1.27-2.86)
Low	1.10 (0.94-1.28)	1.28 (1.11-1.47)	1.53 (1.31-1.80)
p-value for interaction	p=0.038	p=0.520	p=0.257

Living Alone			
Yes	1.24 (1.04-1.49)	1.41 (1.19-1.68)	1.51 (1.25-1.83)
No	1.11 (0.98-1.30)	1.25 (1.09-1.43)	1.45 (1.25-1.68)
p-value for interaction	p=0.377	p=0.274	p=0.718
Education duration			
Less than 5 years	1.11 (0.97-1.27)	1.28 (1.13-1.46)	1.40 (1.22-1.60)
5 years or more	1.14 (0.93-1.40)	1.11 (0.91-1.37)	1.41 (1.13-1.80)
p-value for interaction	p=0.841	p=0.242	p=0.919

*Unadjusted odds ratios